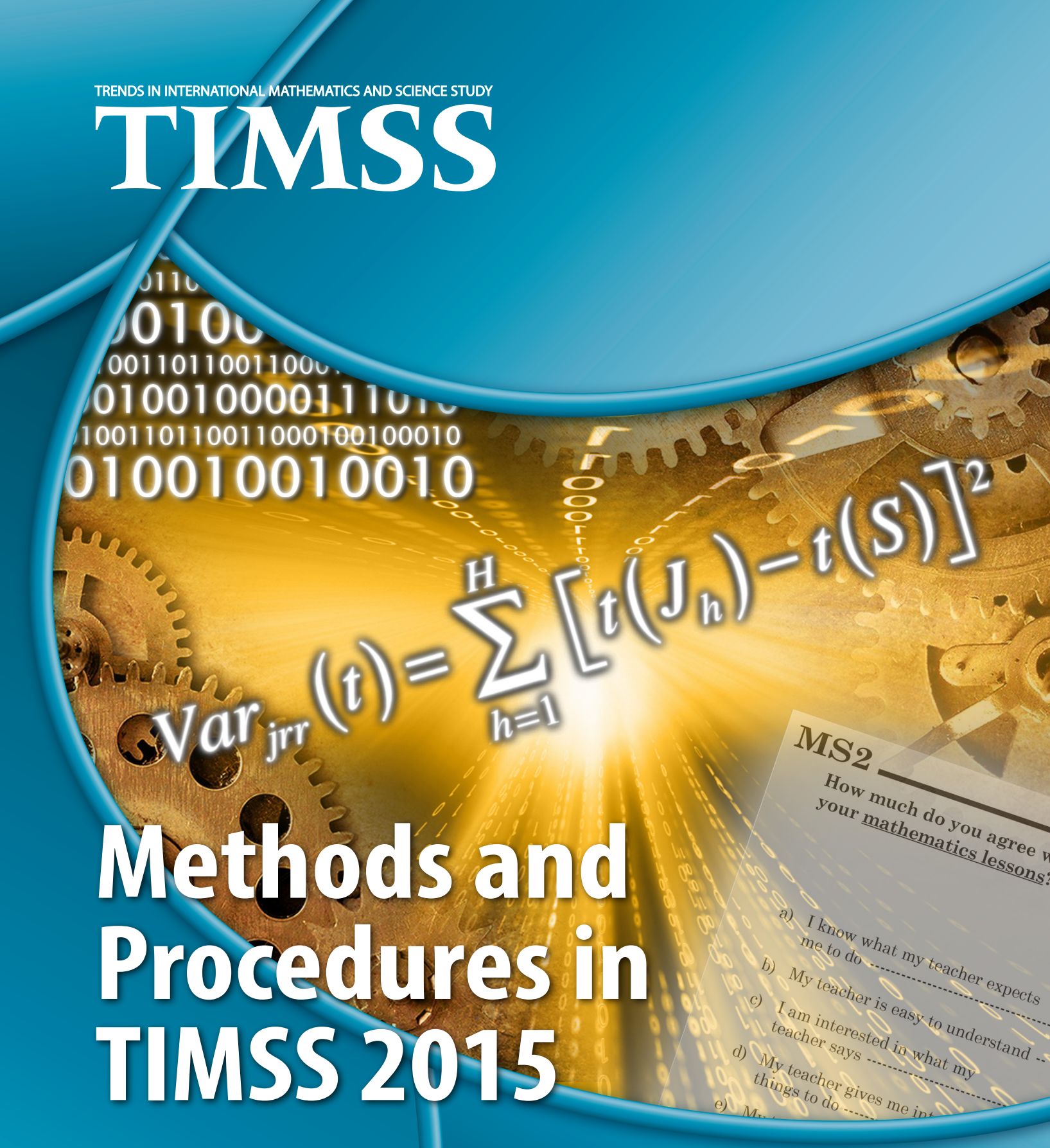
TRENDS IN INTERNATIONAL MATHEMATICS AND SCIENCE STUDY

TIMSS



Methods and Procedures in TIMSS 2015

Editors: Michael O. Martin, Ina V.S. Mullis, and Martin Hooper

IEA
TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

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INSTRUMENT DEVELOPMENT

Chapter 1
DEVELOPING THE TIMSS 2015 ACHIEVEMENT ITEMS 1.1
Ina V.S. Mullis, Kerry E. Cotter, Bethany G. Fishbein, and Victoria A.S. Centurino

Chapter 2
DEVELOPING THE TIMSS 2015 CONTEXT QUESTIONNAIRES 2.1
Martin Hooper

SAMPLING

CHAPTER 3
SAMPLE DESIGN IN TIMSS 2015 . . . . . 3.1
Sylvie LaRoche, Marc Joncas, and Pierre Foy

Chapter 4
ESTIMATING STANDARD ERRORS IN THE TIMSS 2015 RESULTS 4.1
Pierre Foy and Sylvie LaRoche

Chapter 5
SAMPLE IMPLEMENTATION IN TIMSS 2015 . . . 5.1
Sylvie LaRoche and Pierre Foy

DATA COLLECTION PROCEDURES

Chapter 6
SURVEY OPERATIONS PROCEDURES IN TIMSS 2015 . . . . . 6.1
Ieva Johansone

Chapter 7
TRANSLATION AND TRANSLATION VERIFICATION FOR TIMSS 2015 . . . . . 7.1
David Ebbs and Paulina Korsnakova

Chapter 8
LAYOUT VERIFICATION FOR TIMSS 2015 . . . . . 8.1
Erin Wry and Ieva Johansone

Chapter 9
QUALITY ASSURANCE PROGRAM FOR TIMSS 2015 . . . . . 9.1
Ieva Johansone and Erin Wry

Chapter 10
CREATING THE TIMSS 2015 INTERNATIONAL DATABASE 10.1
Sebastian Meyer, Mark Cockle, and Milena Taneva

REPORTING

Chapter 11
REVIEWING THE TIMSS 2015 ACHIEVEMENT ITEM STATISTICS 11.1
Pierre Foy, Michael O. Martin, Ina V.S. Mullis, Liqun Yin, Victoria A.S. Centurino, and Katherine A. Reynolds

Chapter 12
TIMSS 2015 ACHIEVEMENT SCALING METHODOLOGY 12.1

Chapter 13
SCALING THE TIMSS 2015 ACHIEVEMENT DATA **13.1**
Pierre Foy and Liqun Yin

Chapter 14
USING SCALE ANCHORING TO INTERPRET THE TIMSS 2015 ACHIEVEMENT SCALES **14.1**
Ina V.S. Mullis, Kerry E. Cotter, Victoria A.S. Centurino, Bethany G. Fishbein, and Jenny Liu

Chapter 15
CREATING AND INTERPRETING THE TIMSS 2015 CONTEXT QUESTIONNAIRE SCALES **15.1**
Michael O. Martin, Ina V.S. Mullis, Martin Hooper, Liqun Yin, Pierre Foy, and Lauren Palazzo

CHAPTER 1

Developing the TIMSS 2015 Achievement Items

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Victoria A.S. Centurino

Unique Characteristics of TIMSS 2015

The general approach to developing the TIMSS mathematics and science achievement items is similar from assessment cycle to assessment cycle, but each assessment cycle tends to have some unique characteristics that influence the instrument development approach.

- For the first time since 1995, TIMSS and TIMSS Advanced were assessed together in 2015, providing 20 years of trend data for both assessments. TIMSS Advanced is the only international assessment that provides essential information about achievement in advanced mathematics and physics for students in their final year of secondary school. First conducted in 1995 and again in 2008, TIMSS Advanced together with TIMSS 2015 will provide countries with a complete profile of mathematics and science learning from elementary through the end of secondary school.
- TIMSS 2015 was the inaugural year of TIMSS Numeracy. TIMSS Numeracy was introduced in 2015 at the fourth grade to assess fundamental mathematics knowledge, procedures, and problem-solving strategies for students that were likely to find TIMSS 2015 at the fourth grade too difficult.

The TIMSS Approach to Measuring Trends

Because TIMSS is designed to measure trends, the assessments of mathematics and science cannot change dramatically from cycle to cycle. That is, TIMSS is based on a well-known premise for designing trend assessments (ascribed to John Tukey and Albert Beaton):

> "If you want to measure change, do not change the measure."

However, the achievement tests also need to be updated with each cycle to prevent the assessments from becoming dated and no longer relevant to current learning goals. It is important for the content to "keep up with the times" and to be innovative. For example, TIMSS needs

to reflect recent scientific discoveries and to be presented in situations consistent with students' instructional and everyday experiences.

To maintain continuity with past assessments while keeping up with current topics and technology, the TIMSS assessments evolve with each cycle. For assessing mathematics and science, TIMSS has a specific design for the steady release of items after each cycle and replacing them with newly developed items for the following cycle.

Overview of the TIMSS 2015 Achievement Items

Although the majority of the assessment items are carried forward from the previous assessment cycle to measure trends, the task of updating the instruments for each new cycle—every four years for TIMSS since 1995—is a substantial undertaking. Because TIMSS assesses two subjects at two grades, it actually encompasses four different assessments of achievement: mathematics at the fourth and eighth grades and science at the fourth and eighth grades. The two TIMSS 2015 fourth grade assessments required developing and field testing 287 new items, and the two eighth grade assessments required developing and field testing 354 new items. TIMSS Numeracy, the new assessment added at the fourth grade, required developing and field testing 151 items.

The Item Development Process

The TIMSS & PIRLS International Study Center at Boston College uses a collaborative process to develop the new items needed for each TIMSS cycle. A broad overview of the process includes:

- Updating the frameworks for the upcoming assessment
- Developing items and their scoring guides in accordance with the frameworks
- Conducting a full-scale field test
- Selecting the new assessment items based on the frameworks, field test results, and existing items from previous cycles
- Conducting training in how to reliably score responses to constructed response items (i.e., questions to which students provide a written response rather than choosing from a set of options).

The development process is directed and managed by the staff of the TIMSS & PIRLS International Study Center at Boston College, who collectively have considerable experience in the measurement and assessment of mathematics and science achievement. For TIMSS 2015, Executive Director, Ina Mullis, and Assistant Director of Mathematics, Kerry Cotter, managed the mathematics assessment development. Executive Director, Michael Martin, and Associate Director of Science, Victoria Centurino, managed the science assessment development.

Also playing a key role in achievement item development were the National Research Coordinators (NRCs) designated by their countries to be responsible for the complex tasks involved in implementing TIMSS in their countries. The TIMSS & PIRLS International Study Center worked with the NRCs and experts from the countries to develop the new test items including the scoring guides for constructed response items. The NRCs also reviewed the items prior to the field test and helped select the items for the assessment after the field test.

The TIMSS & PIRLS International Study Center prepares an international version of all the TIMSS assessment items in English. Subsequently, the items are translated by participating countries into their languages of instruction with the goal of creating high quality translations that are appropriately adapted for the national context and at the same time are internationally comparable. Therefore, a significant portion of the development and review effort by NRCs is dedicated to ensuring that the test items can be translated accurately.

To provide additional subject-matter expertise and support, external mathematics and science specialists consulted very closely with staff on the development activities. The TIMSS 2015 Chief Mathematics Consultant was Liv Sissel Gronmo, University of Oslo, ILS, Norway, and the TIMSS 2015 Chief Science Consultant was Lee Jones, United States.

Additional advice and guidance were provided through periodic reviews by the Science and Mathematics Review Committee (SMIRC). The SMIRC members for each TIMSS cycle are nominated by countries participating in TIMSS and provide guidance in developing the TIMSS assessments. The TIMSS 2015 SMIRC consisted of 16 members: 6 experts in mathematics and mathematics education and 10 experts in science and science education. It is necessary to have more science members to ensure expertise across the fields of biology, chemistry, and physics. During busy periods, two SMIRC committee members, Mary Lindquist for mathematics and Gerald Wheeler for science, served as advisors to assist in completing specific tasks, such as drafting updated mathematics and science content frameworks and updating scoring guides after the field test.

SMIRC members met four times for TIMSS 2015. At the 1st SMIRC meeting in Oslo, Norway (April 2013), SMIRC reviewed the mathematics and science content frameworks and developed prototype field test items. At the 2nd meeting in St. Petersburg, Russia (September 2013), SMIRC reviewed draft field test items, together with their scoring guides. At the 3rd meeting in Sofia, Bulgaria (July 2014), SMIRC reviewed field test results and made recommendations to the NRCs regarding which items to include in the 2015 mathematics and science assessments. At the final meeting in Seoul, Korea (May 2016), SMIRC conducted the TIMSS 2015 scale anchoring process. Exhibit 1.1 lists the TIMSS 2015 SMIRC members.

Exhibit 1.1: TIMSS 2015 Science and Mathematics Item Review Committee (SMIRC)

Mathematics

Kiril Bankov
Faculty of Mathematics and Informatics
University of Sofia
Bulgaria

Sean Close
Educational Research Centre
St. Patrick's College
Ireland

Khattab Mohammad Ahmad Abulibdeh
National Center for Human Resources Development
Jordan

Sun Sook Noh
College for Education
Ewha Womans University
Korea

Torgeir Onstad
Department of Teacher Education and School
University of Olso, ILS
Norway

Mary Lindquist
United States

Science

Jouni Viiri
Department of Teacher Education
University of Jyväskylä
Finland

Alice Wong
Faculty of Education
University of Hong Kong
Hong Kong SAR

Berenice Michels
National Institute for Curriculum Development
The Netherlands

Newman Burdett
National Foundation for Educational Research
England

Galina Kovaleva
Institute of Content and Methods Education
Russian Academy of Education
Russian Federation

Vitaly Gribov
Physics Faculty
Moscow Lomonosov State University
Russian Federation

Gorazd Planinšič
Faculty of Mathematics and Physics
University of Ljubljana
Slovenia

Wolfgang Dietrich
National Agency for Education
Sweden

Christopher Lazzaro
The College Board
United States

Gerald Wheeler
National Science Teachers' Association
United States

Updating the Mathematics and Science Assessment Frameworks for TIMSS 2015

Updating each TIMSS assessment for 2015 began with reviewing and modifying the assessment frameworks that specify the content to be assessed. The first two chapters of the *TIMSS 2015 Assessment Frameworks*, respectively, describe the mathematics and science frameworks in detail.

The basic structure of the TIMSS mathematics and TIMSS science assessment frameworks is based on two dimensions: content and cognitive. The content domains for mathematics at the fourth grade are number, geometric shapes and measures, and data display. The modified content domains for Numeracy are whole numbers, fractions and decimals, and shapes and measures. At the eighth grade, the mathematics content domains are number, algebra, geometry, and data and chance. For science, the content domains at the fourth grade are life science, physical science, and earth science; at the eighth grade, they are biology, chemistry, physics, and earth science.

Separately for the fourth and eighth grades, the TIMSS mathematics and science frameworks specify several topic areas within each content domain. For example, the algebra content domain contains three topic areas: expressions and operations, equations and inequalities, and relationships and functions. The cognitive domains are the same for mathematics and science: knowing, applying, and reasoning. However, the descriptions of the cognitive skills to be assessed differ somewhat between mathematics and science.

For TIMSS 2015, the mathematics and science frameworks were updated to better reflect the curricula and standards of the countries participating in TIMSS using information from the *TIMSS 2011 Encyclopedia*. These updates were discussed by the NRCs from the participating countries at their first meeting. Following the discussion at the 1st NRC meeting, the NRCs consulted with their national experts and responded to a topic-by-topic survey about how best to update the content and cognitive domains for TIMSS 2015. Next, SMIRC reviewed and revised the frameworks. Using an iterative process, the frameworks as revised by the SMIRC were once again reviewed by the NRCs and updated a final time prior to publication.

Recommendations for updating content and cognitive domains can involve modifying content areas and their weightings (but no more than 5 percent); adding, deleting, or modifying topics within content areas to keep current with research findings and ensure that the number of topics reflects the content area weighting; rewriting to improve clarity for item writers; and perhaps combining some topic areas to reduce redundancy. New for 2015, a new section was added to the science frameworks that describes the science practices to be addressed in science assessments at the fourth and eighth grades. Beyond that, there were no changes in the weighting of content areas for either mathematics or science and only minor revisions to content area topics. The TIMSS 2015 Development schedule is presented in Exhibit 1.2.

Exhibit 1.2: TIMSS 2015 Development Schedule for Achievement Items

Date(s)		Group and Activity
July – December	2012	TIMSS & PIRLS International Study Center conducted content analysis of the curricular topics described in the *TIMSS 2011 Encyclopedia*
October	2012	Task Force proposed updates for the 2015 Assessment Frameworks, incorporating results from the content analysis (Boston, USA)
January	2013	TIMSS & PIRLS International Study Center compiled proposed updates to Assessment Frameworks in preparation for the 1st National Research Coordinator (NRC) meeting
February	2013	NRCs reviewed proposed updates to Assessment Frameworks at 1st NRC meeting (Hamburg, Germany)
March	2013	TIMSS & PIRLS International Study Center incorporated feedback from 1st NRC meeting to further refine the *TIMSS 2015 Assessment Frameworks* and surveyed NRCs online about proposed assessment topic areas and objectives
April	2013	Science and Mathematics Item Review Committee (SMIRC) reviewed proposed mathematics and science frameworks, developed innovative reasoning tasks and prototype items, and reviewed draft *TIMSS 2015 Item Writing Guidelines* at the 1st SMIRC meeting (Oslo, Norway)
May	2013	TIMSS & PIRLS International Study Center prepared final drafts of TIMSS 2015 mathematics and science assessment frameworks, incorporating SMIRC and NRC comments
May	2013	TIMSS & PIRLS International Study Center updated *TIMSS 2015 Item Writing Guidelines*
May	2013	NRCs reviewed *TIMSS 2015 Assessment Frameworks* and developed draft field test items using *TIMSS 2015 Item Writing Guidelines* at 2nd NRC meeting (Amsterdam, The Netherlands)
June – August	2013	TIMSS & PIRLS International Study Center further refined draft field test items and scoring guides and continued to develop additional items to cover frameworks
July	2013	Science and Mathematics Task Forces reviewed and edited draft field test items and scoring guides, developed additional items to cover the frameworks, and classified items into preferred and alternate sets (Boston, USA)
September	2013	SMIRC reviewed draft field test items and scoring guides at 2nd SMIRC meeting (St. Petersburg, Russia)
September	2013	TIMSS & PIRLS International Study Center published *TIMSS 2015 Assessment Frameworks*
September – October	2013	TIMSS & PIRLS International Study Center revised draft field test items and scoring guides to address SMIRC comments
November	2013	NRCs reviewed and approved proposed field test items at 3rd NRC meeting (Budapest, Hungary)
November – December	2013	TIMSS & PIRLS International Study Center assembled field test items into assessment blocks
December	2013	TIMSS & PIRLS International Study Center distributed field test achievement booklets to NRCs
January	2014	TIMSS & PIRLS International Study Center collected student responses to constructed response items from English-speaking countries to develop scoring training materials

Exhibit 1.2: TIMSS 2015 Development Schedule for Achievement Items (Continued)

Date(s)		Group and Activity
February	2014	Science and Mathematics Task Forces modified scoring guides for constructed response items based on student responses and developed scoring training materials for 4th NRC meeting (Boston, USA)
March – April	2014	Countries conducted TIMSS 2015 field test
March	2014	NRCs received scoring training for TIMSS 2015 constructed response field test items at 4th NRC meeting (Sydney, Australia)
April – May	2014	Countries submitted field test achievement data for analysis and review
June	2014	Science and Mathematics Task Forces reviewed field test item statistics
June – July	2014	TIMSS & PIRLS International Study center assembled proposed item blocks in preparation for the 3rd SMIRC meeting
July	2014	SMIRC reviewed proposed item blocks in conjunction with field test results at 3rd SMIRC meeting (Sofia, Bulgaria)
August	2014	NRCs reviewed and approved item blocks for TIMSS 2015 data collection at 5th NRC meeting
August	2014	TIMSS & PIRLS International Study Center distributed TIMSS 2015 data collection achievement booklets to NRCs
October – December	2014	Southern Hemisphere countries conducted TIMSS 2015 data collection
October	2014	TIMSS & PIRLS International Study Center updated and prepared materials for TIMSS 2015 constructed response item scoring training
November	2014	NRCs from Southern Hemisphere countries received scoring training for constructed response items (Wellington, New Zealand)
November	2014	TIMSS & PIRLS International Study Center finalized scoring guides and training materials for constructed response items and distributed them to NRCs
March	2015	NRCs from Northern Hemisphere countries received scoring training for constructed response items at 6th NRC meeting (Prague, Czech Republic)
March – June	2015	Northern Hemisphere countries conducted TIMSS 2015 data collection

Writing and Reviewing the TIMSS 2015 Field Test Items and Scoring Guides

The TIMSS & PIRLS International Study Center uses a collaborative process involving the participating countries to develop test items and scoring guides for the field tests. Most of the 2nd TIMSS NRC meeting in Amsterdam was devoted to a workshop for developing the field test items. The NRCs, together with experienced item writers from participating countries and staff from the TIMSS & PIRLS International Study Center, created the newly developed items for the mathematics and science field tests.

Prior to the workshop, TIMSS & PIRLS International Study Center staff members identified the scope of the item writing task for the field test, examining the weight given to each topic in each of the updated frameworks. Considerations included the total items needed based on the percentage

of weight assigned to a particular area (for example, geometric measurement) in the *TIMSS 2015 Assessment Frameworks*, and the number of topics in that area (two, for example), as well as how many items existed from previous assessments. Because the TIMSS & PIRLS International Study Center generally field tests twice the number of items actually required, the field test included the target number of new items needed multiplied by two. For TIMSS 2015, about 800 items were field tested (see Exhibit 1.4).

In preparation for the item writing workshop, the TIMSS & PIRLS International Study Center updated the *TIMSS 2015 Item Writing Guidelines*, an item writing manual specifically developed for TIMSS assessments. The *Item Writing Guidelines* contain general information about procedures for obtaining good measurement (for instance, items should be independent and not provide clues to the correct responses of other items) as well as specific information on how to deal with translation and comparability issues (for example, using TIMSS' fictitious unit of currency, the "zed," for any money items). The *Item Writing Guidelines* include the necessary steps for developing scoring guides, as well as checklists for reviewing TIMSS items.

At the TIMSS item writing workshop, country representatives were divided into teams and given specific item writing assignments to ensure that enough field test items were developed in each of the content areas and cognitive processes areas specified in the frameworks. The TIMSS & PIRLS International Study Center staff and consultants used the *Item Writing Guidelines* to provide training to the teams on item writing procedures for the TIMSS assessments. Once teams had completed their item writing assignments, each team reviewed the items drafted by other teams. In addition, some teams continued to send items to the TIMSS & PIRLS International Study Center for several weeks after the item writing workshop. Exhibit 1.3 shows the number of participants in the TIMSS 2015 item writing workshop and the number of items written.

Exhibit 1.3: TIMSS 2015 Item Writing Workshop to Develop Field Test Items

Attendees	
Number of Countries and Benchmarking Entities	45
Number of Country Representatives	114
Approximate Number of Field Test Items Written at Item Writing Workshop	
Fourth Grade Mathematics	160
Eighth Grade Mathematics	200
Fourth Grade Science	160
Eighth Grade Science	270

Following the item writing workshop, the draft set of field test items received a thorough review by the TIMSS & PIRLS International Study Center. Reviewers included staff, the chief consultants, and consultants experienced in developing assessment items, such as those from Educational Testing Service, the National Foundation for Educational Research in England, and the Australian Council for Educational Research, as well as SMIRC members with particular item writing skills.

Finally, the proposed field test blocks were reviewed by the TIMSS 2015 SMIRC and NRCs prior to field test instrument production. The TIMSS & PIRLS International Study Center implemented the suggested revisions and provided the final international version of the field test booklets to the NRCs so that they could begin translating the field test materials into their languages of instruction.

The TIMSS 2015 Field Test

The TIMSS field test followed typical TIMSS procedures, where it served as a full-scale "dress rehearsal" operationally for the assessment. That is, the data collection and scoring procedures to be employed in the assessment were practiced in the field test. In addition, the field test provided important information about how well each prospective item functioned and provided a basis for selecting items for the assessment.

The field test was designed to be conducted for approximately 30 schools in each country and yield at least 200 student responses to each mathematics and science item. Generally, the samples for the field test and the assessment are drawn simultaneously, using the same random sampling procedures. This ensures that field test samples closely approximate assessment samples, and that a school is selected for either the field test or the assessment, but not both. For example, if 150 schools are needed for the assessment and another 30 for the field test, then a larger sample of 180 schools is selected and a systematic sample of 30 schools is selected from the 180 schools.

The TIMSS 2015 field test was conducted in March–April 2014. Exhibits 1.4 through 1.8 provide a detailed summary of the field test effort, including the number of students, teachers, and schools that participated, and the number of items listed by format, content domain, and cognitive domain. Approximately 10,000 student responses from more than 40 countries per grade were used to evaluate the measurement properties of each field test assessment item.

Exhibit 1.4: Overview of the TIMSS 2015 Field Test

	Fourth Grade	Numeracy	Eighth Grade
Items			
Mathematics	147	151	182
Science	140		172
Total	**287**	**151**	**354**
Responses per Item (approx.)	200	200	200
Participants			
Countries	43	7	39
Benchmarking Entities	5	0	4
Students	54,679	4,522	51,994
Teachers	3,772	296	6,097
Schools	1,469	164	1,142

Exhibit 1.5: TIMSS 2015 Number of Field Test Items by Content Domain and Item Format – Fourth Grade

Content Domain	Number of Multiple-Choice Items	Number of Constructed Response Items	Total Number of Items	Total Number of Score Points	Percentage of Score Points
Mathematics Items					
Number	42	46	88	93	60%
Geometric Shapes and Measures	23	18	41	43	28%
Data Display	3	15	18	18	12%
Total	**68**	**79**	**147**	**154**	
Mathematics - Numeracy Items					
Whole Numbers	33	42	75	77	50%
Fractions and Decimals	14	11	25	25	16%
Shapes and Measures	26	25	51	52	34%
Total	**73**	**78**	**151**	**154**	
Science Items					
Life Science	28	34	62	66	45%
Physical Science	31	20	51	53	36%
Earth Science	21	6	27	28	19%
Total	**80**	**60**	**140**	**147**	

Exhibit 1.6: TIMSS 2015 Number of Field Test Items by Cognitive Domain and Item Format – Fourth Grade

Cognitive Domain	Number of Multiple-Choice Items	Number of Constructed Response Items	Total Number of Items	Total Number of Score Points	Percentage of Score Points
Mathematics Items					
Knowing	33	25	58	58	38%
Applying	24	35	59	63	41%
Reasoning	11	19	30	33	21%
Total	**68**	**79**	**147**	**154**	
Mathematics - Numeracy Items					
Knowing	39	25	64	64	42%
Applying	25	35	60	61	40%
Reasoning	9	18	27	29	19%
Total	**73**	**78**	**151**	**154**	
Science Items					
Knowing	33	20	53	56	38%
Applying	29	28	57	59	40%
Reasoning	18	12	30	32	22%
Total	**80**	**60**	**140**	**147**	

Exhibit 1.7: TIMSS 2015 Number of Field Test Items by Content Domain and Item Format – Eighth Grade

Content Domain	Number of Multiple-Choice Items	Number of Constructed Response Items	Total Number of Items	Total Number of Score Points	Percentage of Score Points
Mathematics Items					
Number	19	28	47	51	26%
Algebra	24	24	48	51	26%
Geometry	21	25	46	51	26%
Data and Chance	20	21	41	45	23%
Total	**84**	**98**	**182**	**198**	
Science Items					
Biology	31	29	60	72	37%
Chemistry	15	21	36	38	20%
Physics	24	19	43	46	24%
Earth Science	20	13	33	36	19%
Total	**90**	**82**	**172**	**192**	

Exhibit 1.8: TIMSS 2015 Number of Field Test Items by Cognitive Domain and Item Format – Eighth Grade

Cognitive Domain	Number of Multiple-Choice Items	Number of Constructed Response Items	Total Number of Items	Total Number of Score Points	Percentage of Score Points
Mathematics Items					
Knowing	35	12	47	47	24%
Applying	32	46	78	83	42%
Reasoning	17	40	57	68	34%
Total	**84**	**98**	**182**	**198**	
Science Items					
Knowing	46	18	64	75	39%
Applying	32	37	69	74	39%
Reasoning	12	27	39	43	22%
Total	**90**	**82**	**172**	**192**	

Developing the Materials for TIMSS 2015 Field Test Scoring Training

It is necessary to prepare scoring training materials for the newly developed constructed response field test items in advance of the field test so field test scoring can occur immediately upon completion of data collection. To provide "grist" for these materials, Canada, Ireland, and Singapore, administered the newly developed constructed response field test items in a small selection of classrooms with English-speaking students. Pilot materials were completed in December 2013 and responses were gathered from students in January 2014. The goal was to collect a total of approximately 200 responses to each newly developed constructed response field test item to provide example student responses in the field test scoring guides and sets of training materials. Exhibit 1.9 provides the number of items included in the pilot test and the number of student responses collected.

Exhibit 1.9: Pilot Test Student Responses for Field Test Scoring Training Materials Development

	Fourth Grade	Eighth Grade
Items		
Mathematics	24	24
Science	49	76
Total	**73**	**100**
Responses per Item (approx.)	180	160
Participants		
Countries	Canada, Ireland, Singapore	Canada, Ireland, Singapore
Number of Students (approx.)	360	320

Additionally, the United States arranged for cognitive labs in Washington, D.C. and California. Each TIMSS constructed response item was presented to approximately five students, who were observed and prompted to answer questions about the clarity, difficulty, and familiarity of the item content and format. The TIMSS & PIRLS International Study Center received the cognitive lab reports in February 2014. Exhibit 1.10 provides the number of items included in the cognitive labs and the number of student responses collected.

Exhibit 1.10: Cognitive Lab Student Responses

	Fourth Grade	Eighth Grade
Mathematics Items	20	20
Science Items	20	20
Total Items	**40**	**40**
Responses per Item (approx.)	5	5
Number of Students (approx.)	50	50

The TIMSS 2015 NRCs and their scoring supervisors received scoring training for the field test constructed response items in March 2014 in Sydney, Australia, as part of the 4th TIMSS 2015 NRC Meeting. Sets of example and practice papers were created for 34 fourth grade items and 33 eighth grade items. The example and practice paper sets for each item included a scoring guide, approximately 8–10 example papers illustrating the categories in the scoring guide, and approximately 8–10 practice papers so that country representatives could practice making distinctions among categories and reach agreement about how to make consistent scoring decisions across countries.

At the scoring training sessions, the trainers explained the purpose of each item and read it aloud. The trainer then described the scoring guide, explaining each category and the rationale

for the score given to each example paper. After the country representatives scored the practice papers, any inconsistencies in scoring were discussed, and, as necessary, the field test guides were clarified and sometimes categories were revised.

Finalizing the TIMSS 2015 Achievement Items

Subsequent to the field test, the TIMSS & PIRLS International Study Center analyzed the TIMSS field test data and prepared almanacs containing summary item statistics for each field test item. The data almanac for an item contained, row by row for each country: the sample size, the item difficulty and discrimination, the percentage of students answering each option (multiple-choice) or in each score category (constructed response), the point-biserial correlation for each multiple-choice option or constructed response category, and the degree of scoring agreement for constructed response items.

The field test data were used by the TIMSS & PIRLS International Study Center, expert committees, and NRCs to assess the quality of the field test items. The TIMSS & PIRLS International Study Center staff members, together with external consultants, first reviewed the field test data to make an initial judgment about the quality of each item based on its measurement properties (item statistics). Items were eliminated from further consideration if they had poor measurement properties, such as being too difficult or easy or having low discrimination. Particular attention was paid to unusual item statistics in individual countries since these could indicate errors in translation.

After the item-by-item review, the TIMSS & PIRLS International Study Center staff collaborated with consultants to assemble a set of recommended assessment blocks for review by the expert committee (SMIRC). SMIRC members scrutinized the recommendations for the newly developed assessment blocks, reviewing the items and scoring guides for content accuracy, clarity, and adherence to the frameworks. In addition, the newly developed items were considered in relation to the trend item blocks for overall coherence as a complete assessment.

The SMIRC's recommendations were implemented by staff, and the penultimate assessment blocks were sent to the NRCs for review. NRCs had the opportunity to review the recommended materials in light of the field test results and within the security of their own countries. Each country also could check any unusual national results that might be an indication of translation errors and correct the translation as necessary or recommend revisions to accommodate translation. Finally, the 5th NRC meeting held in Paris, France in August 2014 was devoted to reviewing all the newly developed items.

Distribution of TIMSS 2015 Items by Content and Cognitive Domains

Exhibits 1.11 through 1.14 present the number of trend and newly developed items as well as the number of score points in the TIMSS 2015 mathematics and science assessments. The number of items represents the number of distinct questions in the assessment, while the number of score points represents the complexity and weight given to each item.

Exhibit 1.11: TIMSS 2015 Achievement Items by Content Domain – Fourth Grade

Content Domain	Number of Trend Items in TIMSS 2015	Percentage of Trend Score Points	Number of New Items in TIMSS 2015	Percentage of New Score Points	Total Items	Achieved Percentage of Score Points	Target Percentage of Score Points
Mathematics Items							
Number	48 (49)	46%	41 (46)	61%	89 (95)	52%	50%
Geometric Shapes and Measures	37 (38)	36%	19 (21)	28%	56 (59)	32%	35%
Data Display	17 (19)	18%	7 (9)	12%	24 (28)	15%	15%
Total	**102 (106)**		**67 (76)**		**169 (182)**		
Mathematics - Numeracy Items							
Whole Numbers			52 (53)	50%	52 (53)	50%	50%
Fractions and Decimals			15 (15)	14%	15 (15)	14%	15%
Shapes and Measures			35 (38)	36%	35 (38)	36%	35%
Total			**102 (106)**		**102 (106)**		
Science Items							
Life Science	47 (52)	48%	32 (35)	44%	79 (87)	46%	45%
Physical Science	35 (35)	32%	29 (30)	38%	64 (65)	35%	35%
Earth Science	19 (22)	20%	14 (14)	18%	33 (36)	19%	20%
Total	**101 (109)**		**75 (79)**		**176 (188)**		

Score points are shown in parentheses.

Because percentages are rounded to the nearest whole number, some totals may appear inconsistent.

Counts of TIMSS Numeracy achievement items do not include the two fourth grade TIMSS 2015 mathematics blocks (see Chapter 4 of the *TIMSS 2015 Assessment Frameworks*).

Exhibit 1.12: TIMSS 2015 Achievement Items by Cognitive Domain – Fourth Grade

Cognitive Domain	Number of Trend Items in TIMSS 2015	Percentage of Trend Score Points	Number of New Items in TIMSS 2015	Percentage of New Score Points	Total Items	Achieved Percentage of Score Points	Target Percentage of Score Points
Mathematics Items							
Knowing	41 (41)	39%	23 (24)	32%	64 (65)	36%	40%
Applying	42 (45)	42%	30 (35)	46%	72 (80)	44%	40%
Reasoning	19 (20)	19%	14 (17)	22%	33 (37)	20%	20%
Total	**102 (106)**		**67 (76)**		**169 (182)**		
Mathematics - Numeracy Items							
Knowing			55 (55)	52%	55 (55)	52%	50%
Applying			35 (36)	34%	35 (36)	34%	15%
Reasoning			12 (15)	14%	12 (15)	14%	35%
Total			**102 (106)**		**102 (106)**		
Science Items							
Knowing	41 (44)	40%	31 (34)	43%	72 (78)	41%	40%
Applying	40 (43)	39%	27 (28)	35%	67 (71)	38%	40%
Reasoning	20 (22)	20%	17 (17)	22%	37 (39)	21%	20%
Total	**101 (109)**		**75 (79)**		**176 (188)**		

Score points are shown in parentheses.

Because percentages are rounded to the nearest whole number, some totals may appear inconsistent.

Counts of TIMSS Numeracy achievement items do not include the two fourth grade TIMSS 2015 mathematics blocks (see Chapter 4 of the *TIMSS 2015 Assessment Frameworks*).

Exhibit 1.13: TIMSS 2015 Achievement Items by Content Domain – Eighth Grade

Content Domain	Number of Trend Items in TIMSS 2015	Percentage of Trend Score Points	Number of New Items in TIMSS 2015	Percentage of New Score Points	Total Items	Achieved Percentage of Score Points	Target Percentage of Score Points
Mathematics Items							
Number	40 (45)	34%	24 (25)	26%	64 (70)	31%	30%
Algebra	40 (42)	31%	22 (23)	24%	62 (65)	28%	30%
Geometry	22 (22)	16%	21 (25)	26%	43 (47)	21%	20%
Data and Chance	25 (25)	19%	18 (22)	23%	43 (47)	21%	20%
Total	**127 (134)**		**85 (95)**		**212 (229)**		
Science Items							
Biology	47 (51)	38%	28 (36)	34%	75 (87)	36%	35%
Chemistry	26 (27)	20%	18 (19)	18%	44 (46)	19%	20%
Physics	32 (32)	24%	24 (25)	24%	56 (57)	24%	25%
Earth Science	23 (24)	18%	22 (25)	24%	45 (49)	21%	20%
Total	**128 (134)**		**92 (105)**		**220 (239)**		

Score points are shown in parentheses.

Because percentages are rounded to the nearest whole number, some totals may appear inconsistent.

Exhibit 1.14: TIMSS 2015 Achievement Items by Cognitive Domain – Eighth Grade

Cognitive Domain	Number of Trend Items in TIMSS 2015	Percentage of Trend Score Points	Number of New Items in TIMSS 2015	Percentage of New Score Points	Total Items	Achieved Percentage of Score Points	Target Percentage of Score Points
			Mathematics Items				
Knowing	45 (46)	34%	24 (24)	25%	69 (70)	31%	35%
Applying	54 (58)	43%	41 (45)	47%	95 (103)	45%	40%
Reasoning	28 (30)	22%	20 (26)	27%	48 (56)	24%	25%
Total	**127 (134)**		**85 (95)**		**212 (229)**		
			Science Items				
Knowing	40 (41)	31%	37 (44)	42%	77 (85)	36%	35%
Applying	58 (61)	46%	33 (37)	35%	91 (98)	41%	35%
Reasoning	30 (32)	24%	22 (24)	23%	52 (56)	23%	30%
Total	**128 (134)**		**92 (105)**		**220 (239)**		

Score points are shown in parentheses.
Because percentages are rounded to the nearest whole number, some totals may appear inconsistent.

Distribution of TIMSS 2015 Item Formats within Content and Cognitive Domains

Exhibits 1.15 through 1.18 display the number of items (and score points) by item format for each content and cognitive domain. As described in the *TIMSS 2015 Assessment Frameworks*, at least half of the total number of score points represented by all the questions should come from multiple-choice items. Most TIMSS multiple-choice items are worth one score point, although some compound multiple-choice items are worth two score points. The 2-point compound multiple-choice items are scored as all parts answered correctly as fully correct (2 score points), and most parts answered correctly as partially correct (1 score point). Constructed response items generally are worth one or two score points depending on the degree of complexity involved. The 1-point constructed response items are scored as correct (1 score point) or incorrect (0 score points), whereas 2-point constructed response items are scored as fully correct (2 score points), partially correct (1 score point), or incorrect (0 score points). Fully correct responses show a complete or deeper understanding of a task while partially correct responses demonstrate only a partial understanding of the concepts or procedures embodied in the task.

Exhibit 1.15: TIMSS 2015 Achievement Items by Content Domain and Item Format – Fourth Grade

Content Domain	Multiple-Choice Items		Constructed Response Items		Total Items	Percentage of Score Points
	Four Response Options	Compound	1 Point	2 Points		
Mathematics Items						
Number	44 (44)	2 (2)	37 (37)	6 (12)	89 (95)	52%
Geometric Shapes and Measures	35 (35)		18 (18)	3 (6)	56 (59)	32%
Data Display	8 (8)		12 (12)	4 (8)	24 (28)	15%
Total	**87 (87)**	**2 (2)**	**67 (67)**	**13 (26)**	**169 (182)**	
Achieved Percentage of Score Points	**49%**		**51%**			
Target Percentage of Score Points	**50%**		**50%**			
Mathematics – Numeracy Items						
Whole Numbers	21 (21)		30 (30)	1 (2)	52 (53)	50%
Fractions and Decimals	7 (7)		8 (8)		15 (15)	14%
Shapes and Measures	17 (17)	1 (1)	14 (14)	3 (6)	35 (38)	36%
Total	**45 (45)**	**1 (1)**	**52 (52)**	**4 (8)**	**102 (106)**	
Achieved Percentage of Score Points	**43%**		**57%**			
Target Percentage of Score Points	**50%**		**50%**			
Science Items						
Life Science	37 (37)	2 (2)	32 (32)	8 (16)	79 (87)	46%
Physical Science	32 (32)	4 (4)	27 (27)	1 (2)	64 (65)	35%
Earth Science	21 (21)	2 (2)	7 (7)	3 (6)	33 (36)	19%
Total	**90 (90)**	**8 (8)**	**66 (66)**	**12 (24)**	**176 (188)**	
Achieved Percentage of Score Points	**52%**		**48%**			
Target Percentage of Score Points	**50%**		**50%**			

Score points are shown in parentheses.

Because percentages are rounded to the nearest whole number, some totals may appear inconsistent.

Counts of TIMSS Numeracy achievement items do not include the two fourth grade TIMSS 2015 mathematics blocks (see Chapter 4 of the *TIMSS 2015 Assessment Frameworks*).

Exhibit 1.16: TIMSS 2015 Achievement Items by Cognitive Domain and Item Format – Fourth Grade

Cognitive Domain	Multiple-Choice Items		Constructed Response Items		Total Items	Percentage of Score Points
	Four Response Options	Compound	1 Point	2 Points		
Mathematics Items						
Knowing	35 (35)	2 (2)	26 (26)	1 (2)	64 (65)	36%
Applying	36 (36)		28 (28)	8 (16)	72 (80)	44%
Reasoning	16 (16)		13 (13)	4 (8)	33 (37)	20%
Total	**87 (87)**	**2 (2)**	**67 (67)**	**13 (26)**	**169 (182)**	
Achieved Percentage of Score Points	**49%**		**51%**			
Target Percentage of Score Points	**50%**		**50%**			
Mathematics – Numeracy Items						
Knowing	29 (29)	1 (1)	25 (25)		55 (55)	52%
Applying	11 (11)		23 (23)	1 (2)	35 (36)	34%
Reasoning	5 (5)		4 (4)	3 (6)	12 (15)	14%
Total	**45 (45)**	**1 (1)**	**52 (52)**	**4 (8)**	**102 (106)**	
Achieved Percentage of Score Points	**43%**		**57%**			
Target Percentage of Score Points	**50%**		**50%**			
Science Items						
Knowing	42 (42)	5 (5)	19 (19)	6 (12)	72 (78)	41%
Applying	31 (31)	1 (1)	31 (31)	4 (8)	67 (71)	38%
Reasoning	17 (17)	2 (2)	16 (16)	2 (4)	37 (39)	21%
Total	**90 (90)**	**8 (8)**	**66 (66)**	**12 (24)**	**176 (188)**	
Achieved Percentage of Score Points	**52%**		**48%**			
Target Percentage of Score Points	**50%**		**50%**			

Score points are shown in parentheses.

Because percentages are rounded to the nearest whole number, some totals may appear inconsistent.

Counts of TIMSS Numeracy achievement items do not include the two fourth grade TIMSS 2015 mathematics blocks (see Chapter 4 of the *TIMSS 2015 Assessment Frameworks*).

Exhibit 1.17: TIMSS 2015 Achievement Items by Content Domain and Item Format – Eighth Grade

Content Domain	Multiple-Choice Items		Constructed Response Items		Total Items	Percentage of Score Points
	Four Response Options	Compound	1 Point	2 Points		
Mathematics Items						
Number	28 (28)	1 (1)	29 (29)	6 (12)	64 (70)	31%
Algebra	35 (35)		24 (24)	3 (6)	62 (65)	28%
Geometry	22 (22)		17 (17)	4 (8)	43 (47)	21%
Data and Chance	27 (27)	2 (4)	12 (12)	2 (4)	43 (47)	21%
Total	**112 (112)**	**3 (5)**	**82 (82)**	**15 (30)**	**212 (229)**	
Achieved Percentage of Score Points	**51%**		**49%**			
Target Percentage of Score Points	**50%**		**50%**			
Science Items						
Biology	35 (35)	1 (1)	27 (27)	12 (24)	75 (87)	36%
Chemistry	19 (19)	4 (5)	20 (20)	1 (2)	44 (46)	19%
Physics	31 (31)	2 (3)	23 (23)		56 (57)	24%
Earth Science	26 (26)	3 (4)	13 (13)	3 (6)	45 (49)	21%
Total	**111 (111)**	**10 (13)**	**83 (83)**	**16 (32)**	**220 (239)**	
Achieved Percentage of Score Points	**52%**		**48%**			
Target Percentage of Score Points	**50%**		**50%**			

Score points are shown in parentheses.
Because percentages are rounded to the nearest whole number, some totals may appear inconsistent

Exhibit 1.18: TIMSS 2015 Achievement Items by Cognitive Domain and Item Format – Eighth Grade

Cognitive Domain	Multiple-Choice Items		Constructed Response Items		Total Items	Percentage of Score Points
	Four Response Options	Compound	1 Point	2 Points		
Mathematics Items						
Knowing	49 (49)	1 (1)	18 (18)	1 (2)	69 (70)	31%
Applying	48 (48)		39 (39)	8 (16)	95 (103)	45%
Reasoning	15 (15)	2 (4)	25 (25)	6 (12)	48 (56)	24%
Total	**112 (112)**	**3 (5)**	**82 (82)**	**15 (30)**	**212 (229)**	
Achieved Percentage of Score Points	**51%**		**49%**			
Target Percentage of Score Points	**50%**		**50%**			
Science Items						
Knowing	59 (59)	5 (7)	7 (7)	6 (12)	77 (85)	36%
Applying	39 (39)	5 (6)	41 (41)	6 (12)	91 (98)	41%
Reasoning	13 (13)		35 (35)	4 (8)	52 (56)	23%
Total	**111 (111)**	**10 (13)**	**83 (83)**	**16 (32)**	**220 (239)**	
Achieved Percentage of Score Points	**52%**		**48%**			
Target Percentage of Score Points	**50%**		**50%**			

Score points are shown in parentheses.
Because percentages are rounded to the nearest whole number, some totals may appear inconsistent.

TIMSS 2015 Constructed Response Scoring Training

In preparation for the main data collection scoring training, some TIMSS 2015 scoring guides were further refined or clarified based on the results of the field test. This also included a thorough review of the field test scoring training materials to ensure that the student responses were still suitable for the updated scoring guides. In some cases, example and practice sets used in the field test were expanded to further illustrate particular aspects of a scoring guide. For TIMSS 2015 scoring training, the example and practice paper training sets included those used in TIMSS 2011 for the trend items and the updated training sets for the newly developed items selected for TIMSS 2015, resulting in 27 example and practice paper sets for fourth grade and 29 for eighth grade.

To provide scoring training for all the countries participating in TIMSS 2015, the TIMSS & PIRLS International Study Center conducted two training sessions. First, the NRCs for Southern Hemisphere countries and their scoring supervisors received scoring training in November 2014 in Wellington, New Zealand. NRCs for Northern Hemisphere countries and their scoring supervisors received scoring training in March 2015 in Prague, Czech Republic as part of the 6th TIMSS 2015 NRC Meeting. Exhibit 1.19 shows the number of participants in the two scoring training sessions.

Exhibit 1.19: TIMSS 2015 Scoring Training Participation

Participants	Southern Hemisphere	Northern Hemisphere
Number of Countries	8	58
Number of Benchmarking Entities	1	5
Number of Country Representatives	32	152

The Process Following Instrument Development

In general, after the participating countries received the international version of the assessment instruments, they began the process of translation and cultural adaptation (some adaptation to local usage typically is necessary even in English-speaking countries) and production of the materials for printing. At the same time, countries made final arrangements for data collection, including the host of activities necessary to obtain school participation, implement test administration, and score the responses to the tests and questionnaires (see following chapters).

CHAPTER 2

Developing the TIMSS 2015 Context Questionnaires

Martin Hooper

The primary purpose of the TIMSS context questionnaires is to study the home, community, school, and classroom contexts in which students learn mathematics and science. To this end, questionnaire data are collected from students, and their parents, teachers, and principals. National Research Coordinators (NRCs) from participating countries provide country-level data. The questionnaire data when analyzed in relation to TIMSS achievement yield insights into factors related to student achievement that can be relevant in developing educational policy.

The context questionnaire results form the basis for seven of the ten chapters of the TIMSS 2015 International Results reports. The descriptive data collected through the TIMSS Curriculum Questionnaires complement each country's chapter included in the *TIMSS 2015 Encyclopedia*.

Development Process for the TIMSS 2015 Context Questionnaires

Developing the TIMSS 2015 context questionnaires was a collaborative process involving multiple rounds of reviews by staff at the TIMSS & PIRLS International Study Center, policy analysis experts on the TIMSS 2015 Questionnaire Item Review Committee (QIRC), and the NRCs from the participating countries. In broad strokes, the TIMSS 2015 context questionnaire development process for the student, home, school, and teacher questionnaires included:

- Updating the context questionnaire framework for 2015
- Modifying and developing new context questionnaire items by staff at the TIMSS & PIRLS International Study Center
- Reviewing and revising the questionnaires by the QIRC and NRCs
- Administering the TIMSS 2015 field test
- Using the field test results to refine the questionnaires

Developing the Curriculum Questionnaires followed a collaborative cycle similar to other TIMSS questionnaires, including identifying important framework topics, developing questionnaire items, and iterative reviews by NRCs.

Exhibit 2.1 presents the TIMSS 2015 questionnaire development schedule. The development process was directed and managed by the staff of the TIMSS & PIRLS International Study Center at Boston College, including Executive Directors Ina V.S. Mullis and Michael O. Martin, and the TIMSS Questionnaire Coordinator, Martin Hooper. NRCs had an essential role in updating the questionnaires, providing feedback and ideas through an online review and at successive NRC meetings. The QIRC made major contributions in updating the TIMSS 2015 questionnaires with the 1st QIRC meeting focused on developing TIMSS items/scales, and the 2nd meeting focused on refining the questionnaires in light of the field test results. Exhibit 2.2 lists the members of the QIRC.

Exhibit 2.1: TIMSS 2015 Context Questionnaire Development Schedule

Date(s)		Group and Activity
February	2013	NRCs reviewed TIMSS 2011 context questionnaires at the 1st NRC meeting (Hamburg, Germany)
February–May	2013	Staff at TIMSS & PIRLS International Study Center draft the Context Questionnaire Framework chapter
May	2013	NRCs reviewed the Context Questionnaire Framework chapter at their 2nd NRC meeting (Amsterdam, The Netherlands)
May–June	2013	Staff at TIMSS & PIRLS International Study Center revised the draft Context Questionnaire Framework chapter to incorporate NRC feedback and began questionnaire item writing for TIMSS 2015
June	2013	1st meeting of the Questionnaire Item Review Committee (QIRC) to review the draft TIMSS 2015 Context Questionnaire Framework and the draft TIMSS 2015 questionnaires (Singapore)
July–August	2013	TIMSS & PIRLS International Study Center revised the draft context questionnaires to incorporate QIRC/QDG feedback and finalized a draft of the TIMSS 2015 Context Questionnaire Chapter
August–September	2013	NRCs review draft questionnaires online
September	2013	Staff at TIMSS & PIRLS International Study Center published TIMSS 2015 Assessment Frameworks, which includes the chapter on the Context Questionnaire Framework
September–October	2013	Staff at TIMSS & PIRLS International Study Center revised the draft context questionnaires to address NRC comments from the online review
November	2013	NRCs reviewed and approved proposed context questionnaires at 3rd NRC meeting (Budapest, Hungary)
November–December	2013	Staff at TIMSS & PIRLS International Study Center finalized field test context questionnaire instruments
December	2013	Staff at TIMSS & PIRLS International Study Center provided field test context questionnaires to NRCs
March–April	2014	Countries conducted TIMSS 2015 field test
March	2014	NRCs reviewed and provided feedback on TIMSS 2011 Curriculum Questionnaires at 4th NRC meeting (Sydney, Australia)

Exhibit 2.1: TIMSS 2015 Context Questionnaire Development Schedule (Continued)

Date(s)		Group and Activity
April–May	2014	Countries submitted field test data for analysis and review
June	2014	TIMSS & PIRLS International Study Center conducted an internal review of field test results
July	2014	QIRC reviewed questionnaire field test data and the TIMSS 2011 Curriculum Questionnaire at 2nd QIRC meeting (Muenster, Germany)
August	2014	NRCs reviewed and approved context questionnaires for TIMSS 2015 data collection at 5th NRC meeting (Paris, France)
August	2014	TIMSS & PIRLS International Study Center distributed TIMSS 2015 data collection context questionnaire instruments to NRCs for translation
October–December	2014	Southern Hemisphere countries conducted TIMSS 2015 data collection
January–March	2015	TIMSS & PIRLS International Study Center drafted TIMSS 2015 Curriculum Questionnaires
March	2015	NRCs approved draft TIMSS 2015 Curriculum Questionnaires at the 6th NRC meeting (Prague, Czech Republic)
April–August	2015	TIMSS 2015 Curriculum Questionnaires administered online to NRCs
March–June	2015	Northern Hemisphere countries conducted TIMSS 2015 data collection

Exhibit 2.2: TIMSS 2015 Questionnaire Item Review Committee (QIRC)

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Czech School Inspectorate
Czech Republic

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Chew Leng Poon
Planning Division, Research and Evaluation
Ministry of Education
Singapore

Peter Nyström
National Center for Mathematics Education
University of Gothenburg
Sweden

Jack Buckley
The College Board
United States

Together with TIMSS at the fourth and eighth grades, TIMSS 2015 included TIMSS Numeracy at the fourth grade and the TIMSS Advanced assessments in mathematics and physics at the final year of secondary school. Countries participating in TIMSS Numeracy administered the TIMSS 2015 fourth grade questionnaires. TIMSS Advanced, however, required separate questionnaires geared toward the context for learning of STEM-track students during their final year of schooling. Although the TIMSS eighth grade questionnaires served as a foundation for developing the TIMSS Advanced 2015 questionnaires, the TIMSS Advanced questionnaires included numerous differences from the TIMSS questionnaires. Additional information on developing the TIMSS Advanced questionnaires can be found in Chapter 2 of *Methods and Procedures in TIMSS Advanced 2015*.

Background of TIMSS 2015 Context Questionnaire Development

Similar to the development process for the TIMSS 2015 achievement booklets (see Chapter 1), questionnaire development balanced the dual purposes of maintaining continuity with previous assessments and evolving to reflect the current contexts for student learning. Therefore, the TIMSS 2015 questionnaires can be viewed as the latest evolution of six cycles of TIMSS questionnaires dating back to TIMSS 1995. In particular, the TIMSS 2015 questionnaires are built upon the successes of the TIMSS 2011 questionnaires, with modifications to align the questionnaires with more recent research and policy innovations.

A major methodological innovation in TIMSS 2011 was using context questionnaire scales to measure key educational research topics (Martin, Mullis, Foy, & Arora, 2012). TIMSS 2015 questionnaire development focused on writing items to strengthen the measurement properties of the TIMSS 2011 scales as well as developing new scales to measure emerging areas of educational research.

In 2011, the TIMSS and PIRLS cycles coincided, and 34 countries chose to administer both TIMSS and PIRLS to the same fourth grade students. Accordingly, the TIMSS 2011 and PIRLS 2011 questionnaires were developed in tandem (see *Methods and Procedures in TIMSS and PIRLS 2011* for details). Overall, this joint development process produced a synergy that led to advancements in questionnaire development for both projects, and shared items across TIMSS and PIRLS 2011 allowed results to be compared across projects. TIMSS 2015 made an effort to maintain the consistency with PIRLS by holding the 1st meeting of the QIRC with its PIRLS equivalent—the Questionnaire Development Group (QDG). Also, TIMSS 2015 questionnaire development considered the suggested revisions to overlapping TIMSS/PIRLS questionnaire items made at PIRLS NRCs meetings.

The joint administration of TIMSS and PIRLS 2011 to the same students allowed data collected through the PIRLS home questionnaire to be linked with TIMSS questionnaire and achievement data. Consequently, the TIMSS 2011 reports for the first time included data collected

from parents on areas like early childhood numeracy activities, home resources for learning, and language use in the home. Given the wealth of information provided by the home questionnaire, the TIMSS 2015 NRCs decided that a TIMSS-specific home questionnaire, entitled the *Early Learning Survey*, should be developed and administered at the fourth grade.

Updating the TIMSS 2015 Context Questionnaire Framework

The TIMSS 2015 Context Questionnaire Framework, Chapter 3 of the *TIMSS 2015 Assessment Frameworks*, provided the foundation for updating the TIMSS context questionnaires for 2015. The Framework chapter presents a review of a vast array of educational research that identifies key context questionnaire topics and gives the theoretical justification for asking about these topics within the 2015 questionnaires.

At the 1st NRC meeting in February 2013 in Hamburg, Germany, NRCs described topics they thought should be covered in the TIMSS 2015 questionnaires, including which TIMSS 2011 topics should be retained to measure trends. Taking into account feedback garnered in the meeting, the TIMSS Questionnaire Coordinator conducted an extensive literature review and drafted the TIMSS 2015 Questionnaire Framework chapter. Because the primary purpose of the context questionnaires is to identify factors that may contribute to differences in achievement within and between countries, the framework focuses on topics in educational research found to be related to achievement across a variety of settings and contexts.

The NRCs reviewed the draft chapter at the 2nd NRC meeting in May 2013 in Amsterdam, and the QIRC reviewed it at their first meeting in June 2013 in Singapore. Staff at the TIMSS & PIRLS International Study Center refined the draft based upon the recommendations received at the two meetings and published the final *TIMSS 2015 Assessment Frameworks* online in September 2013, with printed copies distributed thereafter.

Field Test Questionnaire Development

With the draft Context Questionnaire Framework at hand, staff at the TIMSS & PIRLS International Study Center focused the questionnaire development process on improving and expanding the TIMSS context questionnaire scales, developing the TIMSS *Early Learning Survey*, and updating items to align with more recent technological innovations.

For many of the scales retained from TIMSS 2011, modifications for 2015 focused on increasing the number of items to optimize reliability and content coverage. For example, a number of new items were written for the School Emphasis on Academic Success scale, with item development influenced by existing scales in the academic optimism literature (Hoy, Hoy, & Kurz, 2008; McGuigan & Hoy, 2006; Wu, Hoy, & Tarter, 2013). Additional items were also included for the student engagement scales, with one item sourced from Fauth, Decristan, Rieser, Klieme, and Büttner (2014).

Staff at the TIMSS & PIRLS International Study Center worked with the TIMSS QIRC/PIRLS QDG at their joint meeting in June 2013 to recast a number of scales. For instance, the QIRC and QDG revamped the teacher job satisfaction scale to integrate insights gained from the *Utrecht Work Engagement Scale* (Schaufeli, Bakker, & Salanova, 2006). The questionnaire committees also revised the Confidence in Teaching Mathematics/Science scales, with item development influenced by the *Ohio State Teacher Efficacy Scale* (Tschannen-Moran & Hoy, 2001).

Although the PIRLS home questionnaire served as a foundation for the development of the TIMSS *Early Learning Survey*, numerous new items needed to be developed to focus the TIMSS questionnaire on the contexts for learning mathematics and science. One new scale included in the *Early Learning Survey* is the Parental Attitude toward Mathematics and Science scale—developed to assess parents' feelings towards STEM fields.

Finally, updating questionnaires to "keep up with the times" was an essential part of the 2015 development process. Staff at the TIMSS & PIRLS International Study Center worked with the QIRC and QDG to ensure that the questionnaires included items on the availability of prevalent digital resources for education such as ebooks, tablets, and interactive whiteboards.

Review Field Test Results and Refine Questionnaires for Data Collection

TIMSS 2015 countries administered an ambitious field test, eliciting questionnaire data from 111,194 students, 59,200 parents, 2,775 principals, and 10,165 teachers across 43 countries and five benchmarking entities at the fourth grade, 7 countries for TIMSS Numeracy, and 37 countries and 4 benchmarking entities at the eighth grade.

Following field test administration, staff at the TIMSS & PIRLS International Study Center produced data almanacs and scale summaries to facilitate the review of the field test data:

- Data almanacs document the use of response categories for each context questionnaire item as well each item's relationship with achievement
- Scale summaries detail each scale's reliability, dimensionality, fit to the Rasch model, and relationship with achievement

In June 2014, staff at the TIMSS & PIRLS International Study Center reviewed the field test context questionnaire results, proposing revisions to the QIRC. At their 2nd meeting in July 2014, the QIRC accepted many of the recommendations and suggested a few additional changes. In August 2014 at their 5th meeting, NRCs reviewed the final draft questionnaires and accepted the questionnaires with a few minor revisions. Following the NRC meeting, staff at the TIMSS & PIRLS International Study Center implemented the revisions and posted the final TIMSS instruments on August 28, 2014, so that countries could begin the translation process.

Developing the TIMSS 2015 Curriculum Questionnaires

The TIMSS Curriculum Questionnaires complement the student, teacher, school, and home questionnaires by collecting information from NRCs about country-level contexts. The Curriculum Questionnaires cover each country's mathematics and science curricula, goals and standards for instruction, and other national or regional policies such as the preprimary education process and the teacher education process.

Similar to the other TIMSS 2015 questionnaires, the process for updating the TIMSS Curriculum Questionnaires started with the TIMSS 2015 Context Questionnaire Framework. Then, NRCs and the QIRC identified the information from the TIMSS 2011 Curriculum Questionnaires that they thought was useful to continue collecting.

Based on the framework, and the NRC and QIRC feedback, staff at the TIMSS & PIRLS International Study Center updated the TIMSS 2015 Curriculum Questionnaires for review by NRCs at their 6th meeting in March 2015. Following the NRC meeting, staff at the TIMSS & PIRLS International Study Center finalized the questionnaires, incorporating the suggestions that emerged from the meeting. NRCs completed the online Curriculum Questionnaires between April 23, 2015 and August 31, 2015.

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CHAPTER 3

Sample Design in TIMSS 2015

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Introduction

TIMSS is designed to provide valid and reliable measurement of trends in student achievement in countries around the world, while keeping to a minimum the burden on schools, teachers, and students. The TIMSS program employs rigorous school and classroom sampling techniques so that achievement in the student population as a whole may be estimated accurately by assessing just a sample of students from a sample of schools. TIMSS assesses mathematics and science achievement at two grade levels and so TIMSS has two target populations—all students enrolled at the fourth grade and all students enrolled at the eighth grade. Countries may assess either or both student populations. In addition, for the TIMSS 2015 cycle, countries could participate in TIMSS Numeracy— a new, less difficult mathematics assessment at the fourth grade.

TIMSS employs a two-stage random sample design, with a sample of schools drawn as a first stage and one or more intact classes of students selected from each of the sampled schools as a second stage. Intact classes of students are sampled rather than individuals from across the grade level or of a certain age because TIMSS pays particular attention to students' curricular and instructional experiences, and these typically are organized on a classroom basis. Sampling intact classes also has the operational advantage of less disruption to the school's day-to-day business than individual student sampling.

National Sampling Plan

Each country participating in TIMSS needs a plan for defining its national target population and applying the TIMSS sampling methods to achieve a nationally representative sample of schools and students. The development and implementation of the national sampling plan is a collaborative exercise involving the country's National Research Coordinator (NRC) and TIMSS sampling experts.

Statistics Canada is responsible for advising the National Research Coordinator on all sampling matters and for ensuring that the national sampling plan conforms to the TIMSS

standards. In cooperation with sampling staff from the IEA Data Processing and Research Center (IEA DPC), Statistics Canada works with the National Research Coordinator to select the national school sample(s) and produce all supporting documentation for tracking the sampled schools. This includes ensuring that the school sampling frame (the school population list from which the school sample is drawn) provided by the National Research Coordinator is complete and satisfactory; checking that categories of excluded students are clearly defined, justified, and kept to a minimum; assisting the National Research Coordinator in determining the sample size and a stratification plan that will meet both international and national objectives; and drawing a national sample of schools. When sampling has been completed and all data collected, Statistics Canada documents population coverage and school and student participation rates and constructs appropriate sampling weights for use in analyzing and reporting the results.

The TIMSS & PIRLS International Study Center, in cooperation with Statistics Canada and the IEA DPC, provides National Research Coordinators with a series of manuals to guide them through the sampling process. More specifically, *TIMSS 2015 Survey Operations Procedures Unit 1: Sampling Schools and Obtaining their Cooperation* describes the steps involved in defining the national target population and selecting the school sample, and *TIMSS 2015 Survey Operations Procedures Unit 3: Contacting Schools and Sampling Classes for Data Collection* describes the procedure for sampling classes within the sampled schools and making preparations for conducting the assessments. Within-school sampling procedures for the field test are documented in *TIMSS 2015 Survey Operations Procedures Unit 2: Preparing for and Conducting the Field Test*. More information on the Survey Operations Units can be found in Chapter 6 of this volume.

The TIMSS National Research Coordinator is responsible for providing Statistics Canada with all information and documentation necessary to conduct the national sampling, and for conducting all sampling operations in the country. In particular, the NRC is expected to identify the grade(s) that correspond to the international target population(s); create a sampling frame by listing all schools in the population that have classes with students in the target grade(s); determine national population coverage and exclusions, in accordance with the TIMSS international guidelines; work with Statistics Canada to develop a national sampling plan and identify suitable stratification variables, ensuring that these variables are present and correct for all schools; contact all sampled schools and secure their participation; keep track of school participation and the use of replacement schools; and conduct all within-school sampling of classes. Each NRC is required to complete a series of sampling forms documenting the completion of each of these tasks.

A crucial feature of each international meeting of National Research Coordinators is a one-to-one meeting between each NRC and sampling staff at Statistics Canada and the IEA DPC. At these meetings, each step of the sampling process is documented and reviewed in detail, and NRCs have the opportunity to raise issues and ask questions about their national situation and any challenges they face. Statistics Canada consults with the TIMSS & PIRLS International Study Center and the

International Sampling Referee, as necessary, to resolve issues and questions. Final approval of TIMSS national sampling plans is the responsibility of the TIMSS & PIRLS International Study Center, based upon the advice of Statistics Canada and the International Sampling Referee.

Defining the Target Population

As an international study of the comparative effects of education on student achievement in mathematics and science, TIMSS defines its international target populations in terms of the amount of schooling students have received. The number of years of formal schooling is the basis of comparison among participating countries. Thus, the TIMSS international target population at the lower grade is all students in their fourth year of formal schooling, and at the upper grade, all students in their eighth year of formal schooling. Like TIMSS at the lower grade, the international target population for TIMSS Numeracy, is students in their fourth year of formal schooling. UNESCO's *International Standard Classification of Education ISCED 2011* (ISCED, 2012) provides an internationally accepted classification scheme for describing levels of schooling across countries. The ISCED system describes the full range of schooling, from pre-primary (Level 0) to the doctoral level (Level 8). ISCED Level 1 corresponds to primary education or the first stage of basic education. The first year of Level 1 "coincides with the transition point in an education system where systematic teaching and learning in reading, writing and mathematics begins" (UNESCO, 2012, p. 30). Four years after this would be the target grade for fourth grade TIMSS including TIMSS Numeracy, and is the fourth grade in most countries. Similarly, eight years after the first year of ISCED Level 1 is the target grade for eighth grade TIMSS and is the eighth grade in most countries. However, given the cognitive demands of the assessments, TIMSS wants to avoid assessing very young students. Thus, TIMSS recommends assessing the next higher grade (i.e., fifth grade for fourth grade TIMSS and ninth grade for eighth grade TIMSS) if, for fourth grade students, the average age at the time of testing would be less than 9.5 years and, for eighth grade students, less than 13.5 years.

The fourth grade and eighth grade target populations of students are defined as follows:

- **Fourth grade:** All students enrolled in the grade that represents four years of schooling counting from the first year of ISCED Level 1, providing the mean age at the time of testing is at least 9.5 years
- **Eighth grade:** All students enrolled in the grade that represents eight years of schooling counting from the first year of ISCED Level 1, providing the mean age at the time of testing is at least 13.5 years

All students enrolled in the target grade, regardless of their age, belong to the international target population and should be eligible to participate in TIMSS. Because students are sampled in two stages, first by randomly selecting a school and then randomly selecting a class from within

the school, it is necessary to identify all schools in which eligible students are enrolled. Essentially, eligible schools for TIMSS are those that have any students enrolled in the target grade, regardless of type of school. All schools of all educational sub-systems that have students learning full-time in the target grade are part of the international target population, including schools that are not under the authority of the national Ministry of Education.

National Target Populations

For most countries, the target grade for TIMSS is the fourth and/or eighth grade. However, because educational systems vary in structure and in policies and practices with regard to age of starting school and promotion and retention, there are differences across countries in how the target grades are labelled and in the average age of students. To ensure that the appropriate national target grades are selected, each NRC completes Sampling Form 1, which identifies the target grades, the country's name for those grades, and the average age of students in those grades at the time of data collection. An example of a completed Sampling Form 1 is presented in Exhibit 3.1.

Exhibit 3.1: Example of Sampling Form 1

Sampling Form 1 — **General Information**

See Section 2 of TIMSS 2015 Survey Operations Procedures Unit 1

TIMSS 2015 Participant :	< Name of the Country >
National Research Coordinator :	< Name of the NRC >

1. Please indicate the assessment(s) in which your country plans to participate along with the target grade(s), name(s), and expected average age of students at the time of testing:

	Target Grade	Name of the Target Grade	Average Age
TIMSS	4	Primary 4	9.7
	8	Secondary 2	13.7
TIMSS Numeracy	4	Primary 4	9.7

2. Specify the usual start and end date(s) of the school year and the expected date(s) of testing for the data collection.

Start of school year : *(YYYY-MM-DD)*	Expected testing date:	End of school year: *(YYYY-MM-DD)*
September 1, 2014	April 15, 2015	June 21, 2015

3. Will you request that Statistics Canada and/or the IEA DPC select your school sample(s)?
(Click in box and on right arrow to see drop down menu)

Please select Yes or No

4. Specify the language(s) in which the assessment(s) will be administered.

English

5. Describe the grade structure through ISCED Level 1 (primary education or the first stage of basic education) and ISCED Level 2 (basic or lower secondary education) in your country.

Grades 1 to 6 , Primary schools
Grades 7 to 9 , Lower secondary schools

6. Describe the age and birth date rules for entering ISCED Level 1 in your country.

Children must enter school (grade 1) in the autumn of the year in which they have their sixth birthday

National Coverage and Exclusions

TIMSS is designed to describe and summarize student achievement across the entire target grade (fourth or eighth), and so it is very important that national target populations aim for comprehensive coverage of eligible students. However, in some cases, political, organizational, or operational factors make complete national coverage difficult to attain. Thus, in some rare situations, certain groups of schools and students may have to be excluded from the national target population. For example, it may be that a particular geographical region, educational sub-system, or language group cannot be covered. Such exclusion of schools and students from the target population is referred to as reduced population coverage.

Even countries with complete population coverage find it necessary to exclude at least some students from the target population because they attend very small schools, have intellectual or functional disabilities, or are non-native language speakers. Such students may be excluded at the school level (i.e., the whole school is excluded) or within the school on an individual basis.

School Level Exclusions. Although it is expected that very few schools will be excluded from the national target population, NRCs are permitted to exclude schools on the following grounds when they consider it necessary:

- Inaccessibility due to their geographically remote location
- Extremely small size (e.g., four or fewer students in the target grade)
- Offering a grade structure, or curriculum, radically different from the mainstream educational system
- Providing instruction solely to students in the student-level exclusion categories listed below (e.g., catering only to special needs students)

Student Level Exclusions. The international within-school exclusion rules are specified as follows:

- Students with functional disabilities — These are students who have physical disabilities such that they cannot perform in the TIMSS testing situation. Students with functional disabilities who are able to perform should be included in the testing.
- Students with intellectual disabilities — These are students who are considered, in the professional opinion of the school principal or by other qualified staff members, to have intellectual disabilities or who have been tested as such. This includes students who are emotionally or mentally unable to follow even the general instructions of the test. Students should not be excluded solely because of poor academic performance or normal disciplinary problems. It should be noted that students with dyslexia, or other such learning disabilities, should be accommodated in the test situation if possible, rather than excluded.

- Non-native language speakers — These are students who are unable to read or speak the language(s) of the test and would be unable to overcome the language barrier in the test situation. Typically, a student who has received less than one year of instruction in the language(s) of the test should be excluded.

Because disability criteria vary from country to country, NRCs are asked to translate the TIMSS international exclusion standards into the local equivalent. Students should be considered for exclusion strictly in accordance with the international standards. If a sampled school contains a class consisting entirely of students from one of the exclusion categories, such a class is excluded prior to classroom sampling.

NRCs understand that exclusion rates must be kept to a minimum in order that national samples accurately represent the national target population.

- The overall number of excluded students must not account for more than 5% of the national target population of students in a country. The overall number includes both school-level and within-school exclusions.
- The number of students excluded because they attend very small schools must not account for more than 2% of the national target population of students.

To document population coverage and exclusions, each NRC completes Sampling Form 2, which lists the number of students in the national target population and the number of students excluded at both the school level and within the school for each population to be assessed. An example of a completed Sampling Form 2 is presented in Exhibit 3.2.

Exhibit 3.2: Example of Sampling Form 2

Sampling Form 2 — **Coverage and Exclusions**

See Section 3 of TIMSS 2015 Survey Operations Procedures Unit 1

TIMSS 2015 Participant : < Name of the Country >

1. This Sampling Form refers to:

TIMSS Grade	TIMSS Numeracy Grade
4	

		Number of schools	Number of students
Total enrollment in the target grade:	[a]	822	56,560

2. School-level exclusions *(if applicable)*:

	Description of exclusions	Number of schools	Number of students
1.	Students taught in <language>	8	630
2.	Special education schools	16	325
3.	Very small schools (less than 5 students in grade 4)	40	110
4.			
5.			
TOTAL: *(Sum of exclusions - Calculated automatically)*	[b]	64	1,065

		schools	students
Percentage of school-level exclusions: *(Box [b] ÷ Box [a] x 100)*	[1]	7.8%	1.9%

3. Total enrollment after school-level exclusions: [c] — 758 — 55,495
(Box [c] = Box [a] - Box [b])

Values calculated automatically

4. Within-school exclusions *(if applicable)*:

	Description of exclusions	Number of students
1.	Students with special education needs (based on TIMSS 2011)	640
2.		
3.		
TOTAL: *(Sum of exclusions - Calculated automatically)*	[d]	640

		schools	students
Expected percentage of within-school exclusions: *(Box [d] ÷ Box [c] x 100)*	[2]	0.0%	1.2%

5. **Expected percentage of reduced coverage and exclusions:** — 7.8% — 3.0%
(Box [1] + (1 - Box [1]) X Box [2])

Values calculated automatically

6. Total enrollment in the target grade in previous school years.

Years	Number of schools	Number of students
2011/2012	856	58,451
2010/2011	890	61,489

Requirements for Sampling the Target Population

TIMSS sets high standards for sampling precision, participation rates, and sample implementation in order to achieve national samples of the highest quality and survey estimates that are unbiased, accurate and internationally comparable.

Sampling Precision and Sample Size

Because TIMSS is fundamentally a study of student achievement, the precision of estimates of student achievement is of primary importance. To meet the TIMSS standards for sampling precision, national student samples should provide for a standard error no greater than .035 standard deviation units for the country's mean achievement. With a standard deviation of 100 on the TIMSS achievement scales, this standard error corresponds to a 95% confidence interval of ± 7 score points for the achievement mean and of ± 10 score points for the difference between achievement means from successive cycles (e.g., the difference between a country's achievement mean on TIMSS 2011 and TIMSS 2015). Sample estimates of any student-level percentage estimate (e.g., a student background characteristic) should have a confidence interval of ± 3.5%.

For most countries, the TIMSS precision requirements are met with a school sample of 150 schools and a student sample of 4,000 students for each target grade. Depending on the average class size in the country, one class from each sampled school may be sufficient to achieve the desired student sample size. For example, if the average class size in a country were 27 students, a single class from each of 150 schools would provide a sample of 4,050 students (assuming full participation by schools and students). Some countries choose to sample more than one class per school, either to increase the size of the student sample or to provide a better estimate of school-level effects.

For countries choosing to participate in both TIMSS at the fourth grade and TIMSS Numeracy, the required student sample size is doubled— i.e., around 8000 sampled students. Countries could choose to select more schools or more classes within sampled schools to achieve the required sample size.

A school sample larger than the minimum of 150 schools may be required under the following circumstances:

- The average class size in a country is so small that, even when sampling more than one classroom per school, it is not possible to reach the student sample size requirements by selecting only 150 schools
- Previous cycles of TIMSS showed that the sampling precision requirements cannot be met unless a larger school sample is selected

- Classes within schools are tracked by student performance (more common at eighth grade than at fourth grade). This increases variation between classes in student achievement and can reduce sampling precision. In this situation, it is advisable to sample at least two classrooms per school whenever possible, in addition to sampling more schools.
- A high level of non-response is anticipated, leading to sample attrition and reduced sample size. Note that while a larger school sample helps to maintain sample size in the face of non-response, it does not compensate for non-response bias.

Field Test Sample

The school sample for the TIMSS field test is drawn at the same time and from the same population of schools as the full sample. The field test sample size requirement is 200 students per field test achievement booklet. The total field test sample size is a function of the number of achievement booklets being field tested. Typically, TIMSS has six field test booklets and so requires a field test sample of 1200 students at each grade. For TIMSS 2015, TIMSS Numeracy field tested five field test booklets and therefore required a sample size of 1000 students. As such, countries participating in both TIMSS and TIMSS Numeracy at fourth grade required a field test size of 2200 students.

Participation Rates

To minimize the potential for non-response bias, TIMSS aims for 100% participation by sampled schools, classrooms, and students, while recognizing that some degree of non-participation may be unavoidable. For a national sample to be fully acceptable it must have either:

- A minimum school participation rate of 85%, based on originally sampled schools AND
- A minimum classroom participation rate of 95%, from originally sampled schools and replacement schools AND
- A minimum student participation rate of 85%, from sampled schools and replacement schools

OR

- A minimum combined school, classroom, and student participation rate of 75%, based on originally sampled schools (although classroom and student participation rates may include replacement schools)

Classrooms with less than 50% student participation are deemed to be not participating.

Developing and Implementing the National Sampling Plan

Although National Research Coordinators are responsible for developing and implementing national sampling plans, Statistics Canada and the IEA DPC work closely with NRCs to help ensure that these sampling plans fully meet the standards set by the TIMSS & PIRLS International Study Center, while also adapting to national circumstances and requirements. National sampling plans must be based on the international two-stage sample design (schools as the first stage and classes within schools as the second stage) and must be approved by Statistics Canada.

TIMSS Stratified Two–Stage Cluster Sample Design

The basic international sample design for TIMSS is a stratified two-stage cluster sample design, as follows:

First Sampling Stage. For the first sampling stage, schools are sampled with probabilities proportional to their size (PPS) from the list of all schools in the population that contain eligible students. The schools in this list (or sampling frame) may be stratified (sorted) according to important demographic variables. Schools for the field test and data collection are sampled simultaneously using a systematic random sampling approach. Two replacement schools are also pre-assigned to each sampled school during the sample selection process, and these replacement schools are held in reserve in case the originally sampled school refuses to participate. Replacement schools are used solely to compensate for sample size losses in the event that the originally sampled school does not participate. School sampling is conducted for each country by Statistics Canada with assistance from the IEA DPC, using the sampling frame provided by the country's National Research Coordinator.

Second Sampling Stage. The second sampling stage consists of the selection of one (or more) intact class from the target grade of each participating school. Class sampling in each country is conducted by the National Research Coordinator using the Within-School Sampling Software (WinW3S) developed by the IEA DPC and Statistics Canada. Having secured a sampled school's agreement to participate in the assessment, the NRC requests information about the number of classes and teachers in the school and enters it in the WinW3S database. Classes smaller than a specified minimum size are grouped into pseudo-classes prior to sampling. The software selects classes with equal probabilities within schools. All students in each sampled class participate in the assessment. Sampled classes that refuse to participate may not be replaced.

For countries participating in both TIMSS at the fourth grade and TIMSS Numeracy, students within a sampled class are randomly assigned either a TIMSS or TIMSS Numeracy booklet through a booklet rotation system. This is done to ensure that TIMSS and TIMSS Numeracy are administered to probabilistically equivalent samples.

Stratification

Stratification consists of arranging the schools in the target population into groups, or strata, that share common characteristics such as geographic region or school type. Examples of stratification variables used in TIMSS include region of the country (e.g., states or provinces); school type or source of funding (e.g., public or private); language of instruction; level of urbanization (e.g., urban or rural area); socioeconomic indicators; and school performance on national examinations.

In TIMSS, stratification is used to:

- Improve the efficiency of the sample design, thereby making survey estimates more reliable
- Apply different sample designs, such as disproportionate sample allocations, to specific groups of schools (e.g., those in certain states or provinces)
- Ensure proportional representation of specific groups of schools in the sample

School stratification can take two forms: explicit and implicit. In explicit stratification, a separate school list or sampling frame is constructed for each stratum and a sample of schools is drawn from that stratum. In TIMSS, the major reason for considering explicit stratification is disproportionate allocation of the school sample across strata. For example, in order to produce equally reliable estimates for each geographic region in a country, explicit stratification by region may be used to ensure the same number of schools in the sample for each region, regardless of the relative population size of the regions.

Implicit stratification consists of sorting the schools by one or more stratification variables within each explicit stratum, or within the entire sampling frame if explicit stratification is not used. The combined use of implicit strata and systematic sampling is a very simple and effective way of ensuring a proportional sample allocation of students across all implicit strata. Implicit stratification also can lead to improved reliability of achievement estimates when the implicit stratification variables are correlated with student achievement.

National Research Coordinators consult with Statistics Canada and the IEA DPC to identify the stratification variables to be included in their sampling plans. The school sampling frame is sorted by the stratification variables prior to sampling schools so that adjacent schools are as similar as possible. Regardless of any other explicit or implicit variables that may be used, the school size is always included as an implicit stratification variable.

To document the stratification variables used in their sampling plans, each NRC completes Sampling Form 3, which lists the variables to be used for explicit and implicit stratification, and the number of levels of each stratification variable. An example of a completed Sampling Form 3 is presented in Exhibit 3.3. Appendix 3A provides the list of explicit and implicit stratification variables implemented by the countries participating at the fourth grade and Appendix 3B provides the equivalent list for eighth grade. Further details on the explicit and implicit stratification variables for each country can be found in the Characteristics of National Samples section in Chapter 5: Sampling Implementation.

Exhibit 3.3: Example of Sampling Form 3

Sampling Form 3 — Stratification

See Section 4 of TIMSS 2015 Survey Operations Procedures Unit 1

TIMSS 2015 Participant : < Name of the Country >

1. This Sampling Form refers to:

TIMSS Grade	TIMSS Numeracy Grade
4 and 8	4

Stratification of schools

2. List and describe the variables to be used for stratification in order of importance:
(Please note that the choice of variables used for explicit or implicit stratification will be discussed during consultations with Statistics Canada)

Stratification Variables			
	Name	Description	# of levels
1	School type	public, private	2
2	Socio-economic status	high, medium, low	3
3			
4			
5			
6			

Include additional information if necessary:

3. If applicable, describe additional requirements for sub-national estimates (e.g., oversampling of specific groups of the population):

would like to have reliable estimates for students from the private schools

School Sampling Frame

One of the National Research Coordinator's most important sampling tasks is the construction of a school sampling frame for the target population. The sampling frame is a list of all schools in the country that have students enrolled in the target grade, and is the list from which the school sample is drawn. A well-constructed sampling frame provides complete coverage of the national target population without being contaminated by incorrect or duplicate entries or entries that refer to elements that are not part of the defined target population.

A suitable school measure of size (MOS) is a critical aspect of the national sampling plan, because the size of a school determines its probability of selection. The most appropriate school measure of size is an up-to-date count of the number of students in the target grade. If the number of students in the target grade is not available, total student enrollment in the school may be the best available substitute.

Sampling Form 4, presented in Exhibit 3.4, provides some basic information about the school sampling frame, including the average class size at the target grade, the number of classrooms to be sampled per school, the school measure of size (MOS) to be used for school sampling, and the school year from which the frame was constructed.

Exhibit 3.4: Example of Sampling Form 4

Sampling Form 4 — **Classroom Information and Sampling Frame**

See Section 5 of TIMSS 2015 Survey Operations Procedures Unit 1

TIMSS 2015 Participant : < Name of the Country >

1. This Sampling Form refers to:

TIMSS Grade	TIMSS Numeracy Grade
4	

2. Specify the school measure of size (MOS) to be used.

Please select the MOS to be used:
(Click in box and on right arrow to see drop down menu)

1. Number of students in the target grade (preferred)

Name of the MOS variable in the school frame: GR4_STD

If "Other," please describe:

3. Specify the average class size (ACS) for the target grade in your schools. 24

4. Specify how many classrooms you plan to sample per school. *(Click in box and on right arrow to see drop down menu)*

2. More than one classroom in tracked schools

If "Other," please describe:

5. Specify the school year for which enrollment data will be used for the school MOS. 2012/2013

6. If a frame other than a single-level sampling frame (list of all schools) is to be used, please provide a preliminary description of the information available to construct this frame.

n.a.

The school sampling frame is usually a spreadsheet containing a single entry for each school. This entry includes a unique identification number and contact information (if appropriate given the country's privacy laws), the values of the stratification variables for the school, and the school measure of size. It is useful if the school entry also includes the number of classes in the school in the target grade because this provides a mechanism for predicting in advance the size of the eventual student sample. This predicted sample size may be compared with the eventual student sample size as a check on the sampling process.

Exhibit 3.5 provides an example of a partial sampling frame for a country assessing TIMSS 2015 at the eighth grade. In this example, region and urbanization could be used as stratification variables.

Exhibit 3.5: Example of a Partial Sampling Frame

	A	B	C	D	E	F	G	H	I	J
1	School ID	Region	Urbani-zation	Grade 8 Students	Grade 8 Classes	School Name	School Address	Postal code	Town	Tel
2	15104	South	Rural	211	8	Campbell College	Jelly Bean Ave 23	01604	Dinsdale	040 / 5699
3	15113	North	Rural	176	7	Stromboli High School	Barracuda Street 5	01611	Lowrie	040 / 5666
4	15115	North	Rural	182	7	Central Park School	Wales Crescent 45	01600	Kristin	041 / 5599
5	15123	North	Urban	104	4	Obi Wan School	Wheel Crescent 23	01903	Curtain	040 / 5000
6	15933	North	Rural	228	9	Alfred Hitchcock High School	Dennis Street 45	01600	Tortilla Plains	041 / 5566
7	15937	North	Urban	186	7	Begonia High School	Morning Street 125	01614	Peacew	040 / 5644
8	15940	North	Urban	153	6	Calmar High School	Casey Crescent 1	01905	Waltington	040 / 5633
9	15942	North	Urban	169	7	Western High School	Travis Ave 54	01905	Waltington	040 / 5644
10	15944	North	Urban	8	1	Manhattan College	Launcaster Street 63	01614	Peacew	040 / 5577
11	15945	South	Rural	229	9	Karaoke High School	Bean Street 45	01614	Blue Lake	040 / 5700
12	15946	South	Rural	164	7	J. Oliver High Cuisine School	Cambridge Crescent 136	01905	Cinder	049 / 5777
13	15953	South	Urban	89	4	Douglas College	Douglas Drive 78	01619	Hawn	049 / 5762
14	15956	South	Urban	22	1	Emily Dickinson College	Phillip Glass Avenue 23	01619	Hawn	049 / 5645
15	15958	North	Urban	65	3	Tinsdale College	McGyver Crescent 49	01903	Curtain	040 / 5811
16	15968	South	Urban	34	1	Gualajara District High School	Strong Street 79	01615	Flowerburgh	040 / 5612
17	15970	South	Urban	188	8	Dry Creek School	Galloway Street 46	01615	Flowerburgh	040 / 5295
18	15974	South	Rural	6	1	Eagle College	Monday Street 123	01614	Candid	040 / 5774
19	15981	South	Rural	81	3	St John High School	Alec Baldwin Drive 75	01617	Holster	040 / 5511
20	15983	South	Rural	88	4	Kum Ba Yah High School	O'Malley Circuit 56	01901	Book Haven	049 / 5693
21	15984	South	Rural	54	2	La Giocconda College	Dodo Bank 45	01616	Kathleen River	049 / 5709
22	15985	South	Urban	45	2	Lake Titicaca College	Collin Benjamin Street 1	01900	Evans	049 / 5622
23	15986	South	Rural	213	9	Paul Bunyan High School	Heidelberg Street 100	01905	Charpwood	049 / 5767
24	15988	South	Rural	290	12	Lynn High School	Good Street 45	01601	Heintz	049 / 5639
25	[illegible]	[illegible]	[illegible]	128	5	Fruit Tree High School	[illegible]	01615	Karburetta	049 / 5611
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9	E. Cochra[illegible]	[illegible]	[illegible]	Garden Heights	049 / [illegible]

Sampling Schools

Once the school sampling frame is structured to meet all international and national requirements, Statistics Canada can draw the school sample. If the sampling frame is explicitly stratified, it is necessary to decide how the school sample is to be allocated among the explicit strata (i.e., the number of schools to be sampled in each stratum). When this has been decided, a sample of schools is selected within each explicit stratum using systematic sampling with probabilities proportional to size. The PPS technique means that the larger schools, those with more students, have a higher probability of being sampled than the smaller schools. However, this difference in the selection probabilities of larger and smaller schools is largely offset at the second stage of sampling by

selecting a fixed number of classes (usually one or two) with equal probability from the sampled school. Classes in large schools with many classes at the target grade have a lower probability of selection than classes in smaller schools that have just one or two classes. A description of the school sampling procedure is provided in Appendix 3C.

Even though the field test is scheduled in the school year before the year of data collection in most countries, the preferred approach in TIMSS is to select both samples of schools at the same time. This ensures that both the field test and data collection samples constitute random samples representative of all schools in the country, and that no school is selected for both samples.

Replacement Schools. Ideally, all schools sampled for TIMSS should participate in the assessments, and NRCs work hard to achieve this goal. Nevertheless, it is anticipated that a 100 percent participation rate may not be possible in all countries. To avoid sample size losses, the sampling plan identifies, *a priori*, specific replacement schools for each sampled school. Each originally sampled school has two pre-assigned replacement schools, usually the school immediately preceding the originally sampled school on the school sampling frame and the one immediately following it. Replacement schools always belong to the same explicit stratum as the original but may come from different implicit strata if the school they are replacing is either the first or last school of an implicit stratum.

The main justification for replacement schools in TIMSS is to ensure adequate sample sizes for analysis of subpopulation differences. Although the use of replacement schools does not eliminate the risk of bias due to school nonparticipation, employing implicit stratification and ordering the school sampling frame by school size increases the chances that a sampled school's replacements would have similar characteristics. This approach maintains the desired sample size while restricting replacement schools to strata where nonresponse occurs. Since the school frame is ordered by school size, replacement schools also tend to be similar in size to the school they are designated to replace.

NRCs understand that they should make every effort to secure the participation of all of the sampled schools. Only after all attempts to persuade a sampled school to participate have failed is the use of its replacement school considered.

Common Adjustments to the TIMSS School Sampling Design

TIMSS school sample design offers considerable flexibility in allowing countries to maximize or minimize the extent to which the same schools are assessed. In order to increase operational efficiency, some countries that administer TIMSS at both the fourth and eighth grades, where fourth and eighth graders attend the same school, find it more efficient to administer TIMSS at the same school for both grades. In other cases, countries try to ensure that assessments are spread across schools and therefore prefer that TIMSS at the fourth and eighth grades are not administered at the same school and/or that TIMSS sampling avoid, when possible, selecting schools that have

recently administered other national and international assessments. To provide flexibility to meet these requests, Statistics Canada implements modified sampling procedures—the details of which are described in Appendix 3D.

Sampling Classes

Within each sampled school, all classes with students at the target grade are listed, and one or more intact classes are selected with equal probability of selection using systematic random sampling. This procedure is implemented using the WinW3S sampling software. The selection of classes with equal probability, combined with the PPS sampling method for schools, in general results in a self-weighting student sample. If the school has multi-grade classes (i.e., the class contains students from more than one grade level), only students from the target grade are eligible for sampling.

When a country participates in both TIMSS and TIMSS Numeracy at fourth grade, students within the sampled classes are randomly assigned to one study or the other by rotating the TIMSS and TIMSS Numeracy booklets within the sampled classes. This is done automatically by the WinW3S software.

Because small classes tend to increase the risk of unreliable survey estimates and can lead to reduced overall student sample size, it is necessary to avoid sampling too many small classes. Based on consideration of the size distribution of classes and the average class size, a lower class size limit or minimum class size (MCS) is specified for each country. Prior to sampling classes in a school, any class smaller than the MCS is combined with another class in the school to form a pseudoclass for sampling purposes. The procedure for sampling classes within schools is described in more detail in the Survey Operations Procedures chapter of this volume.

Sampling Weights

National student samples in TIMSS are designed to accurately represent the target populations within a specified margin of sampling error, as described previously. After the data have been collected and processed, sample statistics such as means and percentages that describe student characteristics are computed as weighted estimates of the corresponding population parameters, where the weighting factor is the sampling weight. A student's sampling weight is essentially the inverse of the student's probability of selection, with appropriate adjustments for nonresponse. In principle, the stratified two-stage sampling procedure used in TIMSS, where schools are sampled with probability proportional to school size and classes are sampled with probability inversely proportional to school size, provides student samples with equal selection probabilities. However, in practice disproportionate sampling across explicit strata by varying the number of classes selected and differential patterns of nonresponse can result in varying selection probabilities, requiring a unique sampling weight for the students in each participating class in the study.

The student sampling weight in TIMSS is a combination of weighting components reflecting selection probabilities and sampling outcomes at three levels—school, class, and student. At each level, the weighting component consists of a basic weight that is the inverse of the probability of selection at that level, together with an adjustment for nonparticipation. The overall sampling weight for each student is the product of the three weighting components: school, class (within school), and student (within class).

Note that sampling weights are calculated independently for each grade and each study. In general, a country will have only one set of sampling weights per target population (fourth and/or eighth grade). However, with the introduction of TIMSS Numeracy in 2015, a country that participates in both TIMSS and TIMSS Numeracy would have two sets of sampling weights at fourth grade as sampling weights are calculated separately for TIMSS and TIMSS Numeracy.

School Weighting Component

Given that schools in TIMSS are sampled with probability proportional to school size, the basic school weight for the i^{th} sampled school (i.e., the inverse of the probability of the i^{th} school being sampled) is defined as:

$$BW_{sc}^{i} = \frac{M}{n \cdot m_i}$$

where n is the number of sampled schools, m_i is the measure of size for the i^{th} school, and

$$M = \sum_{i=1}^{N} m_i$$

where N is the total number of schools in the explicit stratum.[1]

School Nonparticipation Adjustment. If a sampled school does not participate in TIMSS and its two designated replacement schools do not participate, it is necessary to adjust the basic school weight to compensate for the reduction in sample size. The school-level nonparticipation adjustment is calculated separately for each explicit stratum, as follows:

$$A_{sc} = \frac{n_s + n_{r1} + n_{r2} + n_{nr}}{n_s + n_{r1} + n_{r2}}$$

where n_s is the number of originally sampled schools that participated, n_{r1} and n_{r2} the number of first and second replacement schools, respectively, that participated, and n_{nr} is the number of schools that did not participate. Sampled schools that are found to be ineligible[2] are not included in the calculation of this adjustment.

1 For countries such as the Russian Federation that include a preliminary sampling stage, the basic school weight also incorporates the probability of selection in this preliminary stage. The basic school weight in such cases is the product of the preliminary stage weight and the school weight.

2 A sampled school is ineligible if it is found to contain no eligible students (i.e., no students in the target grade). Such schools usually are in the sampling frame by mistake or are schools that recently have closed.

Combining the basic school weight and the school nonparticipation adjustment, the final school weighting component for the i^{th} school becomes:

$$FW_{sc}^{i} = A_{sc} \cdot BW_{sc}^{i}$$

It should be noted that, as well as being a crucial component of the overall student weight, the final school weighting component is a sampling weight in its own right, and can be used in analyses where the school is the analytic unit.

Class Weighting Component

The class weighting component reflects the class-within-school selection probability. After a school has been sampled and has agreed to participate in TIMSS, one or two classes are sampled with equal probability from the list of all classes in the school at the target grade. Because larger schools have more classes from which to sample than smaller schools, the probability of class selection varies with school size, with students in small schools more likely to have their class selected than students in large schools. This relatively greater selection probability for students in small schools offsets their lower selection probability at the first stage, where probability-proportional-to-size school sampling results in higher selection probabilities for larger schools.

The basic class-within-school weight for a sampled class is the inverse of the probability of the class being selected from all of the classes in its school. For the i^{th} sampled school, let C^i be the total number of eligible classes and c^i the number of sampled classes. Using equal probability sampling, the basic class weight for all sampled classes in the i^{th} school is:

$$BW_{cl}^{i} = \frac{C^i}{c^i}$$

For most TIMSS participants, c^i takes the values 1 or 2.

Class Nonparticipation Adjustment. Basic class weights are calculated for all sampled classes in the sampled and replacement schools that participate in TIMSS. A class-level nonparticipation adjustment is applied to compensate for classes that do not participate or where the student participation rate is below 50 percent.[3] Such sampled classes are assigned a weight of zero. Class nonparticipation adjustments are applied at the explicit stratum level rather than at the school level to minimize the risk of bias. The adjustment is calculated as follows:

$$A_{cl} = \frac{\sum_{i}^{s+r1+r2} 1}{\sum_{i}^{s+r1+r2} \delta_i / c^i}$$

3 Although sampling weights are calculated separately for each study when countries participate in both TIMSS and TIMSS Numeracy at fourth grade, the criteria to evaluate if student participation within a class is below 50% uses the student participation from both studies combined. Therefore, if 50% or more students from a class participated in either TIMSS or TIMSS Numeracy, the class is considered as participating when calculating sampling weights for TIMSS or TIMSS Numeracy.

where c^i is the number of sampled classes in the i^{th} school, as defined earlier, and δ_i gives the number of participating classes in the i^{th} school.

Combining the basic class weight and the class nonparticipation adjustment, the final class weighting component, assigned to all sampled classes in the i^{th} school, becomes:

$$FW_{cl}^{i,j} = A_{cl} \cdot BW_{cl}^{i}$$

Student Weighting Component

The student weighting component represents the student-within-class selection probability. The basic student weight is the inverse of the probability of a student in a sampled class being selected.

In the typical TIMSS situation where intact classes are sampled, all students in the class are included, and so this probability is unity. However, under certain circumstances, students may be sampled within the class, and in these circumstances the probability is less than unity. For TIMSS 2015, within-class sampling occurred in countries that decided to administer both TIMSS and TIMSS Numeracy at the fourth grade.

For an intact class with no student subsampling, the basic student weight for the j^{th} class in the i^{th} school is computed as follows:

$$BW_{st1}^{i,j} = 1.0$$

For classes with student subsampling, the basic student weight for the j^{th} class in the i^{th} school is:

$$BW_{st2}^{ij} = \frac{n_{rg}^{i,j} + n_{bs}^{i,j}}{n_{rg}^{i,j}}$$

where $n_{rg}^{i,j}$ is the number of students in the j^{th} class of the i^{th} school selected to participate in TIMSS and $n_{bs}^{i,j}$ is the number of students in the class not selected. In the case of countries administering both TIMSS and TIMSS Numeracy at fourth grade, a set of weights is calculated for each study and the basic student weight is calculated differently, as the participation status is known for all the students in each sampled class. In this case, the basic student weight for the j^{th} class in the i^{th} school for study k is given by:

$$BW_{st3}^{ij} = \begin{cases} 1, & \text{For students who left school or were excluded,} \\ \dfrac{n_{rg'}^{i,j} + n_{bs}^{i,j}}{n_{rg'}^{i,j}}, & \text{For all other students selected for study } k \end{cases}$$

where k represents either TIMSS or TIMSS Numeracy, $n_{rg'}^{i,j}$ and $n_{bs'}^{i,j}$ represent the number of students in the j^{th} class of the i^{th} school selected to participate in study k and the number of

students in the j^{th} class of the i^{th} school not selected for study k respectively, without counting students who either were excluded or left school after the class listing was completed.

Adjustment for Non-Participation. The student nonparticipation adjustment for the j^{th} classroom in the i^{th} school is calculated as:

$$A_{st1}^{i,j} = A_{st2}^{i,j} = A_{st3}^{i,j} = \frac{s_{rs}^{i,j} + s_{nr}^{i,j}}{s_{rs}^{i,j}}$$

where $s_{rs}^{i,j}$ is the number of participating students (i.e., students that participated in TIMSS or TIMSS Numeracy and have assessment scores) in the j^{th} class of the i^{th} school and $s_{nr}^{i,j}$ is the number of students sampled in this class who were expected to have assessment scores but did not participate in the assessment. For intact classes, the sum of $s_{rs}^{i,j}$ and $s_{nr}^{i,j}$ is the total number of students listed in the class, not counting excluded students or students who have left the school since class list was published.

The final student weighting component for students in the j^{th} classroom of the i^{th} school is:

$$FW_{st}^{i,j} = A_{st\Delta}^{i,j} \cdot BW_{st\Delta}^{i,j}$$

where Δ equals 1 when there was no student subsampling (intact classes), 2 when a sample of students was drawn from the students in the class and 3 when both TIMSS and TIMSS Numeracy were administered at fourth grade within the same schools and classes.

Overall Student Sampling Weight. The overall student sampling weight is the product of the final weighting components for schools, classes, and students, as follows:

$$W^{i,j} = FW_{sc}^{i} \cdot FW_{cl}^{i,j} \cdot FW_{st}^{i,j}$$

Overall student sampling weights are only attributed to participating students, with non-participants weighted at 0. All student data reported in the TIMSS international reports are weighted by the overall student sampling weight, known as TOTWGT in the TIMSS international databases.

Participation Rates

Because nonparticipation can result in sample bias and misleading results, it is important that the schools, classes, and students that are sampled to participate in TIMSS actually take part in the assessments. To show the level of sampling participation in each country, TIMSS calculates both unweighted participation rates (i.e., based on simple counts of schools, classes, and students) and weighted participation rates based on the sampling weights described in the previous section. Unweighted participation rates provide a preliminary indicator that may be used to monitor

progress in securing the participation of schools and classes, whereas weighted participation rates are the ultimate measure of sampling participation.

TIMSS reports weighted and unweighted participation rates for schools, classes, and students, as well as overall participation rates that are a combination of all three. To distinguish between participation based solely on originally sampled schools and participation that also relies on replacement schools, school and overall participation rates are computed separately for originally sampled schools only and for originally sampled together with replacement schools.

Unweighted School Participation Rate

The unweighted school participation rate is the ratio of the number of participating schools to the number of originally sampled schools, excluding any sampled schools found to be ineligible. A school is considered to be a participating school if at least one of its sampled classes has a student participation rate of at least 50 percent. The two unweighted school participation rates are calculated as follows:

R_{unw}^{sc-s} = unweighted school participation rate for originally sampled schools only

R_{unw}^{sc-r} = unweighted school participation rate, including originally sampled and first and second replacement schools

$$R_{unw}^{sc-s} = \frac{n_s}{n_s + n_{r1} + n_{r2} + n_{nr}}$$

$$R_{unw}^{sc-r} = \frac{n_s + n_{r1} + n_{r2}}{n_s + n_{r1} + n_{r2} + n_{nr}}$$

Unweighted Class Participation Rate

The unweighted class participation rate is the ratio of the number of sampled classes that participated to the number of classes sampled, as follows:

$$R_{unw}^{cl} = \frac{\sum_{i}^{s+r1+r2} c_*^i}{\sum_{i}^{s+r1+r2} c^i}$$

where c^i is the number of sampled classes in the i^{th} school, and c_*^i is the number of participating classes in the i^{th} school. Both summations are across all participating schools.

Unweighted Student Participation Rate

The unweighted student participation rate is the ratio of the number of selected students that participated in TIMSS to the total number of selected students that should have been assessed in the participating schools and classes. Classes where less than 50 percent of the students participate are considered to be not participating, and so students in such classes also are considered to be nonparticipants.[4] The unweighted student participation rate is computed as follows:

$$R_{unw}^{st} = \frac{\sum_{i,j} s_{rs}^{i,j}}{\sum_{i,j} s_{rs}^{i,j} + \sum_{i,j} s_{nr}^{i,j}}$$

Overall Unweighted Participation Rate

The overall unweighted participation rate is the product of the unweighted school, class, and student participation rates. Because TIMSS computes two versions of the unweighted school participation rate, one based on originally sampled schools only and the other including replacements as well as originally sampled schools, there also are two overall unweighted participation rates:

R_{unw}^{ov-s} = unweighted overall participation rate for originally sampled schools only

R_{unw}^{ov-r} = unweighted overall participation rate, including originally sampled and first and second replacement schools

$$R_{unw}^{ov-s} = R_{unw}^{sc-s} \cdot R_{unw}^{cl} \cdot R_{unw}^{st}$$

$$R_{unw}^{ov-r} = R_{unw}^{sc-r} \cdot R_{unw}^{cl} \cdot R_{unw}^{st}$$

Weighted School Participation Rate

The weighted school participation rate is the ratio of two estimates of the size of the target student population. The numerator is derived from the measure of size of those sampled schools that participated in TIMSS and the denominator is the weighted estimate of the total student enrollment in the population. Weighted school participation rates are computed for originally sampled schools and for originally sampled and replacement schools combined, as follows:

R_{wtd}^{sc-s} = weighted school participation rate for originally sampled schools only

R_{wtd}^{sc-r} = weighted school participation rate, including originally sampled and first and second replacement schools

4 For countries that participated in both TIMSS and TIMSS Numeracy at fourth grade, this 50% criteria is applied to student participation from both studies combined.

$$R^{sc-s}_{wtd} = \frac{\sum_{i,j}^{s} BW^{i}_{sc} \cdot FW^{i,j}_{cl} \cdot FW^{i,j}_{st}}{\sum_{i,j}^{s+r1+r2} FW^{i}_{sc} \cdot FW^{i,j}_{cl} \cdot FW^{i,j}_{st}}$$

$$R^{sc-r}_{wtd} = \frac{\sum_{i,j}^{s+r1+r2} BW^{i}_{sc} \cdot FW^{i,j}_{cl} \cdot FW^{i,j}_{st}}{\sum_{i,j}^{s+r1+r2} FW^{i}_{sc} \cdot FW^{i,j}_{cl} \cdot FW^{i,j}_{st}}$$

Summations in both the numerator and denominator are over all responding students and include appropriate class and student sampling weights. Note that the basic school weight appears in the numerator, whereas the final school weight appears in the denominator.

Weighted Class Participation Rate

The weighted class participation rate is computed as follows:

$$R^{st}_{wtd} = \frac{\sum_{i,j}^{s+r1+r2} BW^{i}_{sc} \cdot BW^{i,j}_{cl} \cdot FW^{i,j}_{st}}{\sum_{i,j}^{s+r1+r2} BW^{i}_{sc} \cdot FW^{i,j}_{cl} \cdot FW^{i,j}_{st}}$$

where both the numerator and denominator are summations over all responding students from classes with at least 50 percent of their students participating in the study, and the appropriate student-level sampling weights are used. In this formula, the basic class weight appears in the numerator, whereas the final class weight appears in the denominator. And, the denominator in this formula is the same quantity that appears in the numerator of the weighted school participation rate for all schools, whether originally sampled or replacement.

Weighted Student Participation Rate

The weighted student participation rate is computed as follows:

$$R^{st}_{wtd} = \frac{\sum_{i,j}^{s+r1+r2} BW^{i}_{sc} \cdot BW^{i,j}_{cl} \cdot BW^{i,j}_{st}}{\sum_{i,j}^{s+r1+r2} BW^{i}_{sc} \cdot BW^{i,j}_{cl} \cdot FW^{i,j}_{st}}$$

where both the numerator and denominator are summations over all responding students from participating schools. In this formula, the basic student weight appears in the numerator, whereas the final student weight appears in the denominator. Also, the denominator in this formula is the same quantity that appears in the numerator of the weighted class participation rate for all participating schools, whether originally sampled or replacement.

Overall Weighted Participation Rate

The overall weighted participation rate is the product of the weighted school, class, and student participation rates. Because there are two versions of the weighted school participation rate, one based on originally sampled schools only and the other including replacement as well as originally sampled schools, there also are two overall weighted participation rates:

R_{wtd}^{ov-s} = weighted overall participation rate for originally sampled schools only

R_{wtd}^{ov-r} = weighted overall participation rate, including sampled, first and second replacement schools

$$R_{wtd}^{ov-s} = R_{wtd}^{ov-s} \cdot R_{wtd}^{cl} \cdot R_{wtd}^{st}$$

$$R_{wtd}^{ov-r} = R_{wtd}^{sc-r} \cdot R_{wtd}^{cl} \cdot R_{wtd}^{st}$$

Weighted school, class, student, and overall participation rates are computed for each TIMSS participant using these procedures.

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Appendix 3A: TIMSS 2015 Fourth Grade Stratification Variables

Country	Explicit Stratification Variables	Number of Explicit Strata	Implicit Stratification Variables
Australia	State or territory (8)	8	Geographic location (3) School type (3) Socioeconomic status (2)
Bahrain	Governorate (5) Gender (2)	9	None
Belgium (Flemish)	Region (6) School type (3) Socioeconomic status (4)	18	None
Bulgaria	School type (3) Urbanization (3)	8	Urbanization (2)
Canada	Province (5) Language (2) School type (2) within Alberta Grade 4 only / grade 4 and 8 within Ontario (2) School type (3) within Ontario School type (2) within Quebec	15	Region (4) in public and Catholic schools within Ontario Postal code area (6) in English schools within Alberta
Chile	Grade 4 / grade 4 and 8 schools (2) School type (3) Urbanization (2)	7	National assessment score level (5)
Chinese Taipei	Urbanization (3)	3	None
Croatia	School type (3) Urbanization (2) Region group (6)	15	None
Cyprus	Districts (4)	4	Urbanization (2)
Czech Republic	Region (14)	14	None
Denmark	School type (2)	2	None
England	School type (2) Attainment level (5)	6	None
Finland	Region (6) Urbanization (2)	10	None
France	School type (3)	3	None
Georgia	Grade 4 only / grade 4 and 8 schools (2) Region (4) Math average score (3)	14	None
Germany	School type (2) Socioeconomic status (4)	5	None
Hong Kong SAR	School finance type (5)	5	None
Hungary	Grade 4 only / grade 4 and 8 schools (2) National assessment score (2) Type of community (3)	7	None

Appendix 3A: TIMSS 2015 Fourth Grade Stratification Variables (Continued)

Country	Explicit Stratification Variables	Number of Explicit Strata	Implicit Stratification Variables
Indonesia	Performance (3) School type (2) School funding (2)	9	None
Iran, Islamic Rep. of	School type (2) Gender (3) Region group (3) Province (6)	22	None
Ireland	DEIS (3) Language of instruction (3) Gender (3)	8	Urbanization (2)
Italy	School type (2) Region (6)	7	None
Japan	Urbanization (4)	4	None
Jordan	School type (6) Achievement level (6)	31	Gender (3)
Kazakhstan	Grade 4 only / grade 4 and 8 schools (2) Region (4) Urbanization (2) Language (2)	18	None
Korea, Rep. of	Urbanization (3)	3	None
Kuwait	School type (2) Region (6) Gender (2) Language (3)	15	None
Lithuania	Grade 4 / grade 4 and 8 schools (2) Languages (5)	10	Urbanization (4)
Morocco	School type (2) Region (16)	18	Urbanization (2)
Netherlands	Socioeconomic status level (5) Urbanization (5)	12	None
New Zealand	School type (2) Socioeconomic status (4) Urbanization (2)	9	None
Northern Ireland	Region (5) Deprivation (5)	14	None
Norway (5)	Grade 5 only / grade 5 and 9 schools (2) Language (2) Municipality size (3)	8	None
Oman	School type (3) Governorates (11)	13	None
Poland	Urbanization (4) School performance level (5)	15	None
Portugal	Region (7) School type (2)	9	None

Appendix 3A: TIMSS 2015 Fourth Grade Stratification Variables (Continued)

Country	Explicit Stratification Variables	Number of Explicit Strata	Implicit Stratification Variables
Qatar	Grade 4 only / grade 4 and 8	2	School type (4) Gender (3)
Russian Federation	Region (42)	42	None
Saudi Arabia	Gender school (2) Type of education (2) School type (2)	6	None
Serbia	Region (3) Urbanization (2) School hierarchy (2)	7	None
Singapore	None	1	None
Slovak Republic	Language (2) Socioeconomic status (4) Geographical area (5)	10	None
Slovenia	Performance level (4)	4	None
South Africa (5)	School type (2) Province (9) Socioeconomic status (2)	11	Performance level (3) Region (2)
Spain	Region (7) School type (2)	14	None
Sweden	Grade 4 / grade 4 and 8 schools (2) Grade average (3)	4	School type (2)
Turkey	Urbanization (2) Statistical region (12)	13	None
United Arab Emirates	Grade 4 only / grade 4 and 8 schools (2) Educational zone (4) National assessment score (4) Curriculum (3) School type (2) within Dubai Region (3) within Abu Dhabi School type (2) within Abu Dhabi Curriculum (3) within Abu Dhabi Performance level (3) within Abu Dhabi	27	Educational zones (5) Language of test (3)
United States	Poverty level (2) School type (2) Census Region (4)	12	Urbanization (4) Ethnicity status (2)

Appendix 3A: TIMSS 2015 Fourth Grade Stratification Variables (Continued)

Country	Explicit Stratification Variables	Number of Explicit Strata	Implicit Stratification Variables
Benchmarking Participants			
Buenos Aires, Argentina	Grade 4 only / grade 4 and 8 schools (2) School type (2) Socioeconomic status (3)	10	None
Ontario, Canada	Grade 4 / grade 4 and 8 schools (2) Language (2) School type (3)	6	Regional office (3)
Quebec, Canada	School type (2) Language (2)	4	None
Norway (4)	Grade 5 only / grade 5 and 9 schools / grade 4 only (3) Language (2) Municipality size (3)	9	None
Abu Dhabi, UAE	Grade 4 only / grade 4 and 8 schools Region (3) School type (2) Curriculum (3) Performance level (3)	13	None
Dubai, UAE	Grade 4 only / grade 4 and 8 schools schools (2) School type (2)	4	Language of test (3)
Florida, US	Poverty level (2)	2	Urbanization (4) Ethnicity status (2)

Appendix 3B: TIMSS 2015 Eighth Grade Stratification Variables

Country	Explicit Stratification Variables	Number of Explicit Strata	Implicit Stratification Variables
Australia	State or territory (8)	8	Geographic location (3) School type (3) Socioeconomic status (2)
Bahrain	Governorate (5) Gender (2)	9	None
Botswana (9)	School type (2) Region (6) Socioeconomic status (2)	11	None
Canada	Province (4) Language (2) Grade 8 only / grade 4 and 8 (2) within Ontario School type (3) within Ontario School type (2) within Quebec	12	Region (4) in public and Catholic schools within Ontario Achievement (4) within Quebec (all but English private schools)
Chile	Grade 8 / grade 4 and 8 schools (2) School type (3) Urbanization (2)	6	National assessment score level (5)
Chinese Taipei	Urbanization (3) Performance level (6)	15	None
Egypt	School type (4) Region (3) Urbanization (2) Gender schools (3)	14	None
England	School type (2) Attainment level (5)	6	None
Georgia	Grade 8 only / grade 4 and 8 schools (2) Region (4) Math average score (3)	14	None
Hong Kong SAR	School finance type (4)	4	Other school characteristic (3)
Hungary	Grade 8 only / grade 4 and 8 schools (2) National assessment score (2) Type of community (3)	8	None
Iran, Islamic Rep. of	School type (2) Gender (3) Region group (3) Province (6)	20	None
Ireland	School sector (3) Socioeconomic status (3) Gender (3)	13	None
Israel	School sector (4) Socioeconomic status (3) Subgroups within Arab sector (3)	9	None
Italy	School type (2) Region (6)	7	None
Japan	Urbanization (4) School type (2)	5	None

Appendix 3B: TIMSS 2015 Eighth Grade Stratification Variables (Continued)

Country	Explicit Stratification Variables	Number of Explicit Strata	Implicit Stratification Variables
Jordan	School type (6) Achievement level (6)	31	Region or grouped regions (5)
Kazakhstan	Grade 8 only / grade 4 and 8 schools (2) Region (4) Urbanization (2) Language (2)	18	None
Korea, Rep. of	Urbanization (3) School gender (3)	9	None
Kuwait	School type (2) Region (6) Gender (2) Language (2)	14	None
Lebanon	Perfomance level (2) School type (2)	3	Region (7)
Lithuania	Grade 8 / grade 4 and 8 schools (2) Languages (5)	9	Urbanization (4)
Malaysia	School type (6) Score level (6) Urbanization (2)	15	
Malta	None	1	School type (3) Gender (3)
Morocco	School type (2) Region (16)	18	Urbanization (2)
New Zealand	School type (2) Socioeconomic status (4) Urbanization (2) Gender schools (3)	13	None
Norway (9)	Grade 9 / grade 5 and 9 schools (2) Language (2) Municipality size (3)	8	None
Oman	School type (3) Governorates (11)	13	Gender (3)
Qatar	Grade 8 only / grade 4 and 8	2	School type (4) Gender (3)
Russian Federation	Region (42)	42	None
Saudi Arabia	Gender school (2) Type of education (2) School type (2)	6	None
Singapore	None	1	None
Slovenia	Performance level (4)	4	None
South Africa (9)	School type (2) Province (9) Language (3) Socioeconomic status (2)	17	Performance level (5) Region (2)

Appendix 3B: TIMSS 2015 Eighth Grade Stratification Variables (Continued)

Country	Explicit Stratification Variables	Number of Explicit Strata	Implicit Stratification Variables
Sweden	Grade average (7)	7	Grade 8 / grade 4 and 8 schools (2)
Thailand	Jurisdiction (STRA) (7) Region (3)	9	None
Turkey	Urbanization (2) Statistical region (12)	13	None
United Arab Emirates	Grade 8 only / grade 4 and 8 schools (2) Educational zone (4) National assessment score (4) Curriculum (3) School type (2) within Dubai Region (3) within Abu Dhabi School type (3) within Abu Dhabi Performance level (3) within Abu Dhabi	23	Educational zones (5) Language of test (3)
United States	Poverty level (2) School type (2) Census Region (4)	12	Urbanization (4) Ethnicity status (2)
Benchmarking Participants			
Buenos Aires, Argentina	Grade 8 only / grade 4 and 8 schools (2) School type (2) Socioeconomic status (3)	10	None
Ontario, Canada	Grade 8 / grade 4 and 8 schools (2) Language (2) School type (3)	6	Regional office (3)
Quebec, Canada	School type (2) Language (2)	4	Math average score (3)
Norway (8)	Grade 9 / grade 5 and 9 schools (2) Language (2) Municipality size (3)	8	None
Abu Dhabi, UAE	Grade 8 only / grade 4 and 8 schools (2) Region (3) School type (3) Performance level (3)	11	None
Dubai, UAE	Grade 8 only / grade 4 and 8 schools (2) School type (2)	4	Language of test (3)
Florida, US	Poverty level (2)	2	Urbanization (4) Ethnicity status (2)

Appendix 3C: Sampling Schools

TIMSS employs random-start fixed-interval systematic sampling to draw the school sample, with each school selected with probability proportional to its size (PPS).

To sample schools using the PPS systematic sampling method, the schools from each explicit stratum in the sampling frame are sorted by implicit stratification variables and by their measure of size (MOS), as shown in the example. The MOS is accumulated from school to school and the running total (the Cumulative MOS) is listed next to each school. The cumulative MOS across the entire stratum (the Total Measure of Size) is a measure of the size of the school population in the stratum (59,614 students in the example).

First Step: Compute the Sampling Interval

Dividing the Total MOS by the number of schools required for the sample (50 in the example) gives the sampling interval.

- **59,614 ÷ 50 = 1,192.2800**

Second Step: Generate a Random Start

Generate a random number from a uniform (0,1) distribution and multiply it by the sampling interval. The school whose cumulative MOS contains the resulting number is the first school in the sample.

- **0.5481 x 1,192.2800 = 653.4887**
- **School 1718**, with cumulative **MOS** of **690**, is the first school in the sample.

Third Step: Identify the Next School in the Sample (repeat until all schools have been sampled)

- Add the sampling interval to the number computed in the previous step.
- **653.4887 + 1,192.2800 = 1,845.7687**
- **School 0067,** with cumulative **MOS** of **1,855**, is the second school in the sample.
- Repeat until all schools have been sampled. For example, to identify the third school:
- **1,845.7687 + 1,192.2800 = 3,038.0487**
- **School 0333**, with cumulative **MOS** of **3,038**, is the third school in the sample.

Fourth Step: Identify Replacement Schools

Two replacement schools are identified for each sampled school. The first replacement (R1) is the school that immediately follows the sampled school in the sampling frame, and the second replacement (R2) the school that immediately precedes the sampled school.

PPS Systemic Sampling—Schools

Sampling Parameters	
Total Number of schools:	2,119
Total Measure of Size:	59,614
School Sample Size:	50
Sampling Interval:	1,192.2800
Random Start:	653.4887

First Step

Compute the Sampling Interval:

59,6914 ÷ 50 = 1,192.2800

Second Step

Generate a random start:

0.5481 X 1,192.2800 = 653.4887

Third Step (repeat until complete)

Compute the next selection numbers:

653.4887 + 1,192.2800 = 1,845.7687

1,845.7687 + 1,192.2800 = 3,038.0487

Fourth Step

Identify Replacement Schools

(R1, R2)

School Identifier	School MOS	Cumulative MOS	Sampled Schools
0829	110	110	
0552	101	211	
1802	98	309	
1288	98	407	
2043	95	502	
0974	94	596	*R2*
1718	94	690	✓
1807	93	783	*R1*
0457	93	876	
0244	93	969	
1817	91	1,060	
1741	90	1,150	
1652	89	1,239	
0121	89	1,328	
0309	89	1,417	
0032	89	1,506	
0021	89	1,595	
0609	88	1,683	
0399	86	1,769	*R2*
0067	86	1,855	✓
0202	86	1,941	*R1*
0063	86	2,027	
1467	86	2,113	
1381	86	2,199	
1043	84	2,283	
1318	84	2,367	
0659	84	2,451	
0612	83	2,534	
1696	82	2,616	
0867	82	2,698	
0537	81	2,779	
1794	80	2,859	
0695	80	2,939	
0031	80	3.019	*R2*
0333	79	3,098	✓
0051	79	3,177	*R1*
0384	79	3,256	
1361	79	3,335	
1189	79	3,414	
0731	78	3,492	
0634	78	3,570	
1230	77	3,647	

Appendix 3D: School Sampling Design Options to Accommodate Other Samples

TIMSS provides optional modifications to its sampling design for countries that want to maximize or minimize sampling overlap between schools sampled by TIMSS at the fourth and eighth grades as well as for countries that want to minimize overlap between schools sampled for TIMSS and schools sampled for other national or international assessments.

To provide options for countries in designing their school samples, Statistics Canada implemented two special sampling procedures. Method A was applied when data collection occurred simultaneously for two or more populations (as was the case in 2015 with TIMSS at fourth grade and eighth grades) and the country wanted to control the overlap between the schools. Method B was used primarily to ensure that the TIMSS samples avoided schools sampled for other studies, and also used when Method A was not appropriate.

Sampling Method A: Sampling Modifications for Simultaneous Data Collection

This procedure stratifies the school population according to whether schools contain students from both populations to be sampled (fourth and eighth grades, for example), or students from one population only (fourth grade only or eighth grade only) as a way of controlling sample overlap. Each school is assigned a measure of size (MOS) based on the number of students in the two populations combined (i.e., fourth grade and eighth grade combined). Schools are sampled according to the sampling design described in this chapter. When selecting schools from strata comprising students from both populations, a country can choose to maximize or minimize the number of schools to be sampled at each grade level.

The example below shows a hypothetical country participating in TIMSS at both grades. For reasons of administrative efficiency, the country wants to maximize the overlap between the fourth and eighth grade school samples. The 8,805 schools from the combined school frames (fourth and eighth grades) were first split in three strata and then a school sample of 164 was drawn as shown in the accompanying table.

Method A: Allocation of School Samples in a Country Participating at Two Grade Levels

Overlap Strata	Total Sampled Schools	Allocation	
		To TIMSS Grade 4	To TIMSS Grade 8
Grade 4 only	14	14	0
Grade 8 only	14	0	14
Grade 4 & Grade 8	136	136	136
Total	**164**	**150**	**150**

Choosing as many schools as possible from the Grade 4 & Grade 8 stratum resulted in a sample of 150 schools (136+14) for each grade level, from a total of 164 sampled schools. In this case, both studies were administered in the 136 schools selected from the Grade 4 & Grade 8 stratum.

This sampling technique was most often used for TIMSS countries and benchmarking participants that had schools with students in both fourth and eighth grade populations, where there was a strong correlation between the measure of size at both grades across these schools, and when school samples could be drawn at the same time.

Sampling Method B: Sampling Modifications for Sequential Data Collection

Method B was used to minimize overlap with another study such as a national study that also samples schools, and was also used when Method A was not appropriate (e.g., low correlation between MoS for fourth grade and eighth grade, samples not drawn simultaneously). In Method B, schools were sampled using a technique described in Chowdhury, Chu, and Kaufman (2000). As explained by the authors, the method can be used to either minimize or maximize overlap amongst several samples. This method is illustrated below with an example where the aim was to minimize the overlap between a current sample of schools S_2 and a previously selected school sample S_1. (For a complete description of the method, readers are referred to the original paper).

Let RL (Response Load) be the number of times a school was sampled from previous samples. In this example, given that there is only one previous sample, RL takes the value '1' if the school was already selected and '0' otherwise.

Given that the RL variable splits the current school frame in two distinct subsets of schools, S_1 and $\overline{S}_1$, we have the following relation:

$$P_i(S_2) = P_i(S_2|S_1) \cdot P_i(S_1) + P_i(S_2|\overline{S}_1) \cdot P_i(\overline{S}_1) \quad (1)$$

where $P_i(S_j)$ gives the probability that school i be selected in the sample (S_j), and $P_i(S_j|S_k)$ gives the probability that school i be selected in sample (S_j) given that school i already belongs to (S_k). The idea here is to derive the conditional probabilities in such a way that the unconditional probability of selecting a school in the current sample, $P_i(S_2)$, be equal to the expected probability (as defined by the TIMSS sample design).

Note that the first term after the equal sign in equation (1) is related to cases where the school response load is one, while the last term is related to cases where the school response load is zero. Therefore, minimizing the sample overlap is equivalent to zeroing the first term. In such case, equation (1) becomes:

$$P_i(S_2) = 0 \cdot P_i(S_1) + P_i(S_2|\overline{S}_1) \cdot P_i(\overline{S}_1)$$

and consequently,

$$P_i(S_2|\overline{S}_1) = P_i(S_2)/P_i(\overline{S}_1)$$

In other words, in the current sample S_2, schools would be selected with the following conditional probabilities:

$$\begin{array}{ll} 0 & \text{if school } i \text{ was already selected in the first sample,} \\ P_i(S_2)/P_i(\overline{S}_1) & \text{otherwise} \end{array}$$

However, equation (1) no longer holds if expression $P_i(S_2)/P_i(\overline{S}_1)$ is greater than one. This can be avoided by setting one as an upper bound. We now have the following expression:

$$P_i(S_2) = P_i(S_2|S_1) \cdot P_i(S_1) + 1 \cdot P_i(\overline{S}_1)$$

and consequently

$$\frac{P_i(S_2) - P_i(\overline{S}_1)}{P_i(S_1)} = P_i(S_2|S_1)$$

Combining these two results, the conditional probabilities to use when selecting the current sample of schools are given by:

$$\begin{array}{lll} \text{Max} & \left[0\,,\ \dfrac{P_i(S_2) - P_i(\overline{S}_1)}{P_i(S_1)}\right] & \text{if school } i \text{ was already selected in the first sample} \\ \text{Min} & \left[\dfrac{P_i(S_2)}{P_i(\overline{S}_1)}\,,\ 1\right] & \text{otherwise} \end{array}$$

Note that maximizing rather than minimizing the overlap between two studies can be done by simply zeroing the last term of equation (1) rather than zeroing the first term, and following the above logic to get the conditional probabilities. The Chowdhury, Chu, and Kaufman (2000) method can be generalized to more than two samples as described in their paper.

Further details about the implementation of this method for the countries and benchmark participants can be found in the Sample Implementation in TIMSS 2015 chapter.

CHAPTER 4

Estimating Standard Errors in the TIMSS 2015 Results

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To obtain estimates of students' proficiency in mathematics and science that are both accurate and cost-effective, TIMSS 2015 made extensive use of probability sampling techniques to sample students from national fourth and eighth grade student populations, and applied matrix-sampling assessment designs to target individual students with a subset of the complete pool of assessment items. This approach made efficient use of resources, in particular keeping student response burden to a minimum, but at a cost of some variance or uncertainty in the reported statistics, such as the means and percentages computed to estimate population parameters.

To quantify this uncertainty, each statistic in the TIMSS 2015 international reports is accompanied by an estimate of its standard error. For statistics reporting student achievement, which are based on plausible values, standard errors have two components. The first reflects the uncertainty due to generalizing from student samples to the entire fourth or eighth grade student populations, referred to as sampling variance, and the second reflects uncertainty due to inferring students' performance on the entire assessment from their performance on the subset of items that they took, known as imputation variance. For parameter estimates of variables that are not plausible values, standard errors are based entirely on sampling variance.

Estimating Sampling Variance

TIMSS makes extensive use of probability sampling to derive achievement results from national samples of students. Because many such samples are possible but only one sample is drawn, some uncertainty about how well the sample represents the population is to be expected. The uncertainty caused by sampling students from a target population, known as sampling variance, can be estimated from the data of the one sample drawn.

Whereas estimating the sampling variance from simple random samples is a relatively easy task, estimating the sampling variance from the complex sample design of TIMSS is a more challenging endeavor.

A common way to estimate the sampling variance in multistage cluster sampling designs is through resampling schemes such as the balanced repeated replication and Jackknife techniques (Johnson & Rust, 1992; Wolter, 1985). TIMSS uses one variation of the Jackknife, the Jackknife Repeated Replication (JRR), to estimate sampling variances. JRR was chosen because it is computationally straightforward and provides approximately unbiased estimates of the sampling variances and sampling errors of means, total, and percentages.

At the core of the JRR technique is the grouping of sampling units into zones based on sample design conditions (e.g., strata) and subsequent repeated draws of subsamples from these zones, i.e., repeated replication. For TIMSS, the two main features of the TIMSS sample design that JRR incorporates in its repeated draws of subsamples are the stratification of schools and the clustering of students within schools. This is done by defining Jackknife sampling zones according to the stratification scheme in each zone and by pairing successive schools[1] to model the clustering from each national sample (see Chapter 3 for information on the Sample Design). Since most national samples consist of 150 schools, a total of 75 zones are created. If more than 150 schools are selected, then the additional zones are collapsed into the first 75 zones. The subsampling required by JRR is applied within each sampling zone.

Sampling zones are constructed within explicit strata. When an explicit stratum has an odd number of schools, either by design or because of school non-response, the students in the remaining school are randomly divided to make up two "quasi" schools for the purposes of calculating jackknife standard errors.[2] Each sampling zone then consists of a pair of schools or "quasi" schools.

Exhibit 4.1 lists the number of sampling zones for each TIMSS 2015 participating country.

1 When schools are sampled, schools are ordered within explicit strata by implicit stratification variables and the measure of size. Based on this sorting, successively sampled schools are matched and classified together in each sampling zone. More information can be found in Appendix 3A of Chapter 3.

2 If a remaining school consists of 2 sampled classrooms, each classroom becomes a "quasi" school.

Exhibit 4.1: Number of Sampling Zones for Each TIMSS 2015 Participating Country

Country	TIMSS 2015 Sampling Zones	
	Fourth Grade	Eighth Grade
Australia	75	75
Bahrain	75	75
Belgium (Flemish)	75	–
Botswana (9)	–	75
Bulgaria	75	–
Canada	75	75
Chile	75	75
Chinese Taipei	75	75
Croatia	75	–
Cyprus	75	–
Czech Republic	75	–
Denmark	75	–
Egypt	–	75
England	75	73
Finland	75	–
France	75	–
Georgia	75	75
Germany	75	–
Hong Kong SAR	67	68
Hungary	74	74
Indonesia	75	–
Iran, Islamic Rep. of	75	75
Ireland	75	75
Israel	–	75
Italy	75	75
Japan	75	74
Jordan	75	75
Kazakhstan	75	75
Korea, Rep. of	75	75
Kuwait	75	75
Lebanon	–	70
Lithuania	75	75
Malaysia	–	75
Malta	–	75
Morocco	75	75
Netherlands	68	–

Exhibit 4.1: Number of Sampling Zones for Each TIMSS 2015 Participating Country (Continued)

Country	TIMSS 2015 Sampling Zones	
	Fourth Grade	Eighth Grade
New Zealand	75	74
Northern Ireland	62	–
Norway (5 and 9)	72	73
Oman	75	75
Poland	75	–
Portugal	75	–
Qatar	75	75
Russian Federation	61	59
Saudi Arabia	75	72
Serbia	75	–
Singapore	75	75
Slovak Republic	75	–
Slovenia	75	75
South Africa (5 and 9)	75	75
Spain	75	–
Sweden	73	75
Thailand	–	75
Turkey	75	75
United Arab Emirates	75	75
United States	75	75
Benchmarking Participants		
Buenos Aires, Argentina	70	66
Ontario, Canada	75	71
Quebec, Canada	61	63
Norway (4 and 8)	70	72
Abu Dhabi, UAE	72	75
Dubai, UAE	75	75
Florida, US	27	27

The JRR procedure draws two subsamples from each sampling zone: one where the first school in the pair is included and the second school is removed, and another subsample where the second school is included and the first school is removed.[3] When a school is removed from the sample, the weights of the remaining school are doubled to make up for the omitted school. In both subsamples,

3 Prior to 2015, TIMSS used 75 subsamples and sets of replicate weights to calculate the JRR sampling variances. To provide more accurate estimates, starting in 2015 TIMSS uses 150 subsamples and sets of replicate weights to calculate the JRR sampling variances. Two subsamples are drawn from each sampling zone rather than one randomly selected subsample.

all students in the other sampling zones are included. With this process applied in each of the 75 sampling zones, the JRR procedure yields a total of 150 replicate subsamples, each one with its own set of replicate sampling weights to account for the successive removal of each school from the pair of schools in any given sampling zone.

The process of creating replicate sampling weights for the replicate subsamples defines replicate factors k_{hj} as follows:

$$k_{hj} = \begin{cases} 2 \text{ for students in school } j \text{ of sampling zone } h \\ 0 \text{ for students in the other school of sampling zone } h \\ 1 \text{ for students in any other sampling zone} \end{cases} \quad (1)$$

These replicate factors are used to compute the 150 sets of replicate sampling weights as follows:

$$W_{hji} = k_{hj} \cdot W_{0i} \quad (2)$$

where W_{0i} is the overall sampling weight of student i and W_{hji} is the resulting replicate sampling weight of student i from sampling zone h when school j is included and the other school in the pair is removed.

Exhibit 4.2 illustrates how the replicate factors, necessary to produce the replicate sampling weights, are derived. Within each sampling zone, each school is assigned randomly an indicator u_{hj}, coded either 0 or 1, such that one school has a value of 0 and the other a value of 1. This indicator serves to identify which schools within each zone will be successively included or removed. When a school is removed from a zone, the replicate factor is set to zero and the sampling weights of all students in that school are set to zero; when a school is included, the replicate factor is set to two and the sampling weights of all students in that school are doubled. The sampling weights of students in all other sampling zones remain unchanged.

For example, sampling zone 1 yields two sets of replicate sampling weights. The first set has doubled sampling weights ($k_{11} = 2$) for the students in the first school ($u_{11} = 0$) of zone 1, zeroed sampling weights ($k_{12} = 0$) for the students in the second school ($u_{12} = 1$) of zone 1, and unchanged sampling weights ($k_{hj} = 1$) for all students in the other sampling zones. The second set of replicate sampling weights has zeroed sampling weights ($k_{11} = 0$) for the students in the first school ($u_{11} = 0$) of zone 1, doubled sampling weights ($k_{12} = 2$) for the students in the second school ($u_{12} = 1$) of zone 1, and unchanged sampling weights ($k_{hj} = 1$) for all students in the other sampling zones.

Exhibit 4.2: Construction of Replicate Factors Across Sampling Zones

Sample Zone	School Replicate Indicator (u_{hj})	Replicate Factors for Computing JRR Replicate Sampling Weights (k_{hj})											
		Zone 1		Zone 2		Zone 3		…	Zone h		…	Zone 75	
		(1)	(2)	(3)	(4)	(5)	(6)		(2h_1)	(2h)		(149)	(150)
1	0	2	0	1	1	1	1	…	1	1	…	1	1
	1	0	2										
2	0	1	1	2	0	1	1	…	1	1	…	1	1
	1			0	2								
3	0	1	1	1	1	2	0	…	1	1	…	1	1
	1					0	2						
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋱	⋮	⋮	⋮	⋮	⋮
h	0	1	1	1	1	1	1	…	2	0	…	1	1
	1								0	2			
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋱	⋮	⋮
75	0	1	1	1	1	1	1	…	1	1	…	2	0
	1											0	2

The process is repeated across all 75 possible sampling zones, generating 150 sets of replicate sampling weights. The replicate sampling weights are then used to estimate a statistic of interest 150 times. The variation across these 150 jackknife estimates determines the sampling variance.

Given a statistic t to be computed from a national sample, the formula used to estimate the sampling variance of that statistic, based on the TIMSS JRR algorithm, is given by the following equation:

$$Var_{jrr}(t_0) = \frac{1}{2}\sum_{h=1}^{75}\sum_{j=1}^{2}(t_{hj} - t_0)^2 \qquad (3)$$

where the term t_0 denotes the statistic of interest estimated with the overall student sampling weights W_{0i} and the term t_{hj} denotes the same statistic computed using the set of replicate sampling weights W_{hji} obtained from sampling zone h (h=1,...,75), where the j^{th} school (1st or 2nd) in the zone is included and the other removed.

The sampling variance estimated with the TIMSS JRR method properly measures the variation arising from having sampled students using the multi-stage stratified cluster sample design. Its square root is the standard error for any statistic derived from variables other than plausible values. Examples of such statistics include the mean age of students, the mean scale score on the TIMSS *Students Like Learning Mathematics* contextual scale, and the percentage of students with at least one parent with a university degree.

Estimating Imputation Variance

For variables other than plausible values, standard errors were the result solely of sampling variation, and were computed using the JRR technique. However, the situation for plausible values was more complicated. As described in Chapter 4 of the *TIMSS 2015 Assessment Frameworks*, the TIMSS item pool was far too extensive to be administered in its entirety to any one student, and so a matrix-sampling assessment design was adopted whereby each student was given a single test booklet containing only a part of the entire assessment. The results for all of the booklets were then aggregated using item response theory to provide results for the entire assessment. Multiple imputation was used to derive reliable estimates of student performance (plausible values) on the assessment as a whole, even though each student responded to just a subset of the assessment items. Because every student proficiency estimate incorporates a random element, TIMSS 2015 followed the customary procedure of generating five estimates for each student and using the variability among them as a measure of the imputation uncertainty, or error.

The general procedure for estimating the imputation variance when analyzing student achievement data follows the basic principle of performing any statistical analysis five times—once for each set of plausible values—and aggregating the five sets of results (Mislevy et al., 1992). Thus, for any given achievement-based statistic t, estimating that statistic from each plausible value yields five estimates t_m, $m = 1, \ldots, 5$, all of them computed using the overall student sampling weights W_{0i}. The final estimate of that statistic, t_0, is the average of these five estimates:

$$t_0 = \frac{1}{5}\sum_{m=1}^{5} t_m \tag{4}$$

The imputation variance of the statistic t_0 is simply the variance of the five results from the plausible values, computed as follows:

$$Var_{imp}(t_0) = \frac{6}{5}\sum_{m=1}^{5}\frac{(t_m - t_0)^2}{4} \tag{5}$$

where the factor $\frac{6}{5}$ is a correction factor required by the multiple imputation methodology. This imputation variance is then added to the sampling variance to produce the total variance estimate of the statistic t_0, as follows:

$$Var_{tot}(t_0) = Var_{jrr}(t_0) + Var_{imp}(t_0) \tag{6}$$

The sampling variance in this context is the average of the sampling variances from the five plausible values, as follows:

$$Var_{jrr}(t_0) = \frac{1}{5}\sum_{m=1}^{5} Var_{jrr}(t_m) \tag{7}$$

where

$$Var_{jrr}(t_m) = \frac{1}{2}\sum_{h=1}^{75}\sum_{j=1}^{2}(t_{mhj} - t_m)^2 \quad (8)$$

and t_{mhj} is the appropriate JRR estimate based on plausible value computed using the set of replicate sampling weights from sampling zone h where school j is included. The square root of the total variance is then the proper standard error for any statistic based on plausible values, such as the average TIMSS mathematics achievement for girls and the percentage of students who reach the TIMSS advanced international benchmark of mathematics achievement.

Appendices 4A-D provide details on the jackknife sampling variance, the imputation variance, the total variance, and the overall standard error for each country's mean proficiency estimates in mathematics at the fourth grade, science at the fourth grade, mathematics at the eighth grade, and science at the eighth grade, respectively.

Estimating Standard Errors for International Averages

Some exhibits in the TIMSS 2015 reports include international averages and their standard errors. For example, Exhibit 1.10 reports the international average for the percentages of girls and boys and their fourth grade mathematics and science achievement. International averages are computed using the data from the participating countries included in the main table of an exhibit. Data from the benchmarking participants is not included in the estimation of international averages.

For any given statistic t_0, its international average is given by:

$$t_{int} = \frac{1}{N}\sum_{i=1}^{N} t_{0i} \quad (9)$$

where N is the number of countries contributing to the international average and t_{0i} is the estimate of our statistic of interest for the i^{th} country.

The variance of the international average t_{int} is given by:

$$Var(t_{int}) = \frac{1}{N^2}\sum_{i=1}^{N} Var_{tot}(t_{0i}) \quad (10)$$

where $Var_{tot}(t_{0i})$ is the total variance of our statistic of interest for the i^{th} country, as given in equation (6) above. For statistics based on plausible values, the total variance includes the sampling variance and the imputation variance. For statistics not based on plausible values, such as percentages, the total variance is based entirely on the sampling variance, as shown in equation (3) above. The standard error of the international average is the square root of the total variance.

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Appendix 4A: Summary Statistics and Standard Errors for Proficiency in Mathematics at the Fourth Grade

Summary Statistics and Standard Errors for Proficiency in Overall Mathematics at the Fourth Grade

Country	Sample Size	Overall Mathematics				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	6057	517.227	9.180	0.174	9.354	3.058
Bahrain	8575	451.033	2.144	0.533	2.678	1.636
Belgium (Flemish)	5404	545.657	4.087	0.184	4.270	2.066
Bulgaria	4228	524.284	26.748	0.899	27.648	5.258
Canada	12283	510.556	5.420	0.066	5.486	2.342
Chile	4756	458.582	5.510	0.301	5.811	2.411
Chinese Taipei	4291	596.619	3.192	0.289	3.481	1.866
Croatia	3985	502.335	2.968	0.104	3.072	1.753
Cyprus	4125	523.026	6.540	0.599	7.139	2.672
Czech Republic	5202	528.138	4.982	0.004	4.985	2.233
Denmark	3710	538.653	6.661	0.791	7.452	2.730
England	4006	546.187	7.841	0.227	8.068	2.840
Finland	5015	535.288	3.854	0.232	4.086	2.021
France	4873	488.168	7.660	0.893	8.553	2.925
Georgia	3919	463.149	12.819	0.292	13.111	3.621
Germany	3948	521.634	3.927	0.221	4.148	2.037
Hong Kong SAR	3600	614.520	8.074	0.147	8.220	2.867
Hungary	5036	529.191	9.784	0.144	9.928	3.151
Indonesia	8319	397.463	12.752	1.024	13.777	3.712
Iran, Islamic Rep. of	7928	431.488	8.672	1.836	10.508	3.242
Ireland	4344	547.337	4.373	0.218	4.591	2.143
Italy	4373	506.848	5.650	0.863	6.513	2.552
Japan	4383	592.826	3.422	0.382	3.804	1.950
Jordan	7861	388.466	8.536	0.835	9.371	3.061
Kazakhstan	4702	544.420	19.711	0.530	20.241	4.499
Korea, Rep. of	4669	608.035	4.106	0.791	4.897	2.213
Kuwait	7296	353.064	19.132	2.303	21.435	4.630
Lithuania	4529	535.341	5.991	0.114	6.106	2.471
Morocco	10428	377.455	11.087	0.794	11.881	3.447
Netherlands	4515	529.819	2.564	0.345	2.910	1.706

Summary Statistics and Standard Errors for Proficiency in Overall Mathematics at the Fourth Grade (Continued)

Country	Sample Size	Overall Mathematics				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
New Zealand	6322	490.561	5.360	0.125	5.485	2.342
Northern Ireland	3116	570.261	8.349	0.321	8.669	2.944
Norway (5)	4329	549.080	5.657	0.474	6.131	2.476
Oman	9105	425.483	5.474	0.753	6.227	2.495
Poland	4747	534.773	4.367	0.157	4.523	2.127
Portugal	4693	541.200	4.494	0.496	4.989	2.234
Qatar	5194	438.996	11.187	0.580	11.767	3.430
Russian Federation	4921	563.922	11.152	0.544	11.696	3.420
Saudi Arabia	4337	383.489	13.929	2.566	16.495	4.061
Serbia	4036	517.998	11.696	0.809	12.505	3.536
Singapore	6517	617.671	14.631	0.074	14.705	3.835
Slovak Republic	5773	498.247	5.669	0.464	6.134	2.477
Slovenia	4445	519.875	3.164	0.398	3.561	1.887
South Africa (5)	10932	375.738	11.392	0.857	12.249	3.500
Spain	7764	505.095	5.641	0.380	6.021	2.454
Sweden	4142	518.647	7.233	0.666	7.899	2.811
Turkey	6456	483.150	9.202	0.170	9.371	3.061
United Arab Emirates	21177	451.582	5.550	0.183	5.733	2.394
United States	10029	539.156	4.810	0.283	5.094	2.257
Benchmarking Participants						
Buenos Aires, Argentina	6435	432.273	7.325	0.894	8.219	2.867
Ontario, Canada	4574	512.460	5.232	0.223	5.454	2.335
Quebec, Canada	2798	535.831	15.503	0.318	15.821	3.978
Norway (4)	4164	492.997	4.926	0.353	5.279	2.298
Abu Dhabi, UAE	5001	419.290	21.292	0.699	21.991	4.689
Dubai, UAE	7453	510.644	1.744	0.317	2.061	1.436
Florida, US	2025	546.136	21.622	0.774	22.396	4.732

Summary Statistics and Standard Errors for Proficiency in Number at the Fourth Grade

Country	Sample Size	Number				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	6057	508.851	9.611	0.280	9.891	3.145
Bahrain	8575	452.815	2.088	0.675	2.763	1.662
Belgium (Flemish)	5404	543.155	4.260	0.104	4.364	2.089
Bulgaria	4228	529.334	20.608	0.515	21.124	4.596
Canada	12283	502.819	5.198	0.441	5.639	2.375
Chile	4756	454.772	5.665	1.715	7.380	2.717
Chinese Taipei	4291	599.348	2.857	0.366	3.223	1.795
Croatia	3985	498.113	2.777	0.431	3.208	1.791
Cyprus	4125	528.457	5.996	0.446	6.443	2.538
Czech Republic	5202	527.843	4.840	0.701	5.541	2.354
Denmark	3710	534.889	6.540	0.798	7.338	2.709
England	4006	546.815	9.374	0.942	10.317	3.212
Finland	5015	531.763	4.039	0.360	4.400	2.098
France	4873	483.394	7.418	1.404	8.822	2.970
Georgia	3919	482.823	11.505	1.086	12.591	3.548
Germany	3948	514.912	3.557	0.650	4.207	2.051
Hong Kong SAR	3600	616.270	8.684	0.858	9.542	3.089
Hungary	5036	531.155	8.829	0.388	9.217	3.036
Indonesia	8319	399.062	12.209	0.683	12.893	3.591
Iran, Islamic Rep. of	7928	434.999	9.226	1.269	10.494	3.239
Ireland	4344	550.958	4.306	0.670	4.977	2.231
Italy	4373	509.849	5.341	0.412	5.752	2.398
Japan	4383	591.630	3.333	0.412	3.745	1.935
Jordan	7861	387.570	8.177	1.584	9.761	3.124
Kazakhstan	4702	551.851	15.616	0.384	16.001	4.000
Korea, Rep. of	4669	609.928	5.283	1.387	6.671	2.583
Kuwait	7296	356.452	19.530	1.197	20.728	4.553
Lithuania	4529	538.033	6.506	0.210	6.717	2.592
Morocco	10428	380.950	10.328	0.772	11.100	3.332
Netherlands	4515	531.301	2.924	1.719	4.643	2.155
New Zealand	6322	485.429	6.303	0.767	7.070	2.659
Northern Ireland	3116	574.436	9.277	0.317	9.594	3.097
Norway (5)	4329	541.911	5.620	0.282	5.902	2.429
Oman	9105	422.905	6.003	0.609	6.612	2.571

Summary Statistics and Standard Errors for Proficiency in Number at the Fourth Grade (Continued)

Country	Sample Size	Number				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Poland	4747	534.465	4.758	0.366	5.125	2.264
Portugal	4693	540.532	4.466	0.144	4.610	2.147
Qatar	5194	446.286	10.509	0.729	11.238	3.352
Russian Federation	4921	566.810	10.385	0.589	10.974	3.313
Saudi Arabia	4337	383.836	14.210	2.737	16.947	4.117
Serbia	4036	524.028	10.989	0.428	11.417	3.379
Singapore	6517	629.864	16.408	0.852	17.260	4.154
Slovak Republic	5773	501.968	4.884	0.882	5.766	2.401
Slovenia	4445	511.296	3.299	0.076	3.376	1.837
South Africa (5)	10932	378.542	11.067	0.637	11.705	3.421
Spain	7764	504.283	5.160	0.969	6.129	2.476
Sweden	4142	513.920	6.836	0.203	7.039	2.653
Turkey	6456	488.944	9.248	0.941	10.188	3.192
United Arab Emirates	21177	455.060	5.181	0.417	5.598	2.366
United States	10029	545.596	4.707	0.244	4.951	2.225
Benchmarking Participants						
Buenos Aires, Argentina	6435	445.025	6.299	2.311	8.610	2.934
Ontario, Canada	4574	499.676	5.949	0.932	6.881	2.623
Quebec, Canada	2798	532.917	16.831	0.450	17.282	4.157
Norway (4)	4164	488.824	4.384	0.627	5.011	2.238
Abu Dhabi, UAE	5001	421.618	20.273	1.405	21.678	4.656
Dubai, UAE	7453	513.505	2.003	0.283	2.286	1.512
Florida, US	2025	556.001	22.518	1.137	23.654	4.864

Summary Statistics and Standard Errors for Proficiency in Geometric Shapes and Measures at the Fourth Grade

Country	Sample Size	Geometric Shapes and Measures				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	6057	527.101	9.110	1.914	11.024	3.320
Bahrain	8575	446.983	2.314	1.300	3.614	1.901
Belgium (Flemish)	5404	563.591	4.317	1.058	5.375	2.318
Bulgaria	4228	524.890	34.326	0.591	34.917	5.909
Canada	12283	517.057	6.077	0.302	6.379	2.526
Chile	4756	459.537	5.383	4.081	9.464	3.076
Chinese Taipei	4291	596.967	4.473	4.359	8.832	2.972
Croatia	3985	512.272	4.422	0.755	5.176	2.275
Cyprus	4125	523.627	7.200	0.890	8.091	2.844
Czech Republic	5202	531.037	6.058	0.257	6.315	2.513
Denmark	3710	555.111	9.843	0.523	10.365	3.220
England	4006	542.060	9.059	1.670	10.730	3.276
Finland	5015	539.141	3.892	2.302	6.194	2.489
France	4873	503.343	7.702	1.457	9.158	3.026
Georgia	3919	428.578	18.556	2.326	20.883	4.570
Germany	3948	530.795	5.253	0.902	6.156	2.481
Hong Kong SAR	3600	616.670	9.473	1.991	11.464	3.386
Hungary	5036	536.005	10.797	1.868	12.665	3.559
Indonesia	8319	394.241	15.327	2.728	18.056	4.249
Iran, Islamic Rep. of	7928	427.768	10.758	1.173	11.932	3.454
Ireland	4344	542.003	4.665	3.678	8.344	2.889
Italy	4373	503.387	7.163	0.633	7.796	2.792
Japan	4383	601.335	3.819	2.186	6.005	2.450
Jordan	7861	394.470	8.976	0.465	9.441	3.073
Kazakhstan	4702	539.582	32.419	0.921	33.340	5.774
Korea, Rep. of	4669	610.438	3.815	1.688	5.503	2.346
Kuwait	7296	337.682	21.996	2.311	24.307	4.930
Lithuania	4529	525.529	6.000	3.257	9.257	3.043
Morocco	10428	385.118	13.204	1.337	14.540	3.813
Netherlands	4515	521.792	2.791	0.962	3.754	1.937
New Zealand	6322	488.749	5.317	2.431	7.747	2.783
Northern Ireland	3116	566.094	9.539	1.619	11.158	3.340

Summary Statistics and Standard Errors for Proficiency in Geometric Shapes and Measures at the Fourth Grade (Continued)

Country	Sample Size	Geometric Shapes and Measures				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Norway (5)	4329	558.861	8.875	3.278	12.152	3.486
Oman	9105	430.235	6.086	2.453	8.540	2.922
Poland	4747	533.610	4.413	1.732	6.144	2.479
Portugal	4693	539.254	6.458	0.264	6.721	2.593
Qatar	5194	423.214	13.913	5.875	19.789	4.448
Russian Federation	4921	556.973	16.603	2.392	18.994	4.358
Saudi Arabia	4337	381.087	17.154	7.893	25.047	5.005
Serbia	4036	502.682	13.408	1.200	14.608	3.822
Singapore	6517	607.494	15.372	2.286	17.658	4.202
Slovak Republic	5773	490.892	5.616	0.928	6.544	2.558
Slovenia	4445	529.762	3.715	0.589	4.304	2.075
South Africa (5)	10932	359.388	12.802	0.547	13.349	3.654
Spain	7764	502.674	6.329	1.336	7.664	2.768
Sweden	4142	522.628	9.932	0.821	10.753	3.279
Turkey	6456	474.829	8.771	0.298	9.069	3.011
United Arab Emirates	21177	441.624	6.742	0.369	7.112	2.667
United States	10029	525.279	6.031	0.487	6.518	2.553
Benchmarking Participants						
Buenos Aires, Argentina	6435	403.053	9.436	0.846	10.282	3.207
Ontario, Canada	4574	526.497	5.859	2.761	8.620	2.936
Quebec, Canada	2798	542.435	20.152	0.677	20.829	4.564
Norway (4)	4164	499.186	5.633	1.425	7.058	2.657
Abu Dhabi, UAE	5001	411.588	24.683	1.420	26.103	5.109
Dubai, UAE	7453	502.647	2.652	1.038	3.690	1.921
Florida, US	2025	529.244	22.829	8.499	31.328	5.597

Summary Statistics and Standard Errors for Proficiency in Data Display at the Fourth Grade

Country	Sample Size	Data Display				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	6057	532.578	9.354	3.846	13.199	3.633
Bahrain	8575	454.062	2.661	2.803	5.465	2.338
Belgium (Flemish)	5404	523.374	4.798	4.496	9.294	3.049
Bulgaria	4228	504.335	51.096	6.259	57.355	7.573
Canada	12283	528.472	6.279	0.950	7.228	2.689
Chile	4756	463.111	7.268	2.768	10.035	3.168
Chinese Taipei	4291	591.358	3.331	1.410	4.741	2.177
Croatia	3985	498.227	4.723	4.156	8.879	2.980
Cyprus	4125	507.391	10.474	4.127	14.600	3.821
Czech Republic	5202	525.064	6.970	1.802	8.772	2.962
Denmark	3710	525.954	7.320	4.669	11.988	3.462
England	4006	552.256	7.784	2.772	10.557	3.249
Finland	5015	541.644	5.594	5.554	11.148	3.339
France	4873	475.753	8.918	0.752	9.670	3.110
Georgia	3919	434.659	18.764	0.754	19.518	4.418
Germany	3948	534.797	6.024	0.759	6.783	2.604
Hong Kong SAR	3600	610.889	8.863	5.787	14.650	3.827
Hungary	5036	512.546	12.580	0.434	13.014	3.607
Indonesia	8319	385.118	13.832	3.627	17.459	4.178
Iran, Islamic Rep. of	7928	415.758	9.111	1.007	10.118	3.181
Ireland	4344	547.754	6.014	8.741	14.755	3.841
Italy	4373	497.977	6.712	1.947	8.659	2.943
Japan	4383	593.359	4.935	1.934	6.870	2.621
Jordan	7861	381.471	10.249	1.001	11.250	3.354
Kazakhstan	4702	524.071	26.742	0.854	27.596	5.253
Korea, Rep. of	4669	606.756	3.950	2.841	6.791	2.606
Kuwait	7296	345.105	24.933	4.313	29.246	5.408
Lithuania	4529	540.017	8.618	4.594	13.212	3.635
Morocco	10428	350.616	16.215	1.644	17.859	4.226
Netherlands	4515	538.839	4.413	6.960	11.373	3.372
New Zealand	6322	506.203	5.888	2.367	8.255	2.873
Northern Ireland	3116	566.730	9.039	5.057	14.096	3.754
Norway (5)	4329	565.844	7.481	1.237	8.717	2.952
Oman	9105	413.710	5.692	0.866	6.559	2.561

Summary Statistics and Standard Errors for Proficiency in Data Display at the Fourth Grade (Continued)

Country	Sample Size	Data Display				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Poland	4747	538.246	5.814	2.154	7.968	2.823
Portugal	4693	546.235	5.386	2.317	7.703	2.775
Qatar	5194	435.237	13.883	1.117	15.000	3.873
Russian Federation	4921	572.662	12.493	0.634	13.127	3.623
Saudi Arabia	4337	365.113	12.777	4.546	17.323	4.162
Serbia	4036	516.945	12.445	1.814	14.259	3.776
Singapore	6517	599.948	13.880	3.047	16.927	4.114
Slovak Republic	5773	496.056	8.627	5.847	14.475	3.805
Slovenia	4445	540.022	5.543	4.288	9.831	3.135
South Africa (5)	10932	380.579	11.780	3.945	15.725	3.965
Spain	7764	508.856	8.475	1.135	9.609	3.100
Sweden	4142	529.223	9.676	5.683	15.359	3.919
Turkey	6456	476.096	10.534	0.921	11.456	3.385
United Arab Emirates	21177	453.440	5.536	0.030	5.566	2.359
United States	10029	540.344	5.071	2.606	7.676	2.771
Benchmarking Participants						
Buenos Aires, Argentina	6435	410.788	10.496	0.968	11.464	3.386
Ontario, Canada	4574	535.797	6.359	0.451	6.810	2.610
Quebec, Canada	2798	541.230	19.117	6.137	25.254	5.025
Norway (4)	4164	495.169	6.841	1.565	8.406	2.899
Abu Dhabi, UAE	5001	423.176	21.837	1.531	23.369	4.834
Dubai, UAE	7453	516.651	2.235	0.762	2.997	1.731
Florida, US	2025	541.136	24.307	13.120	37.428	6.118

Summary Statistics and Standard Errors for Proficiency in Mathematics Knowing at the Fourth Grade

Country	Sample Size	Mathematics Knowing				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	6057	509.001	10.369	1.945	12.315	3.509
Bahrain	8575	453.014	2.633	0.441	3.074	1.753
Belgium (Flemish)	5404	553.714	4.509	0.719	5.228	2.286
Bulgaria	4228	527.190	23.256	2.451	25.707	5.070
Canada	12283	505.351	5.489	0.390	5.880	2.425
Chile	4756	448.738	6.021	1.636	7.657	2.767
Chinese Taipei	4291	620.476	3.286	2.072	5.358	2.315
Croatia	3985	502.195	2.791	0.687	3.478	1.865
Cyprus	4125	518.982	6.296	1.587	7.883	2.808
Czech Republic	5202	519.059	5.177	0.952	6.129	2.476
Denmark	3710	535.910	8.090	2.538	10.627	3.260
England	4006	553.983	10.043	0.722	10.765	3.281
Finland	5015	530.097	4.007	0.970	4.978	2.231
France	4873	484.283	7.325	0.797	8.122	2.850
Georgia	3919	465.674	11.893	3.878	15.772	3.971
Germany	3948	523.914	4.522	0.596	5.117	2.262
Hong Kong SAR	3600	618.027	8.644	1.146	9.790	3.129
Hungary	5036	532.267	8.664	0.848	9.513	3.084
Indonesia	8319	394.766	15.458	2.269	17.726	4.210
Iran, Islamic Rep. of	7928	428.977	9.924	0.461	10.385	3.223
Ireland	4344	554.444	4.818	3.426	8.244	2.871
Italy	4373	510.896	6.652	1.608	8.260	2.874
Japan	4383	601.392	3.620	2.047	5.668	2.381
Jordan	7861	389.412	8.708	0.858	9.566	3.093
Kazakhstan	4702	545.632	19.243	0.182	19.425	4.407
Korea, Rep. of	4669	627.078	6.374	2.016	8.390	2.897
Kuwait	7296	354.123	20.128	0.228	20.356	4.512
Lithuania	4529	532.496	5.615	0.882	6.497	2.549
Morocco	10428	376.760	11.706	2.291	13.997	3.741
Netherlands	4515	520.531	2.877	0.323	3.200	1.789
New Zealand	6322	475.455	6.271	0.658	6.929	2.632
Northern Ireland	3116	581.651	13.913	1.252	15.165	3.894

Summary Statistics and Standard Errors for Proficiency in Mathematics Knowing at the Fourth Grade (Continued)

Country	Sample Size	Mathematics Knowing				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Norway (5)	4329	544.223	6.697	3.186	9.883	3.144
Oman	9105	422.256	6.603	0.841	7.444	2.728
Poland	4747	517.038	4.728	1.126	5.854	2.420
Portugal	4693	547.529	4.729	2.218	6.947	2.636
Qatar	5194	444.125	11.168	0.505	11.674	3.417
Russian Federation	4921	556.499	11.114	0.147	11.260	3.356
Saudi Arabia	4337	373.832	18.404	3.132	21.536	4.641
Serbia	4036	512.730	11.119	1.420	12.539	3.541
Singapore	6517	630.511	14.853	0.890	15.743	3.968
Slovak Republic	5773	490.692	4.757	0.986	5.743	2.396
Slovenia	4445	516.905	3.155	0.368	3.523	1.877
South Africa (5)	10932	377.569	12.337	0.742	13.079	3.616
Spain	7764	505.316	5.401	0.415	5.816	2.412
Sweden	4142	500.810	8.540	2.889	11.428	3.381
Turkey	6456	491.406	10.251	1.328	11.579	3.403
United Arab Emirates	21177	453.023	6.291	1.258	7.549	2.747
United States	10029	547.462	5.009	0.312	5.321	2.307
Benchmarking Participants						
Buenos Aires, Argentina	6435	432.045	7.197	1.144	8.341	2.888
Ontario, Canada	4574	504.923	5.806	0.374	6.180	2.486
Quebec, Canada	2798	541.835	15.931	2.815	18.746	4.330
Norway (4)	4164	479.479	5.992	0.672	6.664	2.582
Abu Dhabi, UAE	5001	417.859	23.227	2.361	25.587	5.058
Dubai, UAE	7453	513.624	2.636	1.172	3.807	1.951
Florida, US	2025	555.185	21.681	5.282	26.962	5.193

Summary Statistics and Standard Errors for Proficiency in Mathematics Applying at the Fourth Grade

Country	Sample Size	Mathematics Applying				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	6057	521.341	7.657	1.391	9.048	3.008
Bahrain	8575	450.027	1.888	0.564	2.452	1.566
Belgium (Flemish)	5404	544.102	4.132	0.501	4.633	2.152
Bulgaria	4228	522.775	28.948	2.386	31.334	5.598
Canada	12283	510.107	5.155	0.187	5.341	2.311
Chile	4756	462.418	5.337	0.343	5.680	2.383
Chinese Taipei	4291	593.254	3.533	0.913	4.446	2.109
Croatia	3985	498.650	3.171	0.439	3.610	1.900
Cyprus	4125	528.734	7.312	0.811	8.122	2.850
Czech Republic	5202	528.127	5.088	0.448	5.537	2.353
Denmark	3710	537.878	6.952	0.668	7.620	2.760
England	4006	544.486	8.172	2.160	10.332	3.214
Finland	5015	536.064	3.703	0.630	4.333	2.082
France	4873	488.325	8.161	1.311	9.472	3.078
Georgia	3919	461.046	13.714	2.841	16.554	4.069
Germany	3948	515.154	4.046	0.890	4.936	2.222
Hong Kong SAR	3600	620.658	9.226	0.512	9.738	3.121
Hungary	5036	526.367	10.508	0.425	10.933	3.306
Indonesia	8319	397.075	12.539	0.358	12.896	3.591
Iran, Islamic Rep. of	7928	434.917	8.362	0.223	8.584	2.930
Ireland	4344	548.663	4.502	0.399	4.900	2.214
Italy	4373	504.010	5.586	0.714	6.299	2.510
Japan	4383	589.199	3.711	0.544	4.255	2.063
Jordan	7861	388.172	8.733	1.046	9.779	3.127
Kazakhstan	4702	540.891	22.856	1.215	24.071	4.906
Korea, Rep. of	4669	595.140	3.746	0.574	4.320	2.078
Kuwait	7296	347.885	21.050	1.522	22.572	4.751
Lithuania	4529	536.735	6.688	0.491	7.179	2.679
Morocco	10428	374.708	11.615	1.199	12.814	3.580
Netherlands	4515	530.504	2.431	0.610	3.041	1.744
New Zealand	6322	497.043	4.959	1.088	6.047	2.459
Northern Ireland	3116	575.489	8.716	1.299	10.016	3.165

Summary Statistics and Standard Errors for Proficiency in Mathematics Applying at the Fourth Grade (Continued)

Country	Sample Size	Mathematics Applying				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Norway (5)	4329	549.799	6.162	0.515	6.677	2.584
Oman	9105	427.889	5.417	0.516	5.933	2.436
Poland	4747	541.019	4.235	0.151	4.386	2.094
Portugal	4693	539.635	5.366	0.450	5.816	2.412
Qatar	5194	434.311	12.135	0.448	12.583	3.547
Russian Federation	4921	566.471	12.319	1.040	13.359	3.655
Saudi Arabia	4337	381.686	14.575	5.896	20.472	4.525
Serbia	4036	521.042	10.525	0.934	11.459	3.385
Singapore	6517	619.284	14.828	1.123	15.951	3.994
Slovak Republic	5773	496.660	5.675	0.568	6.243	2.499
Slovenia	4445	521.018	3.836	0.497	4.333	2.082
South Africa (5)	10932	376.868	10.967	0.906	11.873	3.446
Spain	7764	504.817	5.388	0.279	5.667	2.381
Sweden	4142	521.218	7.024	0.370	7.394	2.719
Turkey	6456	482.096	9.389	2.809	12.198	3.493
United Arab Emirates	21177	452.290	5.703	0.386	6.089	2.468
United States	10029	537.119	5.420	0.219	5.639	2.375
Benchmarking Participants						
Buenos Aires, Argentina	6435	427.029	7.473	1.279	8.752	2.958
Ontario, Canada	4574	513.186	5.163	0.209	5.373	2.318
Quebec, Canada	2798	532.671	16.086	0.689	16.775	4.096
Norway (4)	4164	495.041	4.779	1.323	6.101	2.470
Abu Dhabi, UAE	5001	421.761	21.586	1.571	23.157	4.812
Dubai, UAE	7453	510.185	2.290	1.018	3.309	1.819
Florida, US	2025	544.583	24.128	0.245	24.373	4.937

Summary Statistics and Standard Errors for Proficiency in Mathematics Reasoning at the Fourth Grade

Country	Sample Size	Mathematics Reasoning				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	6057	523.485	7.387	1.522	8.909	2.985
Bahrain	8575	446.748	2.961	0.996	3.958	1.989
Belgium (Flemish)	5404	535.988	5.161	1.995	7.156	2.675
Bulgaria	4228	520.712	30.653	3.072	33.725	5.807
Canada	12283	520.995	5.350	0.202	5.551	2.356
Chile	4756	465.738	4.721	0.497	5.217	2.284
Chinese Taipei	4291	575.575	4.943	4.461	9.404	3.067
Croatia	3985	507.223	4.376	0.243	4.619	2.149
Cyprus	4125	518.624	6.733	3.079	9.811	3.132
Czech Republic	5202	543.721	6.378	2.917	9.295	3.049
Denmark	3710	547.563	6.104	4.426	10.530	3.245
England	4006	539.830	8.679	1.857	10.536	3.246
Finland	5015	540.178	5.143	4.491	9.634	3.104
France	4873	491.320	8.583	3.120	11.703	3.421
Georgia	3919	451.760	16.130	2.866	18.996	4.358
Germany	3948	535.048	4.266	1.351	5.617	2.370
Hong Kong SAR	3600	599.877	9.193	1.220	10.412	3.227
Hungary	5036	529.205	11.562	1.314	12.876	3.588
Indonesia	8319	396.601	10.518	1.650	12.168	3.488
Iran, Islamic Rep. of	7928	426.464	8.743	2.238	10.981	3.314
Ireland	4344	535.295	4.532	2.674	7.205	2.684
Italy	4373	502.583	5.671	5.052	10.723	3.275
Japan	4383	595.017	4.625	2.782	7.407	2.722
Jordan	7861	384.970	8.749	1.824	10.573	3.252
Kazakhstan	4702	553.002	20.464	1.054	21.519	4.639
Korea, Rep. of	4669	618.664	5.072	1.145	6.218	2.494
Kuwait	7296	331.736	24.268	0.861	25.129	5.013
Lithuania	4529	534.260	7.367	0.725	8.092	2.845
Morocco	10428	378.988	11.329	1.916	13.245	3.639
Netherlands	4515	542.924	4.007	2.989	6.996	2.645
New Zealand	6322	503.504	6.516	0.558	7.074	2.660
Northern Ireland	3116	549.654	8.320	2.735	11.055	3.325

Summary Statistics and Standard Errors for Proficiency in Mathematics Reasoning at the Fourth Grade (Continued)

Country	Sample Size	Mathematics Reasoning				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Norway (5)	4329	555.694	6.008	2.479	8.487	2.913
Oman	9105	419.599	5.289	0.351	5.641	2.375
Poland	4747	546.251	4.720	0.599	5.319	2.306
Portugal	4693	531.561	4.571	0.502	5.073	2.252
Qatar	5194	430.897	12.360	7.255	19.614	4.429
Russian Federation	4921	569.990	14.775	0.900	15.675	3.959
Saudi Arabia	4337	382.899	11.746	7.123	18.869	4.344
Serbia	4036	516.704	13.682	0.421	14.103	3.755
Singapore	6517	602.576	18.648	1.570	20.218	4.496
Slovak Republic	5773	515.329	6.702	1.520	8.222	2.867
Slovenia	4445	523.999	4.016	0.894	4.910	2.216
South Africa (5)	10932	368.932	11.454	0.702	12.156	3.487
Spain	7764	501.795	5.844	0.170	6.013	2.452
Sweden	4142	541.537	8.465	2.183	10.649	3.263
Turkey	6456	466.329	9.257	2.879	12.136	3.484
United Arab Emirates	21177	445.104	4.841	0.914	5.756	2.399
United States	10029	530.631	4.800	1.390	6.190	2.488
Benchmarking Participants						
Buenos Aires, Argentina	6435	436.828	8.232	3.136	11.368	3.372
Ontario, Canada	4574	524.363	5.822	0.914	6.736	2.595
Quebec, Canada	2798	536.463	18.720	5.716	24.437	4.943
Norway (4)	4164	506.305	5.330	3.695	9.025	3.004
Abu Dhabi, UAE	5001	413.748	18.339	1.063	19.402	4.405
Dubai, UAE	7453	507.139	2.035	0.777	2.812	1.677
Florida, US	2025	534.291	27.655	10.492	38.146	6.176

Appendix 4B: Summary Statistics and Standard Errors for Proficiency in Science at the Fourth Grade

Summary Statistics and Standard Errors for Proficiency in Overall Science at the Fourth Grade

Country	Sample Size	Overall Science				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	6057	523.628	7.288	0.976	8.264	2.875
Bahrain	4146	458.812	4.238	2.273	6.511	2.552
Belgium (Flemish)	5404	511.508	4.281	0.991	5.272	2.296
Bulgaria	4228	535.704	34.479	0.602	35.082	5.923
Canada	12283	524.782	5.392	1.616	7.008	2.647
Chile	4756	477.710	5.487	1.998	7.485	2.736
Chinese Taipei	4291	555.282	2.666	0.534	3.200	1.789
Croatia	3985	533.442	3.082	1.136	4.218	2.054
Cyprus	4125	481.298	5.755	0.815	6.570	2.563
Czech Republic	5202	534.380	4.097	1.458	5.555	2.357
Denmark	3710	527.029	4.098	0.208	4.306	2.075
England	4006	535.825	5.349	0.519	5.868	2.422
Finland	5015	553.813	3.901	1.451	5.352	2.313
France	4873	487.401	6.580	0.890	7.470	2.733
Georgia	3919	451.245	11.977	2.034	14.010	3.743
Germany	3948	528.467	4.226	1.491	5.716	2.391
Hong Kong SAR	3600	556.547	7.958	0.654	8.612	2.935
Hungary	5036	541.978	10.113	1.056	11.169	3.342
Indonesia	4025	396.666	19.566	3.818	23.385	4.836
Iran, Islamic Rep. of	3823	421.009	14.192	1.978	16.170	4.021
Ireland	4344	528.876	4.841	0.704	5.545	2.355
Italy	4373	516.475	4.955	1.921	6.876	2.622
Japan	4383	569.013	2.515	0.633	3.147	1.774
Kazakhstan	4702	549.556	18.854	0.555	19.408	4.406
Korea, Rep. of	4669	589.320	2.547	1.379	3.926	1.981
Kuwait	3593	337.213	31.918	6.754	38.673	6.219
Lithuania	4529	527.667	4.796	1.497	6.293	2.509
Morocco	5068	352.207	18.127	3.626	21.753	4.664

Summary Statistics and Standard Errors for Proficiency in Overall Science at the Fourth Grade (Continued)

Country	Sample Size	Overall Science				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Netherlands	4515	517.120	4.484	2.550	7.035	2.652
New Zealand	6322	505.517	4.999	2.071	7.070	2.659
Northern Ireland	3116	519.768	4.421	0.562	4.983	2.232
Norway (5)	4329	537.598	5.276	1.736	7.012	2.648
Oman	9105	430.974	7.276	2.432	9.709	3.116
Poland	4747	547.190	3.995	1.842	5.838	2.416
Portugal	4693	508.056	2.168	2.675	4.843	2.201
Qatar	5194	436.258	15.259	1.275	16.534	4.066
Russian Federation	4921	567.196	8.992	1.178	10.170	3.189
Saudi Arabia	4337	390.329	19.728	4.629	24.357	4.935
Serbia	4036	524.509	11.993	1.609	13.602	3.688
Singapore	6517	590.478	12.749	0.944	13.693	3.700
Slovak Republic	5773	520.495	6.579	0.303	6.882	2.623
Slovenia	4445	542.573	4.132	1.824	5.956	2.441
Spain	7764	518.198	5.590	1.085	6.675	2.584
Sweden	4142	540.194	9.954	2.785	12.739	3.569
Turkey	6456	483.399	8.369	2.636	11.005	3.317
United Arab Emirates	21177	451.242	6.896	0.871	7.767	2.787
United States	10029	545.907	4.134	0.761	4.895	2.213
Benchmarking Participants						
Buenos Aires, Argentina	3104	417.835	13.566	8.083	21.649	4.653
Ontario, Canada	4574	530.370	4.419	2.060	6.480	2.545
Quebec, Canada	2798	524.509	14.884	1.856	16.740	4.091
Norway (4)	4164	493.003	4.262	0.456	4.717	2.172
Abu Dhabi, UAE	5001	414.711	30.060	1.035	31.096	5.576
Dubai, UAE	7453	517.936	2.708	0.368	3.076	1.754
Florida, US	2025	548.555	22.651	0.372	23.023	4.798

Summary Statistics and Standard Errors for Proficiency in Life Science at the Fourth Grade

Country	Sample Size	Life Science				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	6057	531.143	8.195	1.095	9.291	3.048
Bahrain	4146	454.854	4.512	3.854	8.366	2.892
Belgium (Flemish)	5404	512.935	4.657	1.094	5.751	2.398
Bulgaria	4228	541.896	38.184	1.687	39.871	6.314
Canada	12283	535.654	5.603	2.240	7.843	2.801
Chile	4756	487.384	5.954	0.880	6.834	2.614
Chinese Taipei	4291	544.770	2.538	1.560	4.098	2.024
Croatia	3985	530.910	3.632	3.352	6.984	2.643
Cyprus	4125	480.827	6.248	1.771	8.020	2.832
Czech Republic	5202	538.053	3.598	0.597	4.195	2.048
Denmark	3710	534.224	3.410	2.521	5.931	2.435
England	4006	535.971	5.262	1.129	6.391	2.528
Finland	5015	555.849	4.092	2.636	6.729	2.594
France	4873	489.621	6.967	2.650	9.617	3.101
Georgia	3919	458.822	12.197	4.827	17.024	4.126
Germany	3948	527.937	3.786	0.322	4.108	2.027
Hong Kong SAR	3600	550.303	11.256	2.443	13.699	3.701
Hungary	5036	550.295	10.296	1.225	11.521	3.394
Indonesia	4025	386.792	20.415	5.631	26.046	5.104
Iran, Islamic Rep. of	3823	417.166	17.090	3.481	20.571	4.536
Ireland	4344	530.541	5.219	0.610	5.830	2.414
Italy	4373	519.045	5.993	1.248	7.240	2.691
Japan	4383	556.100	2.866	1.856	4.722	2.173
Kazakhstan	4702	544.921	16.613	0.543	17.156	4.142
Korea, Rep. of	4669	581.483	2.783	0.914	3.697	1.923
Kuwait	3593	331.391	36.354	7.136	43.490	6.595
Lithuania	4529	527.018	5.698	3.049	8.746	2.957
Morocco	5068	350.497	16.638	1.906	18.545	4.306
Netherlands	4515	525.290	4.721	2.593	7.314	2.704
New Zealand	6322	511.318	5.488	1.920	7.408	2.722
Northern Ireland	3116	521.251	5.785	1.341	7.125	2.669
Norway (5)	4329	545.871	5.289	1.244	6.534	2.556

Summary Statistics and Standard Errors for Proficiency in Life Science at the Fourth Grade (Continued)

Country	Sample Size	Life Science				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Oman	9105	426.230	7.772	2.695	10.466	3.235
Poland	4747	556.672	4.310	2.124	6.434	2.537
Portugal	4693	507.867	1.947	2.483	4.429	2.105
Qatar	5194	435.906	16.166	2.814	18.980	4.357
Russian Federation	4921	568.854	9.162	0.531	9.693	3.113
Saudi Arabia	4337	381.511	19.642	4.031	23.673	4.865
Serbia	4036	530.934	10.414	3.853	14.267	3.777
Singapore	6517	606.860	16.909	2.795	19.705	4.439
Slovak Republic	5773	517.451	6.540	2.128	8.668	2.944
Slovenia	4445	544.839	4.158	1.290	5.447	2.334
Spain	7764	522.877	4.949	2.021	6.970	2.640
Sweden	4142	539.708	9.463	1.585	11.048	3.324
Turkey	6456	472.466	7.690	3.447	11.138	3.337
United Arab Emirates	21177	449.061	7.190	3.653	10.842	3.293
United States	10029	555.412	4.171	0.999	5.170	2.274
Benchmarking Participants						
Buenos Aires, Argentina	3104	425.699	12.786	3.291	16.077	4.010
Ontario, Canada	4574	543.885	5.070	1.619	6.690	2.586
Quebec, Canada	2798	532.924	14.939	3.566	18.505	4.302
Norway (4)	4164	502.293	4.747	0.928	5.675	2.382
Abu Dhabi, UAE	5001	413.128	31.582	4.244	35.826	5.986
Dubai, UAE	7453	517.831	3.313	3.529	6.842	2.616
Florida, US	2025	558.311	25.028	1.283	26.311	5.129

Summary Statistics and Standard Errors for Proficiency in Physical Science at the Fourth Grade

Country	Sample Size	Physical Science				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	6057	515.902	6.804	0.630	7.434	2.727
Bahrain	4146	464.861	5.810	4.634	10.444	3.232
Belgium (Flemish)	5404	505.943	4.365	5.846	10.211	3.195
Bulgaria	4228	529.444	38.458	4.402	42.859	6.547
Canada	12283	517.722	6.036	1.064	7.100	2.665
Chile	4756	466.022	6.930	1.257	8.187	2.861
Chinese Taipei	4291	568.490	2.596	1.212	3.809	1.952
Croatia	3985	535.403	3.593	4.757	8.350	2.890
Cyprus	4125	485.918	6.670	0.362	7.032	2.652
Czech Republic	5202	530.608	4.582	1.100	5.681	2.384
Denmark	3710	515.613	4.713	2.838	7.552	2.748
England	4006	539.948	5.121	2.312	7.433	2.726
Finland	5015	547.208	3.845	1.285	5.130	2.265
France	4873	481.723	6.191	1.038	7.230	2.689
Georgia	3919	437.794	17.228	4.747	21.974	4.688
Germany	3948	532.324	4.570	1.838	6.409	2.532
Hong Kong SAR	3600	554.683	7.980	4.173	12.153	3.486
Hungary	5036	533.663	11.028	1.535	12.563	3.544
Indonesia	4025	405.127	22.387	7.491	29.878	5.466
Iran, Islamic Rep. of	3823	423.346	17.813	7.339	25.151	5.015
Ireland	4344	523.949	4.951	3.061	8.013	2.831
Italy	4373	512.967	4.993	3.162	8.155	2.856
Japan	4383	587.004	2.251	4.536	6.787	2.605
Kazakhstan	4702	558.764	22.379	2.629	25.008	5.001
Korea, Rep. of	4669	597.496	2.549	1.605	4.154	2.038
Kuwait	3593	325.051	36.298	6.274	42.572	6.525
Lithuania	4529	535.089	5.012	1.298	6.309	2.512
Morocco	5068	356.866	20.419	14.175	34.594	5.882
Netherlands	4515	503.727	5.009	1.824	6.833	2.614
New Zealand	6322	497.224	5.451	1.005	6.456	2.541
Northern Ireland	3116	513.986	4.647	1.978	6.625	2.574
Norway (5)	4329	522.028	5.265	2.507	7.772	2.788

Summary Statistics and Standard Errors for Proficiency in Physical Science at the Fourth Grade (Continued)

Country	Sample Size	Physical Science				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Oman	9105	435.117	9.280	2.572	11.852	3.443
Poland	4747	539.830	4.245	0.053	4.298	2.073
Portugal	4693	501.828	2.310	6.167	8.476	2.911
Qatar	5194	435.436	16.540	5.577	22.117	4.703
Russian Federation	4921	567.376	9.830	3.255	13.085	3.617
Saudi Arabia	4337	389.818	23.414	7.260	30.674	5.538
Serbia	4036	528.800	11.906	2.212	14.118	3.757
Singapore	6517	603.304	13.591	0.448	14.039	3.747
Slovak Republic	5773	525.851	7.807	3.841	11.648	3.413
Slovenia	4445	546.182	4.446	1.166	5.612	2.369
Spain	7764	506.946	7.744	0.740	8.484	2.913
Sweden	4142	534.231	11.702	1.113	12.816	3.580
Turkey	6456	495.817	10.077	0.982	11.059	3.325
United Arab Emirates	21177	453.273	7.706	1.073	8.779	2.963
United States	10029	537.443	4.166	2.641	6.808	2.609
Benchmarking Participants						
Buenos Aires, Argentina	3104	413.222	13.104	2.017	15.120	3.889
Ontario, Canada	4574	521.987	4.711	1.753	6.464	2.542
Quebec, Canada	2798	519.492	17.643	6.035	23.679	4.866
Norway (4)	4164	474.873	5.356	2.254	7.610	2.759
Abu Dhabi, UAE	5001	412.939	32.962	2.198	35.160	5.930
Dubai, UAE	7453	520.530	2.517	2.423	4.940	2.223
Florida, US	2025	541.778	26.449	1.103	27.552	5.249

Summary Statistics and Standard Errors for Proficiency in Earth Science at the Fourth Grade

Country	Sample Size	Earth Science				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	6057	519.888	8.899	2.119	11.018	3.319
Bahrain	4146	447.865	5.569	4.944	10.513	3.242
Belgium (Flemish)	5404	512.607	4.856	3.191	8.047	2.837
Bulgaria	4228	531.880	33.707	14.145	47.851	6.917
Canada	12283	512.850	6.630	2.862	9.491	3.081
Chile	4756	464.583	7.158	4.397	11.555	3.399
Chinese Taipei	4291	555.247	3.104	3.382	6.486	2.547
Croatia	3985	535.142	5.184	6.708	11.892	3.448
Cyprus	4125	462.731	8.610	3.587	12.197	3.492
Czech Republic	5202	531.418	6.092	2.852	8.944	2.991
Denmark	3710	530.527	4.867	4.117	8.984	2.997
England	4006	527.412	7.177	3.686	10.864	3.296
Finland	5015	560.232	4.577	2.340	6.917	2.630
France	4873	484.530	9.890	11.804	21.695	4.658
Georgia	3919	440.920	15.537	3.297	18.834	4.340
Germany	3948	518.851	5.799	10.043	15.842	3.980
Hong Kong SAR	3600	574.460	9.062	0.549	9.611	3.100
Hungary	5036	535.214	14.005	1.757	15.762	3.970
Indonesia	4025	383.565	17.661	14.026	31.688	5.629
Iran, Islamic Rep. of	3823	408.046	18.478	4.397	22.874	4.783
Ireland	4344	534.592	5.760	3.479	9.239	3.040
Italy	4373	510.286	8.669	3.701	12.370	3.517
Japan	4383	562.742	4.487	1.856	6.342	2.518
Kazakhstan	4702	541.894	22.305	6.477	28.782	5.365
Korea, Rep. of	4669	590.735	4.940	11.919	16.859	4.106
Kuwait	3593	333.047	26.362	14.028	40.390	6.355
Lithuania	4529	515.383	6.037	7.545	13.581	3.685
Morocco	5068	289.251	28.351	15.527	43.878	6.624
Netherlands	4515	520.226	6.698	2.172	8.870	2.978
New Zealand	6322	505.711	6.827	4.465	11.292	3.360
Northern Ireland	3116	521.971	7.290	1.654	8.944	2.991
Norway (5)	4329	549.166	8.619	5.732	14.351	3.788
Oman	9105	423.144	8.319	4.145	12.465	3.531
Poland	4747	540.431	5.435	1.444	6.879	2.623

Summary Statistics and Standard Errors for Proficiency in Earth Science at the Fourth Grade (Continued)

Country	Sample Size	Earth Science				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Portugal	4693	512.810	4.505	1.862	6.367	2.523
Qatar	5194	426.902	16.688	8.725	25.413	5.041
Russian Federation	4921	562.188	10.257	11.547	21.805	4.670
Saudi Arabia	4337	394.638	20.793	2.031	22.824	4.777
Serbia	4036	495.704	17.192	5.985	23.177	4.814
Singapore	6517	546.409	11.399	2.272	13.670	3.697
Slovak Republic	5773	513.703	7.995	0.753	8.748	2.958
Slovenia	4445	530.660	5.178	11.305	16.483	4.060
Spain	7764	519.759	6.248	2.992	9.240	3.040
Sweden	4142	551.752	13.803	3.180	16.983	4.121
Turkey	6456	479.811	10.043	0.690	10.732	3.276
United Arab Emirates	21177	447.864	7.760	4.146	11.905	3.450
United States	10029	539.282	5.420	0.292	5.712	2.390
Benchmarking Participants						
Buenos Aires, Argentina	3104	390.719	16.845	15.791	32.636	5.713
Ontario, Canada	4574	514.845	6.255	7.132	13.386	3.659
Quebec, Canada	2798	515.031	17.944	1.191	19.136	4.374
Norway (4)	4164	497.894	5.913	7.553	13.467	3.670
Abu Dhabi, UAE	5001	407.997	33.798	13.519	47.317	6.879
Dubai, UAE	7453	510.420	2.476	5.875	8.351	2.890
Florida, US	2025	538.811	31.389	11.287	42.676	6.533

Summary Statistics and Standard Errors for Proficiency in Science Knowing at the Fourth Grade

Country	Sample Size	Science Knowing				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	6057	522.769	8.763	2.158	10.922	3.305
Bahrain	4146	455.649	4.405	2.016	6.421	2.534
Belgium (Flemish)	5404	497.788	5.324	1.806	7.130	2.670
Bulgaria	4228	551.172	38.037	3.978	42.015	6.482
Canada	12283	522.576	5.654	4.088	9.742	3.121
Chile	4756	477.489	6.975	3.016	9.991	3.161
Chinese Taipei	4291	556.940	2.778	3.674	6.452	2.540
Croatia	3985	534.274	4.162	4.264	8.426	2.903
Cyprus	4125	467.490	5.558	4.599	10.157	3.187
Czech Republic	5202	544.539	4.102	5.110	9.213	3.035
Denmark	3710	524.043	3.918	3.006	6.924	2.631
England	4006	533.319	5.849	0.825	6.674	2.583
Finland	5015	555.944	5.027	4.439	9.466	3.077
France	4873	481.674	7.771	6.360	14.131	3.759
Georgia	3919	459.739	11.875	6.086	17.962	4.238
Germany	3948	527.430	5.592	2.518	8.110	2.848
Hong Kong SAR	3600	561.659	7.955	1.071	9.026	3.004
Hungary	5036	550.431	12.488	1.616	14.104	3.756
Indonesia	4025	397.426	21.475	2.078	23.553	4.853
Iran, Islamic Rep. of	3823	416.473	15.224	1.861	17.085	4.133
Ireland	4344	528.730	5.401	1.081	6.481	2.546
Italy	4373	520.605	5.980	3.765	9.744	3.122
Japan	4383	543.657	3.322	1.950	5.272	2.296
Kazakhstan	4702	550.595	19.865	4.929	24.794	4.979
Korea, Rep. of	4669	581.781	3.141	1.778	4.918	2.218
Kuwait	3593	343.421	31.410	9.347	40.757	6.384
Lithuania	4529	523.701	5.377	3.643	9.020	3.003
Morocco	5068	331.292	25.336	5.893	31.229	5.588
Netherlands	4515	508.459	5.184	0.542	5.726	2.393
New Zealand	6322	503.800	6.036	1.872	7.908	2.812
Northern Ireland	3116	518.335	5.212	3.283	8.496	2.915
Norway (5)	4329	532.526	5.989	2.948	8.937	2.989

Summary Statistics and Standard Errors for Proficiency in Science Knowing at the Fourth Grade (Continued)

Country	Sample Size	Science Knowing				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Oman	9105	421.587	8.956	1.562	10.518	3.243
Poland	4747	543.641	4.964	1.522	6.486	2.547
Portugal	4693	506.644	2.554	5.719	8.274	2.876
Qatar	5194	436.984	15.048	5.137	20.185	4.493
Russian Federation	4921	568.536	12.031	3.301	15.332	3.916
Saudi Arabia	4337	394.110	23.780	4.791	28.571	5.345
Serbia	4036	526.584	13.299	1.539	14.838	3.852
Singapore	6517	574.203	14.799	2.303	17.101	4.135
Slovak Republic	5773	529.604	8.353	2.533	10.885	3.299
Slovenia	4445	540.865	5.117	1.603	6.720	2.592
Spain	7764	522.242	7.003	3.856	10.859	3.295
Sweden	4142	538.420	9.647	4.427	14.074	3.752
Turkey	6456	477.707	7.926	0.807	8.733	2.955
United Arab Emirates	21177	453.267	8.926	1.944	10.870	3.297
United States	10029	548.331	5.299	0.844	6.143	2.479
Benchmarking Participants						
Buenos Aires, Argentina	3104	416.900	14.280	5.172	19.452	4.410
Ontario, Canada	4574	527.371	4.819	3.193	8.012	2.831
Quebec, Canada	2798	523.883	15.566	2.648	18.214	4.268
Norway (4)	4164	494.759	5.113	4.167	9.279	3.046
Abu Dhabi, UAE	5001	410.310	38.377	4.649	43.026	6.559
Dubai, UAE	7453	522.599	3.476	1.997	5.473	2.339
Florida, US	2025	553.462	28.309	4.674	32.983	5.743

Summary Statistics and Standard Errors for Proficiency in Science Applying at the Fourth Grade

Country	Sample Size	Science Applying				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	6057	522.276	7.226	0.207	7.433	2.726
Bahrain	4146	461.682	4.224	4.986	9.210	3.035
Belgium (Flemish)	5404	513.250	4.088	2.085	6.173	2.484
Bulgaria	4228	536.175	36.807	1.212	38.019	6.166
Canada	12283	527.648	5.834	0.718	6.552	2.560
Chile	4756	475.640	6.612	2.258	8.870	2.978
Chinese Taipei	4291	553.311	2.713	4.081	6.794	2.607
Croatia	3985	530.205	2.983	2.029	5.012	2.239
Cyprus	4125	488.924	6.395	4.988	11.383	3.374
Czech Republic	5202	528.242	4.402	0.219	4.621	2.150
Denmark	3710	529.189	4.516	1.153	5.669	2.381
England	4006	537.690	4.900	2.151	7.051	2.655
Finland	5015	552.840	4.064	1.607	5.672	2.382
France	4873	493.612	7.592	2.226	9.818	3.133
Georgia	3919	449.466	16.533	6.388	22.921	4.788
Germany	3948	528.765	4.406	1.372	5.778	2.404
Hong Kong SAR	3600	553.844	8.470	2.361	10.830	3.291
Hungary	5036	538.723	10.722	1.067	11.789	3.433
Indonesia	4025	391.567	17.217	10.551	27.768	5.270
Iran, Islamic Rep. of	3823	417.371	16.121	3.738	19.859	4.456
Ireland	4344	530.001	4.846	1.303	6.150	2.480
Italy	4373	513.396	5.862	3.838	9.700	3.114
Japan	4383	576.417	2.797	0.489	3.286	1.813
Kazakhstan	4702	546.956	19.056	2.529	21.585	4.646
Korea, Rep. of	4669	593.732	2.690	0.969	3.659	1.913
Kuwait	3593	324.108	36.201	16.438	52.640	7.255
Lithuania	4529	526.262	4.750	0.885	5.636	2.374
Morocco	5068	357.372	17.111	5.340	22.451	4.738
Netherlands	4515	518.865	4.356	1.555	5.911	2.431
New Zealand	6322	502.185	5.641	3.795	9.436	3.072
Northern Ireland	3116	518.628	4.959	3.256	8.216	2.866
Norway (5)	4329	541.578	5.879	2.568	8.447	2.906

Summary Statistics and Standard Errors for Proficiency in Science Applying at the Fourth Grade (Continued)

Country	Sample Size	Science Applying				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Oman	9105	434.518	8.362	0.251	8.613	2.935
Poland	4747	554.100	4.059	3.643	7.702	2.775
Portugal	4693	508.312	2.688	0.861	3.550	1.884
Qatar	5194	430.333	16.965	4.687	21.652	4.653
Russian Federation	4921	568.380	8.576	2.109	10.685	3.269
Saudi Arabia	4337	387.652	20.328	1.637	21.965	4.687
Serbia	4036	521.795	14.031	5.873	19.903	4.461
Singapore	6517	599.080	14.060	1.919	15.979	3.997
Slovak Republic	5773	516.779	7.135	0.726	7.860	2.804
Slovenia	4445	546.046	5.124	3.005	8.129	2.851
Spain	7764	513.701	5.846	4.875	10.721	3.274
Sweden	4142	540.114	11.624	0.241	11.864	3.444
Turkey	6456	485.988	9.066	0.543	9.609	3.100
United Arab Emirates	21177	451.909	7.206	2.916	10.122	3.181
United States	10029	546.290	4.290	0.497	4.787	2.188
Benchmarking Participants						
Buenos Aires, Argentina	3104	416.424	13.836	7.316	21.152	4.599
Ontario, Canada	4574	534.352	4.948	1.130	6.079	2.466
Quebec, Canada	2798	525.340	17.300	2.808	20.108	4.484
Norway (4)	4164	494.057	5.164	0.775	5.940	2.437
Abu Dhabi, UAE	5001	416.710	30.147	4.551	34.698	5.891
Dubai, UAE	7453	517.381	2.638	5.029	7.667	2.769
Florida, US	2025	549.525	22.541	1.247	23.788	4.877

Summary Statistics and Standard Errors for Proficiency in Science Reasoning at the Fourth Grade

Country	Sample Size	Science Reasoning				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	6057	527.452	7.646	1.300	8.945	2.991
Bahrain	4146	455.186	4.336	4.637	8.973	2.995
Belgium (Flemish)	5404	525.755	4.903	3.462	8.364	2.892
Bulgaria	4228	506.718	39.583	1.150	40.733	6.382
Canada	12283	524.497	4.751	2.188	6.939	2.634
Chile	4756	476.894	4.798	1.635	6.432	2.536
Chinese Taipei	4291	557.882	3.957	5.673	9.630	3.103
Croatia	3985	535.684	3.376	2.617	5.993	2.448
Cyprus	4125	489.644	5.705	7.553	13.257	3.641
Czech Republic	5202	528.733	4.701	1.161	5.862	2.421
Denmark	3710	525.659	4.025	4.325	8.350	2.890
England	4006	538.615	5.145	2.287	7.432	2.726
Finland	5015	552.053	3.693	1.761	5.455	2.336
France	4873	481.178	6.237	1.527	7.764	2.786
Georgia	3919	425.614	14.835	1.161	15.996	3.999
Germany	3948	531.637	3.855	1.487	5.342	2.311
Hong Kong SAR	3600	552.253	12.313	4.102	16.415	4.052
Hungary	5036	532.736	10.248	5.147	15.395	3.924
Indonesia	4025	389.562	27.506	2.849	30.355	5.510
Iran, Islamic Rep. of	3823	422.020	19.077	4.974	24.051	4.904
Ireland	4344	525.845	5.604	3.013	8.617	2.936
Italy	4373	511.235	4.652	7.858	12.509	3.537
Japan	4383	594.389	2.009	1.279	3.288	1.813
Kazakhstan	4702	551.564	19.351	1.029	20.380	4.514
Korea, Rep. of	4669	594.102	2.718	2.183	4.901	2.214
Kuwait	3593	296.992	42.526	22.316	64.842	8.052
Lithuania	4529	537.877	6.044	2.830	8.874	2.979
Morocco	5068	353.794	16.272	6.187	22.459	4.739
Netherlands	4515	525.802	4.234	4.024	8.258	2.874
New Zealand	6322	513.774	4.910	0.773	5.684	2.384
Northern Ireland	3116	519.911	5.248	1.379	6.627	2.574
Norway (5)	4329	536.620	4.748	9.569	14.317	3.784

Summary Statistics and Standard Errors for Proficiency in Science Reasoning at the Fourth Grade (Continued)

Country	Sample Size	Science Reasoning				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Oman	9105	431.034	6.684	2.501	9.185	3.031
Poland	4747	542.020	4.231	6.143	10.374	3.221
Portugal	4693	505.642	2.578	1.087	3.664	1.914
Qatar	5194	433.193	15.679	3.786	19.465	4.412
Russian Federation	4921	560.506	9.429	4.647	14.075	3.752
Saudi Arabia	4337	364.906	21.501	8.013	29.514	5.433
Serbia	4036	520.594	11.389	4.012	15.402	3.924
Singapore	6517	605.115	10.618	2.477	13.095	3.619
Slovak Republic	5773	507.314	6.605	4.620	11.226	3.350
Slovenia	4445	538.302	3.549	3.745	7.295	2.701
Spain	7764	516.646	5.379	1.585	6.964	2.639
Sweden	4142	542.115	9.473	4.929	14.402	3.795
Turkey	6456	483.324	10.555	0.423	10.977	3.313
United Arab Emirates	21177	444.321	5.940	2.950	8.890	2.982
United States	10029	541.636	3.481	3.961	7.442	2.728
Benchmarking Participants						
Buenos Aires, Argentina	3104	416.191	13.192	12.177	25.369	5.037
Ontario, Canada	4574	528.998	4.161	3.401	7.563	2.750
Quebec, Canada	2798	526.174	12.937	7.878	20.815	4.562
Norway (4)	4164	482.447	6.069	4.397	10.467	3.235
Abu Dhabi, UAE	5001	411.754	25.664	2.854	28.518	5.340
Dubai, UAE	7453	510.072	2.608	5.593	8.201	2.864
Florida, US	2025	540.575	23.390	10.295	33.685	5.804

Appendix 4C: Summary Statistics and Standard Errors for Proficiency in Mathematics at the Eighth Grade

Summary Statistics and Standard Errors for Proficiency in Overall Mathematics at the Eighth Grade

Country	Sample Size	Overall Mathematics				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	10338	504.958	8.854	0.810	9.664	3.109
Bahrain	4918	453.953	1.887	0.178	2.066	1.437
Botswana (9)	5964	390.835	3.528	0.650	4.178	2.044
Canada	8757	527.279	4.485	0.155	4.640	2.154
Chile	4849	427.426	8.530	1.825	10.354	3.218
Chinese Taipei	5711	599.105	5.636	0.232	5.869	2.423
Egypt	7822	392.227	15.262	1.752	17.014	4.125
England	4814	518.255	16.718	0.633	17.352	4.166
Georgia	4035	453.195	11.144	0.721	11.865	3.445
Hong Kong SAR	4155	594.253	20.803	0.519	21.323	4.618
Hungary	4893	514.414	13.953	0.321	14.274	3.778
Iran, Islamic Rep. of	6130	436.349	19.233	2.323	21.555	4.643
Ireland	4704	523.494	7.035	0.431	7.466	2.732
Israel	5512	510.899	16.592	0.226	16.818	4.101
Italy	4481	494.394	6.238	0.137	6.374	2.525
Japan	4745	586.469	4.966	0.186	5.152	2.270
Jordan	7865	385.551	9.941	0.494	10.435	3.230
Kazakhstan	4887	527.807	27.489	0.387	27.876	5.280
Korea, Rep. of	5309	605.742	6.105	0.674	6.779	2.604
Kuwait	4503	392.471	19.663	1.921	21.584	4.646
Lebanon	3873	442.425	12.780	0.424	13.204	3.634
Lithuania	4347	511.313	7.007	0.639	7.646	2.765
Malaysia	9726	465.313	12.350	0.381	12.731	3.568
Malta	3817	493.541	0.847	0.133	0.980	0.990
Morocco	13035	384.387	3.671	1.406	5.077	2.253
New Zealand	8142	492.720	10.499	0.766	11.266	3.356
Norway (9)	4697	511.542	4.699	0.364	5.063	2.250
Oman	8883	403.156	5.193	0.701	5.894	2.428

Summary Statistics and Standard Errors for Proficiency in Overall Mathematics at the Eighth Grade (Continued)

Country	Sample Size	Overall Mathematics				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Qatar	5403	437.109	7.449	1.502	8.951	2.992
Russian Federation	4780	537.996	21.058	0.644	21.702	4.659
Saudi Arabia	3759	367.717	15.791	5.263	21.054	4.588
Singapore	6116	620.956	9.345	0.879	10.224	3.198
Slovenia	4257	516.341	4.241	0.112	4.353	2.086
South Africa (9)	12514	372.373	19.635	0.871	20.505	4.528
Sweden	4090	500.722	7.320	0.284	7.604	2.758
Thailand	6482	431.417	22.145	0.555	22.700	4.764
Turkey	6079	457.629	20.377	2.112	22.489	4.742
United Arab Emirates	18012	464.783	3.692	0.315	4.007	2.002
United States	10221	518.296	9.365	0.092	9.457	3.075
Benchmarking Participants						
Buenos Aires, Argentina	3253	396.117	17.284	0.298	17.582	4.193
Ontario, Canada	4520	522.302	7.858	0.270	8.128	2.851
Quebec, Canada	3950	543.356	14.628	0.235	14.863	3.855
Norway (8)	4795	486.767	3.751	0.123	3.873	1.968
Abu Dhabi, UAE	4838	441.673	20.771	1.291	22.062	4.697
Dubai, UAE	6149	511.852	4.190	0.148	4.338	2.083
Florida, US	2074	493.464	41.455	0.100	41.556	6.446

Summary Statistics and Standard Errors for Proficiency in Algebra at the Eighth Grade

Country	Sample Size	Algebra				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	10338	490.523	9.589	1.745	11.334	3.367
Bahrain	4918	482.761	1.961	2.404	4.365	2.089
Botswana (9)	5964	399.825	3.327	1.789	5.116	2.262
Canada	8757	513.149	4.630	0.245	4.875	2.208
Chile	4849	413.446	8.902	2.490	11.393	3.375
Chinese Taipei	5711	613.240	7.111	0.906	8.017	2.831
Egypt	7822	419.700	16.671	2.079	18.750	4.330
England	4814	492.424	20.357	1.609	21.966	4.687
Georgia	4035	468.702	13.696	0.573	14.268	3.777
Hong Kong SAR	4155	593.003	20.614	1.470	22.084	4.699
Hungary	4893	502.822	14.660	2.304	16.964	4.119
Iran, Islamic Rep. of	6130	437.363	22.725	3.604	26.329	5.131
Ireland	4704	500.995	7.448	0.458	7.906	2.812
Israel	5512	517.072	19.507	2.125	21.632	4.651
Italy	4481	481.338	7.275	1.594	8.869	2.978
Japan	4745	595.902	6.459	1.440	7.899	2.810
Jordan	7865	417.572	11.343	1.048	12.391	3.520
Kazakhstan	4887	554.755	31.008	0.759	31.767	5.636
Korea, Rep. of	5309	612.084	7.453	0.922	8.375	2.894
Kuwait	4503	384.030	20.301	2.407	22.708	4.765
Lebanon	3873	465.704	12.817	2.825	15.642	3.955
Lithuania	4347	497.342	10.371	0.254	10.625	3.260
Malaysia	9726	466.857	10.748	0.736	11.484	3.389
Malta	3817	492.445	0.987	2.260	3.247	1.802
Morocco	13035	372.068	4.994	0.510	5.504	2.346
New Zealand	8142	474.775	11.813	0.291	12.104	3.479
Norway (9)	4697	471.239	6.656	0.521	7.176	2.679
Oman	8883	426.333	6.471	1.003	7.473	2.734
Qatar	5403	452.126	6.336	0.439	6.775	2.603
Russian Federation	4780	558.163	25.377	1.245	26.621	5.160
Saudi Arabia	3759	390.954	14.991	4.160	19.151	4.376
Singapore	6116	622.539	10.608	1.138	11.746	3.427
Slovenia	4257	498.243	3.997	2.095	6.092	2.468
South Africa (9)	12514	393.739	17.553	0.786	18.339	4.282

Summary Statistics and Standard Errors for Proficiency in Algebra at the Eighth Grade (Continued)

Country	Sample Size	Algebra				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Sweden	4090	482.127	9.168	1.205	10.372	3.221
Thailand	6482	429.091	24.392	1.789	26.181	5.117
Turkey	6079	459.112	19.672	1.379	21.051	4.588
United Arab Emirates	18012	485.031	3.491	0.651	4.142	2.035
United States	10221	524.861	9.690	0.193	9.884	3.144
Benchmarking Participants						
Buenos Aires, Argentina	3253	370.845	24.589	1.737	26.326	5.131
Ontario, Canada	4520	507.420	8.400	0.575	8.975	2.996
Quebec, Canada	3950	530.393	13.896	5.064	18.960	4.354
Norway (8)	4795	423.282	5.623	1.669	7.292	2.700
Abu Dhabi, UAE	4838	462.161	19.838	0.738	20.576	4.536
Dubai, UAE	6149	528.476	3.921	3.275	7.196	2.683
Florida, US	2074	502.144	45.296	1.210	46.506	6.820

Summary Statistics and Standard Errors for Proficiency in Geometry at the Eighth Grade

Country	Sample Size	Geometry				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	10338	500.112	8.570	1.015	9.584	3.096
Bahrain	4918	449.266	2.737	3.336	6.073	2.464
Botswana (9)	5964	376.868	3.538	2.786	6.324	2.515
Canada	8757	526.593	5.469	1.003	6.472	2.544
Chile	4849	427.534	8.332	2.964	11.296	3.361
Chinese Taipei	5711	606.788	5.958	1.009	6.967	2.640
Egypt	7822	392.824	15.105	2.041	17.146	4.141
England	4814	514.222	16.574	0.353	16.927	4.114
Georgia	4035	440.545	14.942	0.192	15.134	3.890
Hong Kong SAR	4155	601.775	23.819	2.133	25.952	5.094
Hungary	4893	518.216	17.259	0.578	17.837	4.223
Iran, Islamic Rep. of	6130	447.776	20.127	2.409	22.536	4.747
Ireland	4704	503.478	7.666	2.027	9.693	3.113
Israel	5512	487.304	19.939	1.246	21.185	4.603
Italy	4481	503.944	9.966	2.635	12.601	3.550
Japan	4745	597.600	5.319	1.259	6.579	2.565
Jordan	7865	380.748	8.705	3.097	11.802	3.435
Kazakhstan	4887	529.265	39.595	1.143	40.738	6.383
Korea, Rep. of	5309	612.210	6.125	5.492	11.618	3.408
Kuwait	4503	381.922	23.397	4.734	28.131	5.304
Lebanon	3873	443.560	12.849	2.931	15.781	3.972
Lithuania	4347	514.657	9.170	0.301	9.471	3.078
Malaysia	9726	455.281	14.429	0.541	14.970	3.869
Malta	3817	484.018	0.996	1.818	2.814	1.678
Morocco	13035	410.001	2.837	5.990	8.827	2.971
New Zealand	8142	488.092	9.307	0.753	10.060	3.172
Norway (9)	4697	497.733	5.550	0.902	6.452	2.540
Oman	8883	414.633	5.508	2.537	8.045	2.836
Qatar	5403	432.771	7.437	1.392	8.829	2.971
Russian Federation	4780	535.564	30.109	1.338	31.448	5.608
Saudi Arabia	3759	342.398	16.103	11.912	28.015	5.293
Singapore	6116	616.974	9.985	2.540	12.525	3.539
Slovenia	4257	522.142	4.300	3.373	7.672	2.770
South Africa (9)	12514	363.807	18.173	2.126	20.299	4.505

Summary Statistics and Standard Errors for Proficiency in Geometry at the Eighth Grade (Continued)

Country	Sample Size	Geometry				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Sweden	4090	477.830	7.555	3.968	11.523	3.395
Thailand	6482	429.008	22.595	1.103	23.698	4.868
Turkey	6079	462.566	21.504	2.777	24.280	4.928
United Arab Emirates	18012	447.423	4.511	1.415	5.926	2.434
United States	10221	500.102	9.723	0.440	10.163	3.188
Benchmarking Participants						
Buenos Aires, Argentina	3253	358.491	23.897	0.933	24.830	4.983
Ontario, Canada	4520	523.817	9.085	2.825	11.909	3.451
Quebec, Canada	3950	540.202	18.078	0.201	18.279	4.275
Norway (8)	4795	477.270	4.543	1.155	5.697	2.387
Abu Dhabi, UAE	4838	425.275	25.757	3.197	28.955	5.381
Dubai, UAE	6149	496.292	5.624	1.355	6.979	2.642
Florida, US	2074	469.663	37.704	5.120	42.824	6.544

Summary Statistics and Standard Errors for Proficiency in Number at the Eighth Grade

Country	Sample Size	Number				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	10338	511.324	9.704	0.270	9.974	3.158
Bahrain	4918	435.770	2.223	1.828	4.051	2.013
Botswana (9)	5964	393.427	4.176	6.177	10.353	3.218
Canada	8757	536.811	5.294	0.580	5.874	2.424
Chile	4849	427.319	9.703	1.001	10.703	3.272
Chinese Taipei	5711	589.739	5.685	0.250	5.934	2.436
Egypt	7822	393.093	13.020	0.751	13.771	3.711
England	4814	527.575	19.606	0.876	20.482	4.526
Georgia	4035	456.827	11.443	0.137	11.580	3.403
Hong Kong SAR	4155	594.334	20.776	2.980	23.755	4.874
Hungary	4893	517.500	14.924	1.096	16.020	4.002
Iran, Islamic Rep. of	6130	431.704	19.727	2.504	22.230	4.715
Ireland	4704	544.482	8.608	2.545	11.153	3.340
Israel	5512	517.678	13.818	2.116	15.934	3.992
Italy	4481	493.925	6.318	0.807	7.125	2.669
Japan	4745	572.052	4.172	1.580	5.752	2.398
Jordan	7865	380.465	8.467	1.861	10.327	3.214
Kazakhstan	4887	516.401	25.458	0.822	26.281	5.126
Korea, Rep. of	5309	601.180	5.656	0.175	5.830	2.415
Kuwait	4503	394.823	18.738	4.011	22.749	4.770
Lebanon	3873	440.196	11.912	5.051	16.963	4.119
Lithuania	4347	510.970	7.041	1.011	8.052	2.838
Malaysia	9726	471.617	12.490	0.392	12.883	3.589
Malta	3817	500.625	1.036	1.668	2.704	1.644
Morocco	13035	382.389	3.719	0.750	4.469	2.114
New Zealand	8142	499.647	12.217	0.238	12.456	3.529
Norway (9)	4697	528.688	5.580	1.012	6.592	2.567
Oman	8883	388.968	4.655	2.277	6.933	2.633
Qatar	5403	435.139	7.655	1.041	8.696	2.949
Russian Federation	4780	533.008	19.522	0.471	19.994	4.471
Saudi Arabia	3759	352.028	16.851	3.042	19.892	4.460
Singapore	6116	628.949	9.511	0.702	10.213	3.196
Slovenia	4257	523.789	5.021	0.709	5.730	2.394
South Africa (9)	12514	368.479	20.486	1.258	21.745	4.663

Summary Statistics and Standard Errors for Proficiency in Number at the Eighth Grade (Continued)

Country	Sample Size	Number				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Sweden	4090	512.658	6.854	1.386	8.240	2.871
Thailand	6482	430.478	23.770	1.222	24.992	4.999
Turkey	6079	447.424	20.315	1.046	21.361	4.622
United Arab Emirates	18012	463.684	3.397	0.132	3.529	1.879
United States	10221	519.731	9.134	0.329	9.463	3.076
Benchmarking Participants						
Buenos Aires, Argentina	3253	414.676	15.691	2.055	17.746	4.213
Ontario, Canada	4520	529.695	8.952	0.185	9.137	3.023
Quebec, Canada	3950	556.967	17.179	1.490	18.669	4.321
Norway (8)	4795	503.787	4.258	0.750	5.008	2.238
Abu Dhabi, UAE	4838	442.576	18.278	0.683	18.961	4.354
Dubai, UAE	6149	508.555	4.916	1.316	6.233	2.497
Florida, US	2074	498.089	43.085	1.086	44.171	6.646

Summary Statistics and Standard Errors for Proficiency in Data and Chance at the Eighth Grade

Country	Sample Size	Data and Chance				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	10338	518.833	8.784	0.974	9.757	3.124
Bahrain	4918	452.908	2.411	2.643	5.054	2.248
Botswana (9)	5964	373.556	4.734	5.164	9.898	3.146
Canada	8757	533.838	6.184	2.102	8.286	2.879
Chile	4849	429.468	9.887	4.262	14.150	3.762
Chinese Taipei	5711	587.930	5.511	0.617	6.128	2.476
Egypt	7822	338.098	17.400	2.361	19.761	4.445
England	4814	541.417	18.576	3.065	21.641	4.652
Georgia	4035	421.394	12.064	1.478	13.541	3.680
Hong Kong SAR	4155	597.122	25.329	9.463	34.793	5.899
Hungary	4893	518.888	14.434	0.580	15.015	3.875
Iran, Islamic Rep. of	6130	417.001	23.788	1.546	25.333	5.033
Ireland	4704	533.814	11.407	3.310	14.717	3.836
Israel	5512	503.211	18.951	5.530	24.481	4.948
Italy	4481	496.317	6.177	1.024	7.201	2.683
Japan	4745	589.045	5.146	0.370	5.516	2.349
Jordan	7865	346.120	11.274	4.750	16.024	4.003
Kazakhstan	4887	492.125	27.906	2.114	30.020	5.479
Korea, Rep. of	5309	600.133	4.921	0.678	5.599	2.366
Kuwait	4503	377.071	22.396	3.030	25.426	5.042
Lebanon	3873	395.057	18.917	2.634	21.552	4.642
Lithuania	4347	521.495	6.625	0.734	7.359	2.713
Malaysia	9726	451.491	13.888	0.751	14.639	3.826
Malta	3817	486.607	1.226	5.564	6.790	2.606
Morocco	13035	353.269	3.543	4.768	8.311	2.883
New Zealand	8142	508.560	12.670	0.769	13.439	3.666
Norway (9)	4697	542.242	7.575	2.607	10.182	3.191
Oman	8883	376.220	6.447	2.762	9.208	3.035
Qatar	5403	416.941	9.593	5.617	15.210	3.900
Russian Federation	4780	507.042	18.385	6.224	24.608	4.961
Saudi Arabia	3759	361.268	17.906	6.251	24.157	4.915
Singapore	6116	617.045	11.039	0.420	11.459	3.385

Summary Statistics and Standard Errors for Proficiency in Data and Chance at the Eighth Grade (Continued)

Country	Sample Size	Data and Chance				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Slovenia	4257	524.614	5.406	1.808	7.215	2.686
South Africa (9)	12514	356.926	21.357	3.066	24.423	4.942
Sweden	4090	511.909	12.311	1.568	13.879	3.725
Thailand	6482	424.885	20.808	0.750	21.558	4.643
Turkey	6079	466.565	24.949	2.545	27.493	5.243
United Arab Emirates	18012	448.972	4.714	1.349	6.064	2.462
United States	10221	521.848	11.813	0.258	12.070	3.474
Benchmarking Participants						
Buenos Aires, Argentina	3253	372.981	26.761	1.325	28.085	5.300
Ontario, Canada	4520	531.233	10.643	4.281	14.924	3.863
Quebec, Canada	3950	546.109	22.834	2.509	25.343	5.034
Norway (8)	4795	519.419	6.831	2.181	9.012	3.002
Abu Dhabi, UAE	4838	425.722	25.981	3.930	29.910	5.469
Dubai, UAE	6149	503.513	5.444	3.692	9.135	3.022
Florida, US	2074	489.318	52.656	12.160	64.816	8.051

Summary Statistics and Standard Errors for Proficiency in Mathematics Knowing at the Eighth Grade

Country	Sample Size	Mathematics Knowing				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	10338	504.368	8.165	1.309	9.474	3.078
Bahrain	4918	463.186	2.335	2.919	5.253	2.292
Botswana (9)	5964	393.558	4.056	4.688	8.745	2.957
Canada	8757	520.322	4.703	0.647	5.349	2.313
Chile	4849	422.594	8.385	3.375	11.760	3.429
Chinese Taipei	5711	598.180	6.609	1.855	8.464	2.909
Egypt	7822	399.144	18.123	0.393	18.516	4.303
England	4814	513.144	16.263	0.244	16.507	4.063
Georgia	4035	455.982	13.976	2.790	16.766	4.095
Hong Kong SAR	4155	599.748	22.422	3.871	26.293	5.128
Hungary	4893	511.208	14.605	0.912	15.517	3.939
Iran, Islamic Rep. of	6130	435.396	21.659	2.073	23.732	4.872
Ireland	4704	527.348	7.140	2.007	9.147	3.024
Israel	5512	511.124	17.102	0.875	17.977	4.240
Italy	4481	488.636	6.163	0.903	7.066	2.658
Japan	4745	577.630	5.434	1.424	6.857	2.619
Jordan	7865	390.547	9.725	0.372	10.097	3.178
Kazakhstan	4887	533.246	38.945	1.074	40.019	6.326
Korea, Rep. of	5309	606.806	7.154	0.621	7.776	2.788
Kuwait	4503	397.569	21.014	1.284	22.298	4.722
Lebanon	3873	455.722	13.690	0.567	14.258	3.776
Lithuania	4347	501.908	7.702	1.668	9.370	3.061
Malaysia	9726	472.252	14.094	0.514	14.608	3.822
Malta	3817	498.996	0.933	1.253	2.186	1.479
Morocco	13035	382.117	4.357	1.610	5.966	2.443
New Zealand	8142	487.658	9.952	1.326	11.278	3.358
Norway (9)	4697	500.370	4.240	1.166	5.406	2.325
Oman	8883	401.284	6.394	2.962	9.357	3.059
Qatar	5403	439.871	8.557	1.256	9.814	3.133
Russian Federation	4780	543.105	30.444	1.456	31.900	5.648
Saudi Arabia	3759	359.402	21.180	3.312	24.492	4.949
Singapore	6116	633.054	9.865	1.615	11.480	3.388

Summary Statistics and Standard Errors for Proficiency in Mathematics Knowing at the Eighth Grade (Continued)

Country	Sample Size	Mathematics Knowing				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Slovenia	4257	518.009	4.577	1.359	5.936	2.436
South Africa (9)	12514	371.225	24.887	2.573	27.459	5.240
Sweden	4090	484.301	6.875	1.165	8.040	2.835
Thailand	6482	425.315	25.000	1.032	26.031	5.102
Turkey	6079	447.118	22.774	1.171	23.944	4.893
United Arab Emirates	18012	475.660	3.940	0.749	4.689	2.165
United States	10221	527.972	10.425	1.478	11.903	3.450
Benchmarking Participants						
Buenos Aires, Argentina	3253	397.437	18.222	0.704	18.926	4.350
Ontario, Canada	4520	513.055	8.125	0.681	8.805	2.967
Quebec, Canada	3950	540.700	15.553	2.486	18.039	4.247
Norway (8)	4795	476.352	3.168	3.369	6.537	2.557
Abu Dhabi, UAE	4838	453.246	21.157	1.543	22.700	4.764
Dubai, UAE	6149	521.321	4.670	0.748	5.418	2.328
Florida, US	2074	501.238	48.357	5.511	53.868	7.339

Summary Statistics and Standard Errors for Proficiency in Mathematics Applying at the Eighth Grade

Country	Sample Size	Mathematics Applying				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	10338	502.031	9.145	0.121	9.266	3.044
Bahrain	4918	445.218	1.932	0.945	2.878	1.696
Botswana (9)	5964	385.384	3.996	1.522	5.518	2.349
Canada	8757	528.164	4.220	0.477	4.697	2.167
Chile	4849	426.649	9.123	1.808	10.932	3.306
Chinese Taipei	5711	602.105	5.787	0.705	6.492	2.548
Egypt	7822	384.985	14.494	0.653	15.148	3.892
England	4814	519.392	16.766	0.308	17.074	4.132
Georgia	4035	454.431	11.720	0.903	12.623	3.553
Hong Kong SAR	4155	595.227	19.220	1.137	20.357	4.512
Hungary	4893	515.986	13.993	0.701	14.693	3.833
Iran, Islamic Rep. of	6130	434.175	19.054	0.436	19.490	4.415
Ireland	4704	520.417	7.867	1.392	9.259	3.043
Israel	5512	511.867	15.709	0.411	16.119	4.015
Italy	4481	494.952	6.381	0.421	6.802	2.608
Japan	4745	591.560	4.748	0.573	5.321	2.307
Jordan	7865	378.362	9.829	0.387	10.216	3.196
Kazakhstan	4887	527.235	27.304	1.480	28.784	5.365
Korea, Rep. of	5309	606.193	6.573	1.416	7.988	2.826
Kuwait	4503	389.424	17.752	2.832	20.584	4.537
Lebanon	3873	438.615	13.450	2.128	15.577	3.947
Lithuania	4347	519.858	6.895	0.125	7.020	2.650
Malaysia	9726	463.043	11.934	0.986	12.919	3.594
Malta	3817	493.488	0.954	1.416	2.369	1.539
Morocco	13035	385.315	3.379	1.553	4.932	2.221
New Zealand	8142	493.100	10.345	0.704	11.049	3.324
Norway (9)	4697	516.316	4.744	0.557	5.301	2.302
Oman	8883	400.766	5.160	0.848	6.008	2.451
Qatar	5403	434.932	7.292	1.299	8.591	2.931
Russian Federation	4780	540.864	20.827	0.277	21.104	4.594
Saudi Arabia	3759	363.583	14.295	3.366	17.660	4.202
Singapore	6116	619.345	8.786	1.225	10.011	3.164

Summary Statistics and Standard Errors for Proficiency in Mathematics Applying at the Eighth Grade (Continued)

Country	Sample Size	Mathematics Applying				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Slovenia	4257	514.152	4.061	0.528	4.589	2.142
South Africa (9)	12514	362.243	20.678	0.593	21.271	4.612
Sweden	4090	506.669	6.963	0.630	7.592	2.755
Thailand	6482	431.459	21.691	0.708	22.399	4.733
Turkey	6079	459.544	18.267	0.302	18.569	4.309
United Arab Emirates	18012	457.307	3.715	0.621	4.336	2.082
United States	10221	514.657	10.137	0.127	10.263	3.204
Benchmarking Participants						
Buenos Aires, Argentina	3253	391.955	19.901	2.694	22.595	4.753
Ontario, Canada	4520	522.105	7.104	0.886	7.990	2.827
Quebec, Canada	3950	546.492	14.633	1.542	16.175	4.022
Norway (8)	4795	491.983	3.683	1.800	5.484	2.342
Abu Dhabi, UAE	4838	433.731	20.970	0.816	21.786	4.668
Dubai, UAE	6149	505.267	4.602	1.711	6.313	2.513
Florida, US	2074	488.443	43.976	1.571	45.547	6.749

Summary Statistics and Standard Errors for Proficiency in Mathematics Reasoning at the Eighth Grade

Country	Sample Size	Mathematics Reasoning				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	10338	511.998	8.387	0.941	9.328	3.054
Bahrain	4918	451.902	2.400	2.552	4.951	2.225
Botswana (9)	5964	388.986	3.410	0.565	3.974	1.994
Canada	8757	533.893	4.801	0.763	5.564	2.359
Chile	4849	431.854	9.183	1.551	10.733	3.276
Chinese Taipei	5711	602.351	5.660	0.474	6.134	2.477
Egypt	7822	378.866	17.333	0.820	18.153	4.261
England	4814	522.146	16.723	2.299	19.022	4.361
Georgia	4035	440.652	14.320	5.880	20.199	4.494
Hong Kong SAR	4155	591.369	24.076	1.752	25.828	5.082
Hungary	4893	514.927	14.266	0.899	15.165	3.894
Iran, Islamic Rep. of	6130	436.194	21.057	0.700	21.757	4.664
Ireland	4704	521.380	7.245	2.528	9.774	3.126
Israel	5512	509.852	16.543	2.568	19.111	4.372
Italy	4481	500.040	7.342	0.623	7.965	2.822
Japan	4745	590.552	5.882	0.879	6.761	2.600
Jordan	7865	379.646	9.884	0.914	10.798	3.286
Kazakhstan	4887	524.604	28.566	1.600	30.166	5.492
Korea, Rep. of	5309	607.643	5.799	1.429	7.228	2.689
Kuwait	4503	373.908	17.342	2.889	20.232	4.498
Lebanon	3873	405.768	18.084	2.525	20.610	4.540
Lithuania	4347	501.380	8.383	0.690	9.074	3.012
Malaysia	9726	452.956	12.100	1.912	14.012	3.743
Malta	3817	484.406	1.080	3.634	4.715	2.171
Morocco	13035	373.931	2.898	4.990	7.888	2.809
New Zealand	8142	498.549	10.594	1.377	11.971	3.460
Norway (9)	4697	515.873	5.070	0.969	6.039	2.457
Oman	8883	402.412	5.536	3.994	9.530	3.087
Qatar	5403	431.367	7.221	0.551	7.773	2.788
Russian Federation	4780	527.568	22.772	1.785	24.557	4.956
Saudi Arabia	3759	374.162	14.027	2.136	16.163	4.020
Singapore	6116	616.228	11.376	2.204	13.580	3.685

Summary Statistics and Standard Errors for Proficiency in Mathematics Reasoning at the Eighth Grade (Continued)

Country	Sample Size	Mathematics Reasoning				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Slovenia	4257	515.899	5.075	2.368	7.443	2.728
South Africa (9)	12514	383.131	15.878	2.113	17.991	4.242
Sweden	4090	509.436	8.910	3.290	12.200	3.493
Thailand	6482	435.431	22.017	0.681	22.699	4.764
Turkey	6079	472.147	21.271	2.027	23.298	4.827
United Arab Emirates	18012	460.985	3.531	1.251	4.782	2.187
United States	10221	514.041	8.673	0.653	9.326	3.054
Benchmarking Participants						
Buenos Aires, Argentina	3253	382.562	23.511	4.958	28.469	5.336
Ontario, Canada	4520	534.384	8.452	1.438	9.890	3.145
Quebec, Canada	3950	538.211	15.665	2.147	17.812	4.220
Norway (8)	4795	487.809	4.740	0.737	5.477	2.340
Abu Dhabi, UAE	4838	440.120	20.646	1.908	22.554	4.749
Dubai, UAE	6149	509.373	4.057	3.587	7.644	2.765
Florida, US	2074	490.882	36.604	6.687	43.291	6.580

Appendix 4D: Summary Statistics and Standard Errors for Proficiency in Science at the Eighth Grade

Summary Statistics and Standard Errors for Proficiency in Overall Science at the Eighth Grade

Country	Sample Size	Overall Science				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	10338	511.987	6.728	0.432	7.160	2.676
Bahrain	4918	465.853	4.308	0.448	4.756	2.181
Botswana (9)	5964	391.801	5.505	2.040	7.545	2.747
Canada	8757	526.172	4.002	0.764	4.767	2.183
Chile	4849	453.969	8.466	1.069	9.534	3.088
Chinese Taipei	5711	569.474	3.731	0.542	4.273	2.067
Egypt	7822	370.777	17.335	1.168	18.503	4.301
England	4814	536.630	14.131	0.389	14.520	3.811
Georgia	4035	443.166	7.808	1.966	9.774	3.126
Hong Kong SAR	4155	545.760	15.258	0.130	15.389	3.923
Hungary	4893	527.260	10.452	0.965	11.417	3.379
Iran, Islamic Rep. of	6130	456.425	14.837	1.239	16.076	4.010
Ireland	4704	530.097	7.245	0.727	7.973	2.824
Israel	5512	506.731	14.900	0.345	15.245	3.905
Italy	4481	498.926	4.880	0.968	5.848	2.418
Japan	4745	570.900	2.987	0.236	3.222	1.795
Jordan	7865	426.164	9.748	1.583	11.332	3.366
Kazakhstan	4887	532.586	19.520	0.240	19.760	4.445
Korea, Rep. of	5309	555.597	4.475	0.404	4.879	2.209
Kuwait	4503	410.741	25.103	1.510	26.612	5.159
Lebanon	3873	398.157	26.410	2.176	28.586	5.347
Lithuania	4347	519.105	7.339	0.372	7.711	2.777
Malaysia	9726	470.822	16.672	0.396	17.068	4.131
Malta	3817	481.361	1.672	0.939	2.610	1.616
Morocco	13035	393.253	4.065	2.288	6.352	2.520
New Zealand	8142	512.681	9.397	0.218	9.615	3.101
Norway (9)	4697	508.826	7.211	0.595	7.806	2.794
Oman	8883	454.560	5.582	1.456	7.038	2.653

Summary Statistics and Standard Errors for Proficiency in Overall Science at the Eighth Grade (Continued)

Country	Sample Size	Overall Science				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Qatar	5403	456.516	8.021	1.224	9.245	3.041
Russian Federation	4780	544.116	17.005	0.722	17.727	4.210
Saudi Arabia	3759	396.420	18.673	1.389	20.062	4.479
Singapore	6116	596.644	9.827	0.290	10.117	3.181
Slovenia	4257	551.112	4.934	0.828	5.762	2.400
South Africa (9)	12514	357.742	30.162	1.593	31.755	5.635
Sweden	4090	522.269	10.848	0.998	11.846	3.442
Thailand	6482	455.845	16.978	0.990	17.967	4.239
Turkey	6079	493.396	15.523	0.625	16.148	4.018
United Arab Emirates	18012	476.646	4.718	0.496	5.213	2.283
United States	10221	529.996	7.545	0.528	8.073	2.841
Benchmarking Participants						
Buenos Aires, Argentina	3253	386.013	16.815	1.154	17.969	4.239
Ontario, Canada	4520	523.872	5.815	0.472	6.288	2.508
Quebec, Canada	3950	529.716	16.871	2.268	19.139	4.375
Norway (8)	4795	489.221	5.277	0.338	5.615	2.370
Abu Dhabi, UAE	4838	454.249	30.475	0.810	31.284	5.593
Dubai, UAE	6149	524.723	3.391	0.586	3.977	1.994
Florida, US	2074	508.280	33.126	2.615	35.741	5.978

Summary Statistics and Standard Errors for Proficiency in Biology at the Eighth Grade

Country	Sample Size	Biology				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	10338	521.730	6.736	1.215	7.951	2.820
Bahrain	4918	468.749	4.789	1.882	6.670	2.583
Botswana (9)	5964	396.583	6.125	2.049	8.173	2.859
Canada	8757	534.272	4.097	1.470	5.568	2.360
Chile	4849	458.873	8.774	4.143	12.917	3.594
Chinese Taipei	5711	565.146	3.891	0.999	4.890	2.211
Egypt	7822	348.336	19.895	5.365	25.259	5.026
England	4814	542.025	14.369	1.598	15.967	3.996
Georgia	4035	446.708	7.853	1.709	9.563	3.092
Hong Kong SAR	4155	548.515	16.112	5.593	21.706	4.659
Hungary	4893	520.756	9.198	1.619	10.817	3.289
Iran, Islamic Rep. of	6130	448.333	13.477	1.315	14.793	3.846
Ireland	4704	534.167	7.099	1.331	8.430	2.903
Israel	5512	504.168	15.126	2.904	18.030	4.246
Italy	4481	495.540	5.377	1.425	6.802	2.608
Japan	4745	570.340	3.593	4.681	8.274	2.877
Jordan	7865	419.589	10.414	4.687	15.101	3.886
Kazakhstan	4887	520.484	21.324	0.211	21.535	4.641
Korea, Rep. of	5309	553.929	4.186	0.733	4.919	2.218
Kuwait	4503	401.813	32.176	2.053	34.229	5.851
Lebanon	3873	365.964	30.187	8.209	38.396	6.196
Lithuania	4347	520.981	8.524	1.097	9.622	3.102
Malaysia	9726	466.110	18.330	0.637	18.967	4.355
Malta	3817	472.755	2.262	4.969	7.231	2.689
Morocco	13035	379.543	4.263	2.133	6.397	2.529
New Zealand	8142	519.558	10.370	1.635	12.005	3.465
Norway (9)	4697	501.587	6.722	0.285	7.007	2.647
Oman	8883	454.310	5.895	1.393	7.289	2.700
Qatar	5403	454.416	8.577	0.393	8.971	2.995
Russian Federation	4780	539.000	17.210	2.196	19.407	4.405
Saudi Arabia	3759	397.238	20.255	5.740	25.995	5.099
Singapore	6116	609.090	11.646	0.409	12.055	3.472
Slovenia	4257	548.299	4.589	3.285	7.874	2.806
South Africa (9)	12514	356.375	32.590	1.692	34.282	5.855

Summary Statistics and Standard Errors for Proficiency in Biology at the Eighth Grade (Continued)

Country	Sample Size	Biology				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Sweden	4090	519.866	12.056	1.015	13.071	3.615
Thailand	6482	465.849	16.671	0.128	16.799	4.099
Turkey	6079	490.902	14.873	1.612	16.485	4.060
United Arab Emirates	18012	474.639	5.433	0.242	5.675	2.382
United States	10221	540.366	7.913	0.311	8.224	2.868
Benchmarking Participants						
Buenos Aires, Argentina	3253	391.315	18.919	3.621	22.540	4.748
Ontario, Canada	4520	537.624	6.084	2.169	8.253	2.873
Quebec, Canada	3950	527.043	17.592	0.992	18.584	4.311
Norway (8)	4795	485.645	5.238	3.317	8.555	2.925
Abu Dhabi, UAE	4838	452.247	34.637	2.190	36.827	6.069
Dubai, UAE	6149	524.797	4.340	1.417	5.757	2.399
Florida, US	2074	518.191	32.807	0.662	33.469	5.785

Summary Statistics and Standard Errors for Proficiency in Chemistry at the Eighth Grade

Country	Sample Size	Chemistry				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	10338	492.654	8.721	2.403	11.124	3.335
Bahrain	4918	462.318	5.963	1.744	7.707	2.776
Botswana (9)	5964	389.927	5.977	6.948	12.925	3.595
Canada	8757	512.409	4.202	0.590	4.792	2.189
Chile	4849	438.014	10.153	2.812	12.966	3.601
Chinese Taipei	5711	578.517	5.729	1.482	7.211	2.685
Egypt	7822	394.711	16.380	8.427	24.806	4.981
England	4814	528.555	16.319	3.669	19.988	4.471
Georgia	4035	455.951	8.337	5.187	13.524	3.677
Hong Kong SAR	4155	535.921	16.457	0.695	17.152	4.142
Hungary	4893	534.210	11.925	0.901	12.826	3.581
Iran, Islamic Rep. of	6130	457.557	19.754	1.802	21.556	4.643
Ireland	4704	517.110	9.879	2.777	12.657	3.558
Israel	5512	515.961	18.132	3.170	21.302	4.615
Italy	4481	487.227	5.704	0.233	5.937	2.437
Japan	4745	569.973	4.121	1.786	5.907	2.431
Jordan	7865	437.545	11.658	2.854	14.513	3.810
Kazakhstan	4887	553.558	23.993	3.325	27.319	5.227
Korea, Rep. of	5309	550.262	5.221	1.025	6.246	2.499
Kuwait	4503	412.793	25.033	7.155	32.188	5.673
Lebanon	3873	437.808	26.117	12.358	38.475	6.203
Lithuania	4347	517.160	7.143	3.161	10.304	3.210
Malaysia	9726	473.180	15.307	0.597	15.905	3.988
Malta	3817	481.346	2.276	2.271	4.548	2.133
Morocco	13035	399.663	4.744	4.060	8.803	2.967
New Zealand	8142	497.920	10.380	1.820	12.200	3.493
Norway (9)	4697	502.692	7.437	1.185	8.622	2.936
Oman	8883	452.446	6.647	0.515	7.162	2.676
Qatar	5403	454.980	11.016	1.793	12.809	3.579
Russian Federation	4780	558.033	20.485	3.576	24.061	4.905
Saudi Arabia	3759	377.330	21.369	4.080	25.448	5.045
Singapore	6116	593.179	12.246	0.894	13.140	3.625
Slovenia	4257	552.401	5.621	1.108	6.729	2.594
South Africa (9)	12514	368.749	25.950	11.069	37.018	6.084

Summary Statistics and Standard Errors for Proficiency in Chemistry at the Eighth Grade (Continued)

Country	Sample Size	Chemistry				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Sweden	4090	512.367	11.770	0.964	12.733	3.568
Thailand	6482	444.762	20.388	3.589	23.978	4.897
Turkey	6079	493.399	19.972	1.696	21.667	4.655
United Arab Emirates	18012	480.838	6.282	3.737	10.020	3.165
United States	10221	518.907	9.225	0.942	10.167	3.189
Benchmarking Participants						
Buenos Aires, Argentina	3253	353.645	16.427	11.323	27.750	5.268
Ontario, Canada	4520	502.972	6.410	0.681	7.091	2.663
Quebec, Canada	3950	530.532	19.065	2.438	21.503	4.637
Norway (8)	4795	479.355	6.522	6.032	12.554	3.543
Abu Dhabi, UAE	4838	459.049	40.095	5.298	45.393	6.737
Dubai, UAE	6149	528.151	5.301	0.968	6.270	2.504
Florida, US	2074	497.877	42.103	4.831	46.934	6.851

Summary Statistics and Standard Errors for Proficiency in Physics at the Eighth Grade

Country	Sample Size	Physics				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	10338	504.536	6.996	0.243	7.239	2.691
Bahrain	4918	461.198	4.680	1.920	6.600	2.569
Botswana (9)	5964	383.822	6.495	1.151	7.646	2.765
Canada	8757	520.592	4.290	0.678	4.968	2.229
Chile	4849	439.212	8.596	5.671	14.267	3.777
Chinese Taipei	5711	559.892	4.597	4.548	9.145	3.024
Egypt	7822	377.645	18.903	3.212	22.115	4.703
England	4814	535.260	14.424	0.863	15.287	3.910
Georgia	4035	429.363	9.164	12.174	21.338	4.619
Hong Kong SAR	4155	540.128	15.851	0.586	16.437	4.054
Hungary	4893	530.969	13.656	2.475	16.131	4.016
Iran, Islamic Rep. of	6130	475.162	17.469	1.815	19.284	4.391
Ireland	4704	524.915	7.690	2.389	10.079	3.175
Israel	5512	508.455	14.991	1.147	16.138	4.017
Italy	4481	496.322	4.978	1.134	6.113	2.472
Japan	4745	569.628	3.904	1.393	5.297	2.302
Jordan	7865	424.359	10.384	2.374	12.758	3.572
Kazakhstan	4887	543.080	23.166	1.436	24.601	4.960
Korea, Rep. of	5309	564.300	6.668	1.039	7.706	2.776
Kuwait	4503	411.414	23.741	1.955	25.697	5.069
Lebanon	3873	412.310	25.565	18.475	44.040	6.636
Lithuania	4347	512.538	8.246	4.484	12.730	3.568
Malaysia	9726	479.859	14.990	0.327	15.318	3.914
Malta	3817	490.172	1.387	1.867	3.254	1.804
Morocco	13035	395.381	4.725	3.658	8.383	2.895
New Zealand	8142	508.286	9.371	0.749	10.120	3.181
Norway (9)	4697	511.721	8.341	1.497	9.838	3.137
Oman	8883	448.825	6.037	2.924	8.961	2.993
Qatar	5403	459.268	10.325	1.190	11.515	3.393
Russian Federation	4780	547.673	16.731	1.070	17.801	4.219
Saudi Arabia	3759	385.479	21.224	7.083	28.307	5.320
Singapore	6116	608.331	9.081	0.604	9.685	3.112
Slovenia	4257	545.414	5.692	2.735	8.427	2.903
South Africa (9)	12514	359.161	28.369	1.617	29.986	5.476

Summary Statistics and Standard Errors for Proficiency in Physics at the Eighth Grade (Continued)

Country	Sample Size	Physics				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Sweden	4090	524.321	11.070	2.782	13.852	3.722
Thailand	6482	437.004	18.773	1.965	20.738	4.554
Turkey	6079	505.665	17.496	0.174	17.670	4.204
United Arab Emirates	18012	474.566	4.126	2.091	6.217	2.493
United States	10221	516.219	7.992	0.479	8.471	2.911
Benchmarking Participants						
Buenos Aires, Argentina	3253	380.540	17.197	10.011	27.208	5.216
Ontario, Canada	4520	521.493	5.961	2.588	8.548	2.924
Quebec, Canada	3950	519.554	18.463	3.755	22.217	4.714
Norway (8)	4795	483.335	5.519	1.310	6.828	2.613
Abu Dhabi, UAE	4838	453.879	25.703	3.014	28.717	5.359
Dubai, UAE	6149	524.872	4.921	0.737	5.658	2.379
Florida, US	2074	497.758	29.588	3.928	33.515	5.789

Summary Statistics and Standard Errors for Proficiency in Earth Science at the Eighth Grade

Country	Sample Size	Earth Science				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	10338	521.842	6.480	1.705	8.185	2.861
Bahrain	4918	460.553	5.988	6.457	12.445	3.528
Botswana (9)	5964	368.400	6.179	3.490	9.669	3.110
Canada	8757	532.425	3.988	1.267	5.255	2.292
Chile	4849	464.041	9.049	1.369	10.418	3.228
Chinese Taipei	5711	580.830	3.804	3.398	7.202	2.684
Egypt	7822	351.216	16.086	4.741	20.827	4.564
England	4814	535.836	15.415	0.656	16.072	4.009
Georgia	4035	419.961	12.058	0.682	12.740	3.569
Hong Kong SAR	4155	557.851	17.518	0.710	18.228	4.269
Hungary	4893	521.301	12.880	2.130	15.010	3.874
Iran, Islamic Rep. of	6130	438.635	17.339	2.790	20.129	4.487
Ireland	4704	541.982	8.410	1.188	9.597	3.098
Israel	5512	492.638	13.934	1.893	15.827	3.978
Italy	4481	514.145	5.825	1.983	7.808	2.794
Japan	4745	573.941	3.372	0.702	4.073	2.018
Jordan	7865	415.842	8.334	0.872	9.206	3.034
Kazakhstan	4887	507.785	24.217	5.113	29.330	5.416
Korea, Rep. of	5309	554.368	4.424	3.073	7.496	2.738
Kuwait	4503	408.392	21.908	3.720	25.629	5.062
Lebanon	3873	365.366	28.284	13.261	41.545	6.446
Lithuania	4347	518.076	9.322	1.411	10.733	3.276
Malaysia	9726	460.456	19.807	0.750	20.557	4.534
Malta	3817	480.902	2.117	4.371	6.488	2.547
Morocco	13035	394.695	3.022	1.687	4.709	2.170
New Zealand	8142	516.666	11.422	1.603	13.025	3.609
Norway (9)	4697	522.678	9.026	2.129	11.155	3.340
Oman	8883	456.212	4.887	1.007	5.894	2.428
Qatar	5403	445.684	10.735	2.911	13.646	3.694
Russian Federation	4780	531.859	18.850	3.185	22.035	4.694
Saudi Arabia	3759	403.099	14.024	4.884	18.908	4.348
Singapore	6116	564.610	10.574	2.600	13.174	3.630
Slovenia	4257	564.497	5.897	2.322	8.219	2.867
South Africa (9)	12514	330.186	38.678	2.605	41.283	6.425

Summary Statistics and Standard Errors for Proficiency in Earth Science at the Eighth Grade (Continued)

Country	Sample Size	Earth Science				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Sweden	4090	531.890	10.760	9.420	20.180	4.492
Thailand	6482	459.171	18.168	2.365	20.532	4.531
Turkey	6079	477.376	13.527	1.480	15.007	3.874
United Arab Emirates	18012	474.829	5.040	0.667	5.707	2.389
United States	10221	534.927	8.518	1.232	9.750	3.122
Benchmarking Participants						
Buenos Aires, Argentina	3253	388.266	23.945	6.267	30.212	5.497
Ontario, Canada	4520	526.285	5.892	4.097	9.989	3.161
Quebec, Canada	3950	542.238	15.380	1.856	17.236	4.152
Norway (8)	4795	505.612	7.364	3.095	10.459	3.234
Abu Dhabi, UAE	4838	453.136	32.202	1.645	33.848	5.818
Dubai, UAE	6149	518.058	4.084	1.030	5.114	2.261
Florida, US	2074	504.699	42.265	2.377	44.642	6.681

Summary Statistics and Standard Errors for Proficiency in Science Knowing at the Eighth Grade

Country	Sample Size	Science Knowing				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	10338	510.277	6.315	0.787	7.102	2.665
Bahrain	4918	461.543	4.330	1.941	6.271	2.504
Botswana (9)	5964	371.265	7.288	5.768	13.056	3.613
Canada	8757	518.051	4.019	1.284	5.303	2.303
Chile	4849	465.793	7.824	2.232	10.055	3.171
Chinese Taipei	5711	589.283	4.763	0.361	5.124	2.264
Egypt	7822	372.065	23.597	2.989	26.586	5.156
England	4814	522.604	14.362	2.327	16.689	4.085
Georgia	4035	452.299	7.787	3.418	11.204	3.347
Hong Kong SAR	4155	547.343	13.247	0.320	13.566	3.683
Hungary	4893	524.878	10.580	2.004	12.584	3.547
Iran, Islamic Rep. of	6130	455.479	17.562	5.058	22.620	4.756
Ireland	4704	523.041	8.089	2.111	10.200	3.194
Israel	5512	502.839	17.368	1.427	18.795	4.335
Italy	4481	504.522	4.440	2.339	6.779	2.604
Japan	4745	567.432	3.294	1.502	4.796	2.190
Jordan	7865	429.839	9.612	1.078	10.690	3.269
Kazakhstan	4887	528.643	29.684	4.466	34.150	5.844
Korea, Rep. of	5309	555.406	5.727	2.527	8.254	2.873
Kuwait	4503	414.748	24.732	2.649	27.381	5.233
Lebanon	3873	402.863	27.232	7.221	34.453	5.870
Lithuania	4347	513.288	6.658	3.025	9.683	3.112
Malaysia	9726	465.501	19.422	6.623	26.045	5.103
Malta	3817	467.620	1.906	2.697	4.603	2.145
Morocco	13035	395.053	4.443	0.832	5.274	2.297
New Zealand	8142	502.935	9.382	0.700	10.082	3.175
Norway (9)	4697	500.460	7.159	2.147	9.307	3.051
Oman	8883	454.641	6.733	1.772	8.505	2.916
Qatar	5403	447.927	9.836	3.404	13.240	3.639
Russian Federation	4780	557.704	21.680	5.756	27.436	5.238
Saudi Arabia	3759	394.906	16.147	8.517	24.665	4.966
Singapore	6116	593.708	10.867	0.531	11.398	3.376
Slovenia	4257	558.152	5.717	1.288	7.005	2.647

Summary Statistics and Standard Errors for Proficiency in Science Knowing at the Eighth Grade (Continued)

Country	Sample Size	Science Knowing				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
South Africa (9)	12514	337.332	36.168	8.084	44.253	6.652
Sweden	4090	519.440	10.338	0.221	10.559	3.249
Thailand	6482	469.375	18.163	0.267	18.430	4.293
Turkey	6079	489.160	18.151	1.736	19.887	4.459
United Arab Emirates	18012	477.869	5.243	1.008	6.250	2.500
United States	10221	531.693	8.558	2.977	11.536	3.396
Benchmarking Participants						
Buenos Aires, Argentina	3253	397.162	16.746	5.872	22.618	4.756
Ontario, Canada	4520	513.913	5.405	1.319	6.724	2.593
Quebec, Canada	3950	526.944	18.001	8.171	26.172	5.116
Norway (8)	4795	477.495	6.820	3.235	10.055	3.171
Abu Dhabi, UAE	4838	452.706	34.466	3.111	37.577	6.130
Dubai, UAE	6149	527.443	4.809	1.364	6.172	2.484
Florida, US	2074	510.677	39.222	8.212	47.434	6.887

Summary Statistics and Standard Errors for Proficiency in Science Applying at the Eighth Grade

Country	Sample Size	Science Applying				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	10338	512.382	7.505	1.144	8.649	2.941
Bahrain	4918	464.206	4.518	1.026	5.544	2.355
Botswana (9)	5964	398.492	5.720	8.458	14.178	3.765
Canada	8757	525.506	3.963	0.657	4.619	2.149
Chile	4849	446.405	8.650	0.432	9.082	3.014
Chinese Taipei	5711	565.329	4.029	0.023	4.052	2.013
Egypt	7822	370.699	16.916	2.340	19.256	4.388
England	4814	538.348	14.569	0.839	15.408	3.925
Georgia	4035	442.193	7.451	2.371	9.822	3.134
Hong Kong SAR	4155	540.635	16.909	1.261	18.170	4.263
Hungary	4893	528.208	10.909	0.853	11.762	3.430
Iran, Islamic Rep. of	6130	457.321	15.148	1.079	16.227	4.028
Ireland	4704	532.615	8.398	0.803	9.201	3.033
Israel	5512	504.069	14.240	0.255	14.495	3.807
Italy	4481	496.404	4.708	0.992	5.700	2.387
Japan	4745	574.583	3.717	0.046	3.763	1.940
Jordan	7865	425.058	10.468	0.748	11.216	3.349
Kazakhstan	4887	535.440	19.436	0.711	20.147	4.489
Korea, Rep. of	5309	552.182	4.400	0.318	4.718	2.172
Kuwait	4503	406.171	26.442	0.836	27.278	5.223
Lebanon	3873	397.995	25.341	2.400	27.741	5.267
Lithuania	4347	516.603	8.238	3.277	11.515	3.393
Malaysia	9726	476.035	17.110	0.176	17.287	4.158
Malta	3817	488.950	1.817	1.291	3.107	1.763
Morocco	13035	391.251	4.479	3.213	7.693	2.774
New Zealand	8142	513.276	10.409	1.580	11.990	3.463
Norway (9)	4697	506.680	7.740	0.961	8.701	2.950
Oman	8883	453.715	6.145	2.510	8.654	2.942
Qatar	5403	459.776	9.241	3.665	12.905	3.592
Russian Federation	4780	538.399	18.675	2.313	20.988	4.581
Saudi Arabia	3759	382.860	22.347	1.825	24.172	4.917
Singapore	6116	599.992	10.857	0.450	11.307	3.363

Summary Statistics and Standard Errors for Proficiency in Science Applying at the Eighth Grade (Continued)

Country	Sample Size	Science Applying				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Slovenia	4257	547.132	4.731	0.355	5.086	2.255
South Africa (9)	12514	368.192	30.701	4.131	34.832	5.902
Sweden	4090	518.311	11.005	1.426	12.432	3.526
Thailand	6482	450.126	19.566	2.706	22.271	4.719
Turkey	6079	492.416	15.112	0.478	15.590	3.948
United Arab Emirates	18012	478.082	5.426	0.482	5.907	2.430
United States	10221	531.305	7.735	0.211	7.945	2.819
Benchmarking Participants						
Buenos Aires, Argentina	3253	379.487	16.323	4.076	20.399	4.517
Ontario, Canada	4520	525.284	5.553	0.241	5.794	2.407
Quebec, Canada	3950	524.383	18.436	2.737	21.173	4.601
Norway (8)	4795	488.010	5.551	1.389	6.940	2.634
Abu Dhabi, UAE	4838	456.756	34.141	0.713	34.854	5.904
Dubai, UAE	6149	525.103	4.064	0.966	5.030	2.243
Florida, US	2074	507.723	32.581	1.261	33.842	5.817

Summary Statistics and Standard Errors for Proficiency in Science Reasoning at the Eighth Grade

Country	Sample Size	Science Reasoning				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Australia	10338	512.502	6.782	1.036	7.818	2.796
Bahrain	4918	466.440	4.026	3.719	7.745	2.783
Botswana (9)	5964	389.532	6.022	0.803	6.826	2.613
Canada	8757	533.268	3.824	1.214	5.038	2.245
Chile	4849	448.496	10.340	2.692	13.032	3.610
Chinese Taipei	5711	560.304	3.352	0.524	3.876	1.969
Egypt	7822	358.937	17.228	6.029	23.257	4.823
England	4814	544.759	14.924	1.130	16.054	4.007
Georgia	4035	432.045	10.254	2.067	12.320	3.510
Hong Kong SAR	4155	550.173	17.366	2.012	19.378	4.402
Hungary	4893	523.833	13.016	1.629	14.644	3.827
Iran, Islamic Rep. of	6130	453.656	15.481	0.817	16.298	4.037
Ireland	4704	532.371	7.643	1.577	9.220	3.036
Israel	5512	510.667	15.799	3.362	19.161	4.377
Italy	4481	493.253	5.995	2.041	8.036	2.835
Japan	4745	570.297	3.800	0.795	4.595	2.144
Jordan	7865	419.446	10.097	2.784	12.881	3.589
Kazakhstan	4887	527.979	17.706	4.288	21.994	4.690
Korea, Rep. of	5309	560.369	4.944	2.857	7.801	2.793
Kuwait	4503	399.697	31.597	1.910	33.507	5.789
Lebanon	3873	381.408	31.156	8.538	39.694	6.300
Lithuania	4347	525.430	8.728	1.279	10.007	3.163
Malaysia	9726	467.218	14.268	0.966	15.233	3.903
Malta	3817	478.850	1.917	0.924	2.841	1.685
Morocco	13035	384.520	4.464	2.487	6.951	2.637
New Zealand	8142	519.563	8.972	1.691	10.663	3.265
Norway (9)	4697	518.288	7.859	1.243	9.101	3.017
Oman	8883	454.380	4.719	1.040	5.759	2.400
Qatar	5403	454.131	8.712	1.268	9.980	3.159
Russian Federation	4780	537.602	13.171	1.843	15.014	3.875
Saudi Arabia	3759	404.689	19.921	1.840	21.761	4.665
Singapore	6116	594.549	9.596	0.611	10.208	3.195

Summary Statistics and Standard Errors for Proficiency in Science Reasoning at the Eighth Grade (Continued)

Country	Sample Size	Science Reasoning				
		Mean Proficiency	Jackknife Sampling Variance	Imputation Variance	Total Variance	Overall Standard Error
Slovenia	4257	550.481	4.953	0.383	5.335	2.310
South Africa (9)	12514	350.432	28.924	2.520	31.444	5.607
Sweden	4090	526.400	13.981	1.822	15.804	3.975
Thailand	6482	447.305	15.927	0.466	16.393	4.049
Turkey	6079	495.298	15.803	2.014	17.817	4.221
United Arab Emirates	18012	473.129	4.836	1.051	5.887	2.426
United States	10221	526.422	7.294	0.494	7.787	2.791
Benchmarking Participants						
Buenos Aires, Argentina	3253	373.143	20.852	2.463	23.315	4.829
Ontario, Canada	4520	532.043	5.324	1.644	6.968	2.640
Quebec, Canada	3950	535.308	18.410	2.044	20.453	4.523
Norway (8)	4795	498.235	5.608	0.172	5.781	2.404
Abu Dhabi, UAE	4838	453.523	29.940	2.964	32.904	5.736
Dubai, UAE	6149	520.652	3.792	0.227	4.018	2.005
Florida, US	2074	505.606	34.480	6.416	40.896	6.395

CHAPTER 5

Sample Implementation in TIMSS 2015

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Overview

Rigorous sampling of schools and students was a key component of the TIMSS 2015 project. Implementing the sampling plan was the responsibility of the National Research Coordinator (NRC) in each participating country. NRCs were supported in this endeavor by the TIMSS 2015 sampling consultants, Statistics Canada, and the Sampling Unit of the IEA Data Processing and Research Center (DPC). Sampling consultants conducted the school sampling for most countries and trained NRCs using the Windows® Within-school Sampling Software (WinW3S) provided by the IEA DPC to implement within-school sampling. As an essential part of their sampling activities, NRCs were responsible for providing detailed documentation describing their national sampling plans (sampling data, school sampling frames, and school sample selections). The documentation for each TIMSS participant was reviewed and completed by the sampling consultants, including detailed information on coverage and exclusion levels, stratification variables, sampling, participation rates, and variance estimates. The TIMSS & PIRLS International Study Center and the TIMSS 2015 Sampling Referee, Dr. Keith Rust of Westat, Inc., used this information to evaluate the quality of the samples.

This chapter gives a summary of the major characteristics of the national samples for TIMSS 2015. More detailed summaries of the sample design for each country, including details of population coverage and exclusions, stratification variables, and schools' sampling allocations, are provided in Appendix 5A Characteristics of National Samples.

Target Population

As described in Chapter 3 (Sample Design), the international target populations for the TIMSS 2015 fourth and eighth grade assessments were defined as the grades that represented 4 and 8 years of formal schooling, respectively, counting from the first year of primary or elementary schooling.

As a new initiative for the TIMSS 2015 cycle, countries could participate in TIMSS Numeracy—a new, less difficult mathematics assessment at the fourth grade. TIMSS Numeracy was designed for countries where students found the TIMSS fourth grade mathematics assessment too difficult. Countries considering TIMSS Numeracy had the option of participating in both TIMSS Numeracy and the TIMSS fourth grade assessment or in TIMSS Numeracy only. For countries who participated in both assessments, the student sample size was doubled and the TIMSS and TIMSS Numeracy booklets were rotated within the sampled classes. Thus, students within sampled classes in these countries were given either a TIMSS booklet or a Numeracy booklet.

Bahrain, Indonesia, the Islamic Republic of Iran, Kuwait, and Morocco, along with the benchmarking participant Buenos Aires, administered both TIMSS and TIMSS Numeracy to their fourth grade students. Jordan administered TIMSS Numeracy only at the fourth grade while South Africa administered the TIMSS Numeracy test at the fifth grade.

Exhibits 5.1 and 5.2 present the grades identified as the target grades for sampling by each country, and include the number of years of formal schooling that the grades represent and the average age of students in the target grades at the time of testing.

For most countries, the target grades did indeed turn out to be the grades with 4 and 8 years of schooling, i.e., fourth and eighth grades, respectively. However, in England, Northern Ireland, and New Zealand, children begin primary school at an early age.[1] Therefore, these countries administered the TIMSS fourth grade assessment in the fifth year of schooling. The TIMSS eighth grade assessment for England and New Zealand was administered in the ninth year of schooling. Norway chose to assess its fifth and ninth grades to obtain better comparisons with Sweden and Finland.

To provide a better match with the demands of the assessments, Botswana and South Africa availed themselves of the option to assess students at a higher grade. South Africa administered the TIMSS Numeracy fourth grade assessment at the fifth grade, and Botswana and South Africa administered the eighth grade assessment at the ninth grade.

1 Given the cognitive demands of the assessments, TIMSS wants to avoid assessing very young students. Thus, TIMSS recommends assessing the next higher grade (i.e., fifth grade for fourth grade TIMSS and ninth grade for eighth grade TIMSS) if, for fourth grade students, the average age at the time of testing would be less than 9.5 years and, for eighth grade students, less than 13.5 years.

Exhibit 5.1: National Grade Definition – TIMSS 2015 – Fourth Grade

Country	Country's Name for Grade Tested	Years of Formal Schooling	Average Age at Time of Testing
Australia	Year 4	4	10.0
Bahrain	Grade 4	4	9.9
Belgium (Flemish)	Grade 4	4	10.1
Bulgaria	Grade 4	4	10.8
Canada	Grade 4	4	9.9
Chile	Basic 4	4	10.2
Chinese Taipei	Grade 4	4	10.2
Croatia	Grade 4	4	10.6
Cyprus	Grade 4	4	9.8
Czech Republic	Grade 4	4	10.4
Denmark	Grade 4	4	10.9
England	Year 5	5	10.1
Finland	Grade 4	4	10.8
France	CM1	4	9.9
Georgia	Grade 4	4	9.7
Germany	Grade 4	4	10.4
Hong Kong SAR	Primary 4	4	10.1
Hungary	Grade 4	4	10.7
Indonesia	Grade 4	4	10.4
Iran, Islamic Rep. of	Grade 4	4	10.2
Ireland	Fourth Class	4	10.4
Italy	Primary Grade 4	4	9.7
Japan	Grade 4	4	10.5
Jordan	Grade 4	4	9.8
Kazakhstan	Grade 4	4	10.3
Korea, Rep. of	Elementary School Grade 4	4	10.5
Kuwait	Grade 4	4	9.7
Lithuania	Grade 4	4	10.7
Morocco	Grade 4	4	10.3
Netherlands	Group 6	4	10.0
New Zealand	Year 5	4	10.0
Northern Ireland	Year 6	4	10.4
Norway (5)	Grade 5	5	10.7
Oman	Grade 4	4	9.6

Exhibit 5.1: National Grade Definition – TIMSS 2015 – Fourth Grade (Continued)

Country	Country's Name for Grade Tested	Years of Formal Schooling	Average Age at Time of Testing
Poland	Grade 4	4	10.7
Portugal	Grade 4	4	9.9
Qatar	Grade 4	4	10.1
Russian Federation	Grade 4	4	10.8
Saudi Arabia	Grade 4	4	10.0
Serbia	Grade 4	4	10.7
Singapore	Primary 4	4	10.4
Slovak Republic	Grade 4	4	10.4
Slovenia	Grade 4	4	9.8
South Africa (5)	Grade 5	5	11.5
Spain	Grade 4	4	9.9
Sweden	Grade 4	4	10.8
Turkey	Grade 4	4	9.9
United Arab Emirates	Grade 4	4	9.8
United States	Grade 4	4	10.2
Benchmarking Participants			
Buenos Aires, Argentina	Grade 4	4	9.8
Ontario, Canada	Grade 4	4	9.8
Quebec, Canada	Grade 4	4	10.1
Norway (4)	Grade 4	4	9.7
Abu Dhabi, UAE	Grade 4	4	9.8
Dubai, UAE	Grade 4	4	9.8
Florida, US	Grade 4	4	10.4

Exhibit 5.2: National Grade Definition – TIMSS 2015 – Eighth Grade

Country	Country's Name for Grade Tested	Years of Formal Schooling	Average Age at Time of Testing
Australia	Year 8	8	14.0
Bahrain	Grade 8	8	14.0
Botswana (9)	Grade 9	9	15.6
Canada	Grade 8	8	14.0
Chile	Basic 8	8	14.3
Chinese Taipei	Grade 8	8	14.3
Egypt	Second Preparatory	8	14.1
England	Year 9	9	14.1
Georgia	Grade 8	8	13.7
Hong Kong SAR	Secondary 2	8	14.2
Hungary	Grade 8	8	14.7
Iran, Islamic Rep. of	Grade 8	8	14.2
Ireland	Second Year	8	14.4
Israel	Grade 8	8	14.0
Italy	Lower Secondary Grade 3	8	13.8
Japan	Grade 8	8	14.5
Jordan	Grade 8	8	13.8
Kazakhstan	Grade 8	8	14.3
Korea, Rep. of	Middle School Grade 2	8	14.4
Kuwait	Grade 8	8	13.7
Lebanon	Grade 8	8	14.2
Lithuania	Grade 8	8	14.7
Malaysia	Form 2	8	14.3
Malta	Year 9	8	13.8
Morocco	Middle School Year 2	8	14.5
New Zealand	Year 9	8	14.1
Norway (9)	Grade 9	9	14.7
Oman	Grade 8	8	14.0
Qatar	Grade 8	8	14.1
Russian Federation	Grade 8	8	14.7
Saudi Arabia	Grade 8	8	14.1
Singapore	Secondary 2	8	14.4
Slovenia	Grade 8	8	13.8
South Africa (9)	Grade 9	9	15.7

Exhibit 5.2: National Grade Definition – TIMSS 2015 – Eighth Grade (Continued)

Country	Country's Name for Grade Tested	Years of Formal Schooling	Average Age at Time of Testing
Sweden	Grade 8	8	14.7
Thailand	Grade 8	8	14.4
Turkey	Grade 8	8	13.9
United Arab Emirates	Grade 8	8	13.9
United States	Grade 8	8	14.2
Benchmarking Participants			
Buenos Aires, Argentina	Secondary 1	8	14.1
Ontario, Canada	Grade 8	8	13.8
Quebec, Canada	Secondary 2	8	14.3
Norway (8)	Grade 8	8	13.7
Abu Dhabi, UAE	Grade 8	8	13.9
Dubai, UAE	Grade 8	8	13.9
Florida, US	Grade 8	8	14.4

National Coverage and Exclusions

Exhibits 5.3 and 5.4 summarize population coverage and exclusions for the TIMSS 2015 target populations.

Coverage

National coverage of the international target population was generally comprehensive, with some exceptions. At the fourth grade, these exceptions included Canada (assessed students only from the provinces of Alberta, Manitoba, Newfoundland, Ontario and Quebec) and Georgia (assessed only students taught in Georgian), together with the benchmarking state of Florida from the United States (assessed students only in public schools). These participants chose a national target population that was less than the international target population. At the eighth grade, all countries except Canada (assessed students only from the provinces of Manitoba, Newfoundland, Ontario and Quebec) and Georgia (assessed only students taught in Georgian), as well as the benchmarking state of Florida (only students from public schools) sampled from 100 percent of their international desired population. For the exceptions where coverage was below 100 percent, the results were footnoted in the TIMSS 2015 international reports.

School–Level and Student–Level Exclusions

Within the national target population, it was possible to exclude certain types of schools and students. For the most part, school-level exclusions consisted of schools for students with disabilities and very small or remote schools. Occasionally, schools were excluded for other reasons, as documented in Appendix 5A Characteristics of National Samples.

Student-level, or within-school, exclusions generally consisted of students with disabilities or students who could not be assessed in the language of the test. For most participants, the overall percentage of excluded students (combining school and within-school levels) was 5 percent or less after rounding. However, at the fourth grade, Bahrain, Canada, Denmark, Italy, Lithuania, Portugal, Singapore, Spain, Sweden, United States, and Abu Dhabi had exclusions accounting for between 5 and 10 percent of the desired population, and only Serbia had exclusions exceeding 10 percent. At the eighth grade, Georgia, Italy, Lithuania, and Singapore had exclusions accounting for between 5 and 10 percent of the national target population. Only Israel had exclusions exceeding 10 percent.

Results for participants with an exclusion rate of more than 5 percent were annotated in the international reports. Note that some TIMSS 2015 participants had no within-school exclusions.

Exhibit 5.3: Coverage of TIMSS 2015 – Fourth Grade Target Population

Country	Coverage	Notes on Coverage	Exclusions from National Target Population		
			School-Level Exclusions	Within-Sample Exclusions	Overall Exclusions
Australia	100%		2.1%	2.1%	4.2%
[2] Bahrain	100%		0.4%	5.1%	5.6%
Belgium (Flemish)	100%		0.2%	1.2%	1.4%
Bulgaria	100%		1.2%	1.7%	2.9%
[1 2] Canada	79%	Students from the provinces of Alberta, Manitoba, Newfoundland, Ontario, and Quebec	2.5%	3.6%	6.1%
Chile	100%		1.9%	1.8%	3.7%
Chinese Taipei	100%		0.1%	2.3%	2.4%
Croatia	100%		1.5%	2.9%	4.4%
Cyprus	100%		1.0%	3.6%	4.6%
Czech Republic	100%		3.5%	0.7%	4.2%
[2] Denmark	100%		0.9%	6.6%	7.5%
England	100%		2.1%	0.2%	2.3%
Finland	100%		1.3%	0.7%	2.0%
France	100%		4.7%	0.6%	5.3%
[1] Georgia	90%	Students taught in Georgian	2.1%	2.7%	4.9%
Germany	100%		1.4%	1.3%	2.7%
Hong Kong SAR	100%		1.1%	1.1%	2.2%
Hungary	100%		2.3%	2.5%	4.8%
Indonesia	100%		0.2%	0.0%	0.2%
Iran, Islamic Rep. of	100%		3.9%	0.0%	4.0%
Ireland	100%		1.7%	1.0%	2.7%
[2] Italy	100%		0.9%	5.3%	6.2%
Japan	100%		0.6%	2.4%	2.9%
Jordan	100%		0.0%	1.2%	1.2%
Kazakhstan	100%		3.5%	0.4%	3.9%
Korea, Rep. of	100%		1.2%	1.3%	2.5%
Kuwait	100%		2.5%	0.5%	3.0%
Lithuania	100%		2.5%	3.6%	6.1%
Morocco	100%		1.5%	0.0%	1.5%
Netherlands	100%		2.4%	0.8%	3.2%

1 National Target Population does not include all of the International Target Population.

2 National Defined Population covers 90% to 95% of the National Target Population.

3 National Defined Population covers less than 90% of the National Target population (but at least 77%).

Exhibit 5.3: Coverage of TIMSS 2015 – Fourth Grade Target Population (Continued)

Country	Coverage	Notes on Coverage	Exclusions from National Target Population		
			School-Level Exclusions	Within-Sample Exclusions	Overall Exclusions
New Zealand	100%		2.8%	2.1%	4.8%
Northern Ireland	100%		2.6%	0.1%	2.7%
Norway (5)	100%		1.1%	3.6%	4.7%
Oman	100%		0.1%	0.7%	0.8%
Poland	100%		1.4%	2.6%	4.0%
[2] Portugal	100%		1.0%	5.5%	6.5%
Qatar	100%		1.6%	2.2%	3.8%
Russian Federation	100%		1.9%	2.0%	4.0%
Saudi Arabia	100%		1.9%	0.0%	1.9%
[3] Serbia	100%		5.0%	6.3%	11.3%
[2] Singapore	100%		10.1%	0.0%	10.1%
Slovak Republic	100%		3.2%	1.0%	4.2%
Slovenia	100%		2.9%	1.6%	4.5%
South Africa (5)	100%		1.6%	0.6%	2.2%
[2] Spain	100%		1.6%	4.1%	5.6%
[2] Sweden	100%		1.7%	4.0%	5.7%
Turkey	100%		2.2%	1.4%	3.6%
United Arab Emirates	100%		2.0%	2.7%	4.7%
[2] United States	100%		0.0%	6.8%	6.8%
Benchmarking Participants					
Buenos Aires, Argentina	100%		1.7%	0.2%	1.9%
Ontario, Canada	100%		2.2%	1.3%	3.4%
Quebec, Canada	100%		3.2%	2.2%	5.4%
Norway (4)	100%		1.5%	3.5%	5.0%
[2] Abu Dhabi, UAE	100%		1.5%	4.3%	5.8%
Dubai, UAE	100%		3.3%	2.0%	5.3%
[1] Florida, US	90%	Students from public schools	0.0%	4.7%	4.7%

Exhibit 5.4: Coverage of TIMSS 2015 – Eighth Grade Target Population

Country	Coverage	Notes on Coverage	Exclusions from National Target Population		
			School-Level Exclusions	Within-Sample Exclusions	Overall Exclusions
Australia	100%		1.3%	2.2%	3.5%
Bahrain	100%		0.3%	3.5%	3.8%
Botswana (9)	100%		0.0%	0.3%	0.3%
[1] Canada	67%	Students from the provinces of Manitoba, Newfoundland, Ontario, and Quebec	2.5%	2.4%	4.8%
Chile	100%		1.4%	0.5%	1.9%
Chinese Taipei	100%		0.1%	1.6%	1.7%
Egypt	100%		0.1%	0.0%	0.1%
England	100%		2.3%	0.0%	2.3%
[1 2] Georgia	90%	Students taught in Georgian	2.3%	3.7%	6.0%
Hong Kong SAR	100%		1.3%	0.4%	1.6%
Hungary	100%		2.6%	2.9%	5.4%
Iran, Islamic Rep. of	100%		0.5%	1.7%	2.2%
Ireland	100%		0.3%	0.9%	1.2%
[3] Israel	100%		17.6%	5.3%	22.8%
[2] Italy	100%		0.8%	5.3%	6.1%
Japan	100%		0.8%	1.5%	2.3%
Jordan	100%		0.0%	1.0%	1.0%
Kazakhstan	100%		3.0%	0.8%	3.8%
Korea, Rep. of	100%		1.2%	0.9%	2.1%
Kuwait	100%		2.8%	0.5%	3.3%
Lebanon	100%		1.3%	0.0%	1.3%
[2] Lithuania	100%		3.9%	3.0%	7.0%
Malaysia	100%		1.1%	3.2%	4.3%
Malta	100%		1.9%	1.6%	3.5%
Morocco	100%		0.0%	0.0%	0.0%
New Zealand	100%		1.6%	1.5%	3.1%
Norway (9)	100%		1.0%	2.7%	3.7%
Oman	100%		0.1%	0.3%	0.4%
Qatar	100%		1.7%	1.5%	3.2%
Russian Federation	100%		2.3%	1.4%	3.7%

1 National Target Population does not include all of the International Target Population.

2 National Defined Population covers 90% to 95% of the National Target Population.

3 National Defined Population covers less than 90% of the National Target population (but at least 77%).

Exhibit 5.4: Coverage of TIMSS 2015 – Eighth Grade Target Population (Continued)

Country	Coverage	Notes on Coverage	Exclusions from National Target Population		
			School-Level Exclusions	Within-Sample Exclusions	Overall Exclusions
Saudi Arabia	100%		1.9%	0.2%	2.1%
[2] Singapore	100%		7.0%	0.0%	7.0%
Slovenia	100%		2.1%	1.7%	3.8%
South Africa (9)	100%		1.5%	0.0%	1.5%
Sweden	100%		1.8%	3.6%	5.5%
Thailand	100%		0.2%	0.0%	0.2%
Turkey	100%		0.2%	1.1%	1.3%
United Arab Emirates	100%		2.2%	1.5%	3.6%
United States	100%		0.0%	5.1%	5.1%
Benchmarking Participants					
Buenos Aires, Argentina	100%		2.7%	0.0%	2.7%
Ontario, Canada	100%		1.8%	0.8%	2.5%
Quebec, Canada	100%		3.6%	1.7%	5.3%
Norway (8)	100%		1.4%	2.7%	4.1%
Abu Dhabi, UAE	100%		1.8%	2.3%	4.1%
Dubai, UAE	100%		3.6%	1.6%	5.2%
[1] Florida, US	90%	Students from public schools	0.0%	2.8%	2.8%

Target Population Size

Exhibits 5.5 and 5.6 show the number of schools and students in each participant's target population[2] and sample, as well as an estimate of the student population size based on the sample data. The target population figures are derived from the sampling frame used to select the TIMSS 2015 samples, while the sample figures are based on the number of sampled schools and students that participated in the assessments. The sample figures were computed using sampling weights, which are explained in more detail in Chapter 3. The student population size based on the sampling frame did not take into account the portion of the population excluded within sampled schools and made no adjustment for changes in the population between the date when the information in the sampling frame was collected and the date of the TIMSS 2015 data collection—usually a 2-year interval. Nevertheless, a comparison of the two estimates of population size can be seen as a validity check on the sampling procedure. In most cases, the population size estimated from the sample closely matched the population size from the sampling frame.

2 After school-level exclusions.

Exhibit 5.5: Population and Sample Sizes – TIMSS 2015 – Fourth Grade

Country	Population		Sample		
	Schools	Students	Schools	Students	Student Population Size Estimated From Sample
Australia	6,521	266,439	287	6,057	279,017
Bahrain (Combined)	182	17,585	182	8,575	17,060
Numeracy	182	17,585	182	4,429	17,060
TIMSS	182	17,585	182	4,146	17,060
Belgium (Flemish)	2,428	68,710	153	5,404	70,742
Bulgaria	1,746	60,944	149	4,228	60,747
Canada	9,668	274,226	441	12,283	282,798
Chile	6,034	230,143	179	4,756	224,998
Chinese Taipei	2,665	208,837	150	4,291	206,440
Croatia	1,677	39,944	163	3,985	38,857
Cyprus	273	8,254	148	4,125	8,096
Czech Republic	3,315	90,924	159	5,202	91,936
Denmark	1,716	64,407	193	3,710	62,667
England	15,226	593,519	147	4,006	586,515
Finland	2,327	57,292	158	5,015	58,038
France	31,577	776,184	164	4,873	749,763
Georgia	1,867	45,262	153	3,919	44,177
Germany	17,901	719,596	204	3,948	690,264
Hong Kong SAR	556	50,321	132	3,600	53,297
Hungary	2,913	91,463	144	5,036	87,402
Indonesia (Combined)	163,956	4,581,758	230	8,319	4,650,483
Numeracy	163,956	4,581,758	230	4,294	4,650,483
TIMSS	163,956	4,581,758	230	4,025	4,650,483
Iran, Islamic Rep. of (Combined)	36,817	1,120,197	248	7,928	1,100,939
Numeracy	36,817	1,120,197	248	4,105	1,100,939
TIMSS	36,817	1,120,197	248	3,823	1,100,939
Ireland	2,615	63,188	149	4,344	60,649
Italy	6,776	538,762	164	4,373	533,803
Japan	19,247	1,072,994	148	4,383	1,086,905
Jordan	3,108	145,847	254	7,861	149,855
Kazakhstan	6,149	248,263	171	4,702	254,335
Korea, Rep. of	5,366	468,264	149	4,669	433,071
Kuwait (Combined)	375	48,346	166	7,296	49,926
Numeracy	375	48,346	166	3,703	49,926
TIMSS	375	48,346	166	3,593	49,926
Lithuania	843	26,375	225	4,529	25,271

Exhibit 5.5: Population and Sample Sizes – TIMSS 2015 – Fourth Grade (Continued)

Country	Population		Sample		
	Schools	Students	Schools	Students	Student Population Size Estimated From Sample
Morocco (Combined)	19,016	654,179	358	10,428	616,709
Numeracy	19,016	654,179	358	5,360	616,709
TIMSS	19,016	654,179	358	5,068	616,709
Netherlands	6,361	179,849	129	4,515	173,514
New Zealand	1,706	54,981	174	6,322	55,399
Northern Ireland	765	21,908	118	3,116	21,901
Norway (5)	2,096	57,969	140	4,329	62,765
Oman	669	55,181	300	9,105	55,015
Poland	11,473	368,742	150	4,747	371,667
Portugal	1,228	101,911	217	4,693	98,922
Qatar	193	17,058	211	5,194	19,332
Russian Federation	34,223	1,323,268	208	4,921	1,487,552
Saudi Arabia	11,999	417,369	189	4,337	425,052
Serbia	2,128	69,012	160	4,036	68,773
Singapore	179	38,907	179	6,517	38,900
Slovak Republic	2,008	50,328	198	5,773	48,639
Slovenia	445	18,106	148	4,445	18,116
South Africa (5)	16,194	924,392	297	10,932	879,295
Spain	12,721	472,772	358	7,764	450,806
Sweden	3,318	100,313	144	4,142	106,407
Turkey	21,154	1,189,025	242	6,456	1,125,123
United Arab Emirates	696	74,930	558	21,177	73,524
United States	70,852	4,090,015	250	10,029	4,030,600
Benchmarking Participants					
Buenos Aires, Argentina (Combined)	875	38,808	136	6,435	40,944
Numeracy	875	38,808	136	3,331	40,944
TIMSS	875	38,808	136	3,104	40,944
Ontario, Canada	3,632	138,410	151	4,574	136,030
Quebec, Canada	1,711	75,049	121	2,798	73,815
Norway (4)	2,092	59,991	139	4,164	61,621
Abu Dhabi, UAE	274	28,732	163	5,001	25,666
Dubai, UAE	150	18,999	168	7,453	20,478
Florida, US	2,185	204,187	53	2,025	182,105

Exhibit 5.6: Population and Sample Sizes – TIMSS 2015 – Eighth Grade

Country	Population		Sample		
	Schools	Students	Schools	Students	Student Population Size Estimated From Sample
Australia	2,436	272,115	285	10,338	272,398
Bahrain	105	15,336	105	4,918	14,998
Botswana (9)	224	42,095	159	5,964	41,380
Canada	5,859	245,268	276	8,757	234,893
Chile	5,390	240,740	171	4,849	243,113
Chinese Taipei	931	285,714	190	5,711	271,222
Egypt	9,900	1,300,305	211	7,822	1,341,003
England	3,757	576,504	143	4,814	560,156
Georgia	1,875	41,438	153	4,035	40,519
Hong Kong SAR	477	63,863	133	4,155	59,469
Hungary	2,754	88,395	144	4,893	87,594
Iran, Islamic Rep. of	22,165	997,271	250	6,130	977,286
Ireland	676	60,164	149	4,704	59,081
Israel	918	106,703	200	5,512	102,333
Italy	5,718	554,401	161	4,481	558,617
Japan	10,406	1,162,528	147	4,745	1,162,235
Jordan	2,268	127,653	252	7,865	125,836
Kazakhstan	5,940	221,282	172	4,887	233,323
Korea, Rep. of	3,007	587,190	150	5,309	572,724
Kuwait	327	39,997	168	4,503	39,075
Lebanon	1,635	62,121	138	3,873	59,458
Lithuania	756	31,591	208	4,347	28,149
Malaysia	2,517	440,173	207	9,726	461,892
Malta	48	4,004	48	3,817	4,048
Morocco	2,692	542,288	345	13,035	450,200
New Zealand	435	58,060	145	8,142	56,774
Norway (9)	1,006	61,397	143	4,697	61,140
Oman	764	49,193	301	8,883	46,615
Qatar	124	13,899	131	5,403	15,895
Russian Federation	33,201	1,200,240	204	4,780	1,275,748
Saudi Arabia	7,343	402,639	143	3,759	369,233
Singapore	167	47,626	167	6,116	47,596
Slovenia	445	17,499	148	4,257	17,362
South Africa (9)	9,214	1,081,982	292	12,514	869,406

Exhibit 5.6: Population and Sample Sizes – TIMSS 2015 – Eighth Grade (Continued)

Country	Population		Sample		
	Schools	Students	Schools	Students	Student Population Size Estimated From Sample
Sweden	1,616	95,438	150	4,090	100,540
Thailand	11,242	793,160	204	6,482	672,730
Turkey	15,583	1,298,955	218	6,079	1,201,185
United Arab Emirates	590	57,085	477	18,012	58,200
United States	46,207	4,032,863	246	10,221	3,852,939
Benchmarking Participants					
Buenos Aires, Argentina	481	44,480	128	3,253	42,018
Ontario, Canada	2,877	145,721	138	4,520	139,780
Quebec, Canada	557	80,197	122	3,950	74,422
Norway (8)	1,000	61,174	142	4,795	60,115
Abu Dhabi, UAE	237	22,018	156	4,838	21,677
Dubai, UAE	137	14,628	135	6,149	16,440
Florida, US	1,175	202,092	53	2,074	193,681

Meeting TIMSS 2015 Standards for Sampling Participation

TIMSS 2015 participants understood that the goal for sampling participation was 100 percent for all sampled schools, classrooms, and students. Guidelines for reporting achievement data for participants securing less than full participation were modeled after IEA's previous TIMSS assessment cycles. As summarized below in Exhibit 5.7, countries were assigned to one of three categories on the basis of their sampling participation. Countries in Category 1 were considered to have met all TIMSS 2015 sampling requirements and to have acceptable participation rates. Countries in Category 2 met the participation requirements only after including replacement schools. Countries that failed to meet the participation requirements even with the use of replacement schools were assigned to Category 3. One of the main goals for quality data in TIMSS 2015 was to have as many countries as possible achieve Category 1 status.

Exhibit 5.7: Categories of Sampling Participation

Category 1	Acceptable sampling participation rate **without** the use of replacement schools. In order to be placed in this category, a country had to have: • An **unweighted** school response rate **without** replacement of at least 85% (after rounding to nearest whole percent) AND an **unweighted** student response rate (after rounding) of at least 85% OR • A **weighted** school response rate **without** replacement of at least 85% (after rounding to nearest whole percent) AND a **weighted** student response rate (after rounding) of at least 85% OR • The product of the (unrounded) **weighted** school response rate **without** replacement and the (unrounded) **weighted** student response rate of at least 75% (after rounding to the nearest whole percent). Countries in this category would appear in the tables and figures in international reports without annotation, and will be ordered by achievement as appropriate.
Category 2	Acceptable sampling participation rate **only when replacement schools are included**. A country would be placed in this category 2 if: • It failed to meet the requirements for Category 1 but had a weighted school response rate **without** replacement of at least 50% (after rounding to the nearest percent) AND HAD EITHER • A **weighted** school response rate **with** replacement of at least 85% (after rounding to nearest whole percent) AND a **weighted** student response rate (after rounding) of at least 85% OR • The product of the (unrounded) **weighted** school response rate **with** replacement and the (unrounded) **weighted** student response rate of at least 75% (after rounding to the nearest whole percent). Countries in this category would be annotated with a "†" in the tables and figures in international reports, and ordered by achievement as appropriate.
Category 3	Unacceptable sampling response rate even when replacement schools are included. Countries that could provide documentation to show that they complied with TIMSS sampling procedures and requirements but did not meet the requirements for Category 1 or Category 2 would be placed in Category 3. Countries in this category would be annotated with a "‡" if they nearly met the requirements for Category 2. Countries would be annotated with a "‡" if they failed to meet the participation requirements but had a school participation rate of at least 50% before the use of replacement schools. At last, if none of these conditions are met, countries would appear in a separate section of the achievement tables, below the other countries, in international reports. These countries would be presented in alphabetical order.

Exhibits 5.8 through 5.11 present the school, classroom, student, and overall weighted and unweighted participation rates for each of the participants in the TIMSS 2015 fourth and eighth grade assessments, respectively. Almost all participants had excellent participation rates and belonged in Category 1. At the fourth grade, Belgium (Flemish), Canada, Denmark, Hong Kong, The Netherlands, and the United States achieved the minimum acceptable participation rate only after including replacement schools, and therefore their results were annotated with a dagger (†)

in the achievement exhibits of the international reports (Category 2). Despite efforts to secure full participation, Northern Ireland's overall participation at 71 percent fell below the minimum requirement of 75 percent, even after using replacement schools. Results for Northern Ireland in the international reports were annotated with a double-dagger (‡), indicating that they nearly satisfied the guidelines for sample participation.

At the eighth grade, Canada, New Zealand, the United States, and the benchmarking participant of Buenos Aires, Argentina, achieved the minimum acceptable participation rates only after including replacement schools, and therefore their results were annotated with a dagger (†) in the achievement exhibits of the international reports (Category 2).

Finally, the benchmarking participant of Quebec, Canada, did not meet the required sampling participation rate at the fourth and eighth grades, even with the use of replacement schools and were annotated with a triple-dagger (‡) in the achievement exhibits of the international reports (Category 3).

Exhibit 5.8: Participation Rates (Weighted) – TIMSS 2015 - Fourth Grade

Country	School Participation		Class Participation	Student Participation	Overall Participation	
	Before Replacement	After Replacement			Before Replacement	After Replacement
Australia	98%	99%	100%	95%	94%	94%
Bahrain (Combined)	100%	100%	100%	99%	99%	99%
Numeracy	100%	100%	100%	99%	99%	99%
TIMSS	100%	100%	100%	99%	99%	99%
† Belgium (Flemish)	74%	97%	100%	98%	73%	95%
Bulgaria	97%	97%	100%	96%	93%	93%
† Canada	80%	86%	99%	94%	74%	80%
Chile	87%	94%	100%	94%	82%	88%
Chinese Taipei	99%	100%	100%	99%	98%	99%
Croatia	99%	100%	99%	95%	93%	94%
Cyprus	100%	100%	100%	98%	98%	98%
Czech Republic	100%	100%	100%	95%	95%	95%
† Denmark	53%	91%	100%	95%	50%	86%
England	95%	98%	100%	98%	92%	96%
Finland	99%	100%	100%	97%	95%	97%
France	96%	99%	100%	98%	93%	97%
Georgia	99%	100%	100%	98%	97%	98%
Germany	97%	99%	100%	96%	93%	95%
† Hong Kong SAR	76%	82%	100%	93%	70%	76%
Hungary	99%	99%	100%	97%	96%	96%
Indonesia (Combined)	100%	100%	100%	99%	99%	99%
Numeracy	100%	100%	100%	99%	99%	99%
TIMSS	100%	100%	100%	99%	99%	99%
Iran, Islamic Rep. of (Combined)	100%	100%	100%	99%	99%	99%
Numeracy	100%	100%	100%	99%	99%	99%
TIMSS	100%	100%	100%	99%	99%	99%
Ireland	100%	100%	100%	96%	96%	96%
Italy	80%	99%	99%	95%	75%	94%
Japan	96%	99%	100%	98%	94%	97%
Jordan	100%	100%	100%	96%	96%	96%
Kazakhstan	97%	99%	100%	98%	95%	97%
Korea, Rep. of	100%	100%	100%	97%	97%	97%

TIMSS guidelines for sampling participation: The minimum acceptable participation rates were 85 percent of both schools and students, or a combined rate (the product of school and student participation) of 75 percent. Participants not meeting these guidelines were annotated as follows:

† Met guidelines for sample participation rates only after replacement schools were included.

‡ Nearly satisfied guidelines for sample participation rates after replacement schools were included.

‡ Did not satisfy guidelines for sample participation rates.

Exhibit 5.8: Participation Rates (Weighted) – TIMSS 2015 - Fourth Grade (Continued)

Country	School Participation		Class Participation	Student Participation	Overall Participation	
	Before Replacement	After Replacement			Before Replacement	After Replacement
Kuwait (Combined)	94%	94%	100%	96%	90%	90%
Numeracy	94%	94%	100%	95%	89%	89%
TIMSS	94%	94%	100%	97%	90%	90%
Lithuania	99%	100%	100%	94%	93%	94%
Morocco (Combined)	100%	100%	100%	99%	99%	99%
Numeracy	100%	100%	100%	98%	98%	98%
TIMSS	100%	100%	100%	99%	99%	99%
† Netherlands	48%	87%	100%	96%	46%	83%
New Zealand	81%	96%	100%	94%	76%	90%
‡ Northern Ireland	65%	76%	100%	93%	60%	71%
Norway (5)	93%	93%	100%	95%	89%	89%
Oman	97%	98%	100%	99%	96%	97%
Poland	91%	100%	100%	92%	84%	92%
Portugal	89%	99%	100%	93%	83%	92%
Qatar	100%	100%	100%	99%	99%	99%
Russian Federation	100%	100%	100%	98%	98%	98%
Saudi Arabia	95%	100%	100%	93%	88%	93%
Serbia	99%	100%	100%	96%	95%	96%
Singapore	100%	100%	100%	96%	96%	96%
Slovak Republic	98%	100%	100%	97%	95%	97%
Slovenia	96%	99%	100%	95%	91%	93%
South Africa (5)	99%	100%	100%	98%	98%	98%
Spain	98%	99%	100%	96%	95%	95%
Sweden	100%	100%	100%	95%	95%	95%
Turkey	100%	100%	100%	98%	98%	98%
United Arab Emirates	100%	100%	100%	97%	97%	97%
† United States	77%	85%	100%	96%	74%	81%
Benchmarking Participants						
Buenos Aires, Argentina (Combined)	86%	91%	93%	93%	74%	79%
Numeracy	86%	91%	93%	93%	74%	79%
TIMSS	86%	91%	93%	93%	75%	79%
Ontario, Canada	95%	95%	100%	95%	90%	90%
‡ Quebec, Canada	48%	62%	100%	95%	46%	59%
Norway (4)	94%	94%	100%	95%	89%	89%
Abu Dhabi, UAE	100%	100%	100%	97%	97%	97%
Dubai, UAE	100%	100%	100%	97%	97%	97%
Florida, US	100%	100%	100%	95%	95%	95%

Exhibit 5.9: Participation Rates (Weighted) – TIMSS 2015 – Eighth Grade

Country	School Participation		Class Participation	Student Participation	Overall Participation	
	Before Replacement	After Replacement			Before Replacement	After Replacement
Australia	99%	99%	99%	91%	90%	90%
Bahrain	100%	100%	100%	97%	97%	97%
Botswana (9)	100%	100%	100%	98%	98%	98%
† Canada	80%	85%	99%	93%	73%	78%
Chile	85%	92%	100%	93%	79%	85%
Chinese Taipei	100%	100%	100%	98%	98%	98%
Egypt	95%	100%	100%	91%	87%	91%
England	91%	97%	100%	95%	87%	92%
Georgia	99%	100%	100%	98%	97%	98%
Hong Kong SAR	78%	84%	100%	96%	74%	81%
Hungary	96%	99%	100%	97%	93%	96%
Iran, Islamic Rep. of	100%	100%	100%	98%	98%	98%
Ireland	99%	99%	100%	92%	91%	91%
Israel	91%	100%	100%	93%	84%	93%
Italy	78%	98%	100%	95%	74%	93%
Japan	95%	99%	100%	95%	90%	93%
Jordan	100%	100%	100%	96%	96%	96%
Kazakhstan	97%	99%	100%	98%	95%	97%
Korea, Rep. of	100%	100%	100%	98%	98%	98%
Kuwait	94%	94%	100%	90%	85%	85%
Lebanon	77%	92%	100%	96%	74%	88%
Lithuania	99%	100%	100%	93%	92%	93%
Malaysia	100%	100%	100%	98%	98%	98%
Malta	100%	100%	100%	96%	96%	96%
Morocco	100%	100%	100%	95%	95%	95%
† New Zealand	76%	90%	100%	90%	68%	81%
Norway (9)	96%	96%	100%	91%	87%	87%
Oman	97%	97%	100%	99%	96%	96%
Qatar	98%	98%	100%	98%	96%	96%
Russian Federation	100%	100%	100%	97%	97%	97%
Saudi Arabia	98%	100%	100%	97%	95%	97%
Singapore	100%	100%	100%	97%	97%	97%

TIMSS guidelines for sampling participation: The minimum acceptable participation rates were 85 percent of both schools and students, or a combined rate (the product of school and student participation) of 75 percent. Participants not meeting these guidelines were annotated as follows:

† Met guidelines for sample participation rates only after replacement schools were included.

‡ Nearly satisfied guidelines for sample participation rates after replacement schools were included.

‡ Did not satisfy guidelines for sample participation rates.

Exhibit 5.9: Participation Rates (Weighted) – TIMSS 2015 – Eighth Grade (Continued)

Country	School Participation		Class Participation	Student Participation	Overall Participation	
	Before Replacement	After Replacement			Before Replacement	After Replacement
Slovenia	96%	99%	100%	94%	89%	92%
South Africa (9)	98%	100%	100%	96%	94%	96%
Sweden	97%	100%	100%	94%	91%	94%
Thailand	98%	100%	100%	99%	96%	99%
Turkey	100%	100%	100%	98%	98%	98%
United Arab Emirates	100%	100%	100%	97%	97%	97%
† United States	78%	84%	99%	94%	73%	78%
Benchmarking Participants						
† Buenos Aires, Argentina	81%	85%	98%	85%	68%	71%
Ontario, Canada	93%	94%	99%	93%	85%	87%
‡ Quebec, Canada	50%	63%	99%	92%	46%	58%
Norway (8)	95%	95%	100%	93%	87%	87%
Abu Dhabi, UAE	100%	100%	100%	98%	98%	98%
Dubai, UAE	100%	100%	100%	97%	97%	97%
Florida, US	98%	98%	99%	93%	90%	90%

Exhibit 5.10: Participation Rates (Unweighted) – TIMSS 2015 – Fourth Grade

Country	School Participation		Class Participation	Student Participation	Overall Participation	
	Before Replacement	After Replacement			Before Replacement	After Replacement
Australia	99%	99%	99%	94%	92%	92%
Bahrain (Combined)	100%	100%	100%	98%	98%	98%
Numeracy	100%	100%	100%	98%	98%	98%
TIMSS	100%	100%	100%	98%	98%	98%
Belgium (Flemish)	75%	97%	100%	98%	73%	95%
Bulgaria	97%	97%	100%	96%	93%	93%
Canada	79%	86%	99%	93%	73%	79%
Chile	85%	95%	100%	94%	80%	89%
Chinese Taipei	99%	100%	100%	99%	98%	99%
Croatia	99%	100%	99%	94%	92%	93%
Cyprus	100%	100%	100%	98%	98%	98%
Czech Republic	100%	100%	100%	95%	95%	95%
Denmark	53%	91%	100%	95%	51%	86%
England	95%	98%	100%	97%	92%	95%
Finland	99%	100%	100%	96%	96%	96%
France	96%	99%	100%	97%	93%	96%
Georgia	99%	100%	100%	98%	97%	98%
Germany	96%	98%	100%	96%	92%	94%
Hong Kong SAR	77%	83%	100%	93%	71%	77%
Hungary	99%	99%	100%	97%	95%	96%
Indonesia (Combined)	100%	100%	100%	98%	98%	98%
Numeracy	100%	100%	100%	98%	98%	98%
TIMSS	100%	100%	100%	98%	98%	98%
Iran, Islamic Rep. of (Combined)	100%	100%	100%	99%	99%	99%
Numeracy	100%	100%	100%	99%	99%	99%
TIMSS	100%	100%	100%	99%	99%	99%
Ireland	100%	100%	100%	96%	96%	96%
Italy	82%	99%	99%	96%	77%	93%
Japan	96%	99%	100%	98%	94%	97%
Jordan	100%	100%	100%	95%	95%	95%
Kazakhstan	94%	98%	100%	98%	93%	96%
Korea, Rep. of	100%	100%	100%	97%	97%	97%
Kuwait (Combined)	95%	95%	100%	92%	87%	87%
Numeracy	95%	95%	100%	91%	86%	86%
TIMSS	95%	95%	100%	94%	89%	89%

Exhibit 5.10: Participation Rates (Unweighted) – TIMSS 2015 – Fourth Grade (Continued)

Country	School Participation		Class Participation	Student Participation	Overall Participation	
	Before Replacement	After Replacement			Before Replacement	After Replacement
Lithuania	99%	100%	100%	93%	93%	93%
Morocco (Combined)	100%	100%	100%	97%	97%	97%
Numeracy	100%	100%	100%	97%	97%	97%
TIMSS	100%	100%	100%	98%	97%	97%
Netherlands	50%	87%	100%	96%	48%	83%
New Zealand	81%	96%	100%	94%	76%	90%
Northern Ireland	65%	77%	100%	92%	60%	71%
Norway (5)	93%	93%	100%	95%	88%	88%
Oman	97%	98%	100%	98%	95%	97%
Poland	91%	100%	100%	92%	84%	92%
Portugal	87%	98%	100%	93%	81%	91%
Qatar	100%	100%	100%	99%	99%	99%
Russian Federation	100%	100%	100%	98%	98%	98%
Saudi Arabia	94%	100%	100%	93%	87%	93%
Serbia	99%	100%	100%	96%	95%	96%
Singapore	100%	100%	100%	96%	96%	96%
Slovak Republic	97%	100%	100%	97%	94%	96%
Slovenia	96%	99%	100%	95%	90%	93%
South Africa (5)	99%	100%	100%	98%	97%	98%
Spain	98%	99%	100%	97%	95%	96%
Sweden	100%	100%	100%	95%	95%	95%
Turkey	100%	100%	100%	98%	98%	98%
United Arab Emirates	100%	100%	100%	97%	97%	97%
United States	77%	85%	100%	96%	74%	81%
Benchmarking Participants						
Buenos Aires, Argentina (Combined)	85%	91%	92%	87%	67%	72%
Numeracy	85%	91%	92%	87%	68%	72%
TIMSS	85%	91%	92%	87%	67%	72%
Ontario, Canada	96%	96%	100%	95%	90%	90%
Quebec, Canada	58%	70%	100%	95%	55%	66%
Norway (4)	94%	94%	100%	94%	89%	89%
Abu Dhabi, UAE	100%	100%	100%	96%	96%	96%
Dubai, UAE	100%	100%	100%	97%	97%	97%
Florida, US	100%	100%	100%	95%	95%	95%

Exhibit 5.11: Participation Rates (Unweighted) – TIMSS 2015 – Eighth Grade

Country	School Participation		Class Participation	Student Participation	Overall Participation	
	Before Replacement	After Replacement			Before Replacement	After Replacement
Australia	99%	99%	96%	89%	85%	85%
Bahrain	100%	100%	100%	97%	97%	97%
Botswana (9)	100%	100%	100%	98%	98%	98%
Canada	75%	82%	99%	93%	69%	76%
Chile	84%	93%	100%	93%	78%	87%
Chinese Taipei	100%	100%	100%	98%	98%	98%
Egypt	92%	99%	100%	91%	84%	89%
England	91%	97%	100%	95%	86%	91%
Georgia	99%	100%	100%	97%	96%	97%
Hong Kong SAR	78%	84%	100%	96%	75%	81%
Hungary	97%	99%	100%	97%	93%	96%
Iran, Islamic Rep. of	100%	100%	100%	98%	98%	98%
Ireland	99%	99%	100%	92%	91%	91%
Israel	91%	100%	100%	93%	85%	93%
Italy	81%	98%	100%	95%	76%	93%
Japan	95%	99%	100%	95%	90%	93%
Jordan	100%	100%	100%	96%	96%	96%
Kazakhstan	95%	98%	100%	98%	94%	96%
Korea, Rep. of	100%	100%	100%	98%	98%	98%
Kuwait	95%	95%	100%	91%	86%	86%
Lebanon	77%	92%	100%	96%	75%	89%
Lithuania	98%	100%	100%	93%	91%	93%
Malaysia	100%	100%	100%	98%	98%	98%
Malta	100%	100%	100%	96%	96%	96%
Morocco	100%	100%	100%	95%	95%	95%
New Zealand	74%	90%	100%	91%	67%	81%
Norway (9)	95%	95%	100%	91%	86%	86%
Oman	97%	98%	100%	98%	96%	96%
Qatar	98%	98%	100%	98%	96%	96%
Russian Federation	100%	100%	100%	97%	97%	97%
Saudi Arabia	98%	100%	100%	97%	95%	97%
Singapore	100%	100%	100%	97%	97%	97%
Slovenia	96%	99%	100%	93%	89%	92%
South Africa (9)	97%	100%	100%	95%	92%	95%

Exhibit 5.11: Participation Rates (Unweighted) – TIMSS 2015 – Eighth Grade (Continued)

Country	School Participation		Class Participation	Student Participation	Overall Participation	
	Before Replacement	After Replacement			Before Replacement	After Replacement
Sweden	99%	100%	100%	93%	92%	93%
Thailand	98%	100%	100%	98%	97%	98%
Turkey	100%	100%	100%	98%	98%	98%
United Arab Emirates	100%	100%	100%	97%	97%	97%
United States	78%	84%	99%	94%	73%	79%
Benchmarking Participants						
Buenos Aires, Argentina	81%	85%	97%	87%	68%	72%
Ontario, Canada	92%	94%	99%	93%	85%	87%
Quebec, Canada	59%	70%	99%	93%	54%	65%
Norway (8)	95%	95%	100%	93%	88%	88%
Abu Dhabi, UAE	100%	100%	100%	97%	97%	97%
Dubai, UAE	100%	100%	100%	97%	97%	97%
Florida, US	98%	98%	99%	92%	90%	90%

Exhibits 5.12 through 5.15 show the achieved sample sizes in terms of schools and students for each of the participants in the TIMSS 2015 fourth and eighth grade assessments, respectively.

Exhibit 5.12: School Sample Sizes – TIMSS 2015 – Fourth Grade

Country	Number of Schools in Original Sample	Number of Eligible Schools in Original Sample	Number of Schools in Original Sample that Participated	Number of Replacement Schools that Participated	Total Number of Schools that Participated
Australia	290	289	285	2	287
Bahrain	182	182	182	0	182
Belgium (Flemish)	160	157	117	36	153
Bulgaria	154	153	148	1	149
Canada	520	513	403	38	441
Chile	190	189	161	18	179
Chinese Taipei	150	150	149	1	150
Croatia	168	163	161	2	163
Cyprus	150	148	148	0	148
Czech Republic	160	159	159	0	159
Denmark	220	212	113	80	193
England	150	150	142	5	147
Finland	160	158	157	1	158
France	166	165	159	5	164
Georgia	162	153	151	2	153
Germany	210	208	199	5	204
Hong Kong SAR	160	160	123	9	132
Hungary	150	145	143	1	144
Indonesia	230	230	230	0	230
Iran, Islamic Rep. of	250	248	248	0	248
Ireland	149	149	149	0	149
Italy	166	166	136	28	164
Japan	150	149	143	5	148
Jordan	257	254	254	0	254
Kazakhstan	176	175	165	6	171
Korea, Rep. of	150	149	149	0	149
Kuwait	176	175	166	0	166
Lithuania	231	225	223	2	225
Morocco	361	359	358	0	358
Netherlands	150	148	74	55	129
New Zealand	182	182	147	27	174
Northern Ireland	154	154	100	18	118
Norway (5)	150	150	140	0	140
Oman	308	305	296	4	300

Exhibit 5.12: School Sample Sizes –TIMSS 2015 – Fourth Grade (Continued)

Country	Number of Schools in Original Sample	Number of Eligible Schools in Original Sample	Number of Schools in Original Sample that Participated	Number of Replacement Schools that Participated	Total Number of Schools that Participated
Poland	150	150	137	13	150
Portugal	222	221	193	24	217
Qatar	220	211	211	0	211
Russian Federation	208	208	208	0	208
Saudi Arabia	198	189	178	11	189
Serbia	160	160	158	2	160
Singapore	179	179	179	0	179
Slovak Republic	200	199	193	5	198
Slovenia	150	150	144	4	148
South Africa (5)	300	297	293	4	297
Spain	364	363	357	1	358
Sweden	150	144	144	0	144
Turkey	260	242	242	0	242
United Arab Emirates	573	558	558	0	558
United States	300	295	228	22	250
Benchmarking Participants					
Buenos Aires, Argentina	150	150	127	9	136
Ontario, Canada	160	158	151	0	151
Quebec, Canada	176	174	101	20	121
Norway (4)	152	148	139	0	139
Abu Dhabi, UAE	173	163	163	0	163
Dubai, UAE	170	168	168	0	168
Florida, US	54	53	53	0	53

Exhibit 5.13: School Sample Sizes – TIMSS 2015 – Eighth Grade

Country	Number of Schools in Original Sample	Number of Eligible Schools in Original Sample	Number of Schools in Original Sample that Participated	Number of Replacement Schools that Participated	Total Number of Schools that Participated
Australia	290	287	285	0	285
Bahrain	105	105	105	0	105
Botswana (9)	159	159	159	0	159
Canada	344	337	253	23	276
Chile	184	184	154	17	171
Chinese Taipei	190	190	190	0	190
Egypt	214	214	197	14	211
England	150	148	135	8	143
Georgia	162	153	151	2	153
Hong Kong SAR	158	158	123	10	133
Hungary	150	145	140	4	144
Iran, Islamic Rep. of	250	250	250	0	250
Ireland	150	150	149	0	149
Israel	200	200	182	18	200
Italy	165	165	133	28	161
Japan	150	149	142	5	147
Jordan	260	252	252	0	252
Kazakhstan	176	176	168	4	172
Korea, Rep. of	150	150	150	0	150
Kuwait	178	177	168	0	168
Lebanon	150	150	116	22	138
Lithuania	211	208	204	4	208
Malaysia	212	207	207	0	207
Malta	48	48	48	0	48
Morocco	353	345	345	0	345
New Zealand	162	162	120	25	145
Norway (9)	150	150	143	0	143
Oman	310	308	300	1	301
Qatar	136	134	131	0	131
Russian Federation	204	204	204	0	204
Saudi Arabia	154	143	140	3	143
Singapore	167	167	167	0	167
Slovenia	150	150	144	4	148
South Africa (9)	300	292	282	10	292

Exhibit 5.13: School Sample Sizes – TIMSS 2015 – Eighth Grade (Continued)

Country	Number of Schools in Original Sample	Number of Eligible Schools in Original Sample	Number of Schools in Original Sample that Participated	Number of Replacement Schools that Participated	Total Number of Schools that Participated
Sweden	154	150	149	1	150
Thailand	204	204	200	4	204
Turkey	240	218	218	0	218
United Arab Emirates	489	477	477	0	477
United States	300	293	229	17	246
Benchmarking Participants					
Buenos Aires, Argentina	150	150	122	6	128
Ontario, Canada	152	147	135	3	138
Quebec, Canada	176	174	102	20	122
Norway (8)	150	150	142	0	142
Abu Dhabi, UAE	165	156	156	0	156
Dubai, UAE	137	135	135	0	135
Florida, US	54	54	53	0	53

Exhibit 5.14: Student Sample Sizes – TIMSS 2015 – Fourth Grade

Country	Within-School Student Participation (Weighted Percentage)	Number of Sampled Students in Participating Schools	Number of Students Withdrawn from Class/School	Number of Students Excluded	Number of Eligible Students	Number of Students Absent	Number of Students Assessed
Australia	95%	6,705	149	129	6,427	370	6,057
Bahrain (Combined)	99%	9,335	63	540	8,732	157	8,575
Numeracy	99%	4,825	38	277	4,510	81	4,429
TIMSS	99%	4,510	25	263	4,222	76	4,146
Belgium (Flemish)	98%	5,580	24	32	5,524	120	5,404
Bulgaria	96%	4,563	78	80	4,405	177	4,228
Canada	94%	13,583	118	294	13,171	888	12,283
Chile	94%	5,196	68	64	5,064	308	4,756
Chinese Taipei	99%	4,461	37	84	4,340	49	4,291
Croatia	95%	4,354	25	109	4,220	235	3,985
Cyprus	98%	4,343	12	132	4,199	74	4,125
Czech Republic	95%	5,562	41	31	5,490	288	5,202
Denmark	95%	4,213	57	241	3,915	205	3,710
England	98%	4,232	117	0	4,115	109	4,006
Finland	97%	5,251	17	34	5,200	185	5,015
France	98%	5,110	66	35	5,009	136	4,873
Georgia	98%	4,091	30	59	4,002	83	3,919
Germany	96%	4,202	44	45	4,113	165	3,948
Hong Kong SAR	93%	3,936	17	45	3,874	274	3,600
Hungary	97%	5,329	24	102	5,203	167	5,036
Indonesia (Combined)	99%	8,730	207	0	8,523	204	8,319
Numeracy	99%	4,522	118	0	4,404	110	4,294
TIMSS	99%	4,208	89	0	4,119	94	4,025
Iran, Islamic Rep. of (Combined)	99%	8,115	77	3	8,035	107	7,928
Numeracy	99%	4,203	35	2	4,166	61	4,105
TIMSS	99%	3,912	42	1	3,869	46	3,823
Ireland	96%	4,624	31	52	4,541	197	4,344
Italy	95%	4,859	18	264	4,577	204	4,373
Japan	98%	4,511	7	35	4,469	86	4,383
Jordan	96%	8,514	276	0	8,238	377	7,861
Kazakhstan	98%	4,830	51	0	4,779	77	4,702
Korea, Rep. of	97%	4,903	54	54	4,795	126	4,669
Kuwait (Combined)	96%	7,991	79	4	7,908	612	7,296
Numeracy	95%	4,128	38	2	4,088	385	3,703
TIMSS	97%	3,863	41	2	3,820	227	3,593

Students attending a sampled class at the time the sample was chosen but leaving the class before the assessment was administered were classified as "withdrawn."
Students with a disability or language barrier that prevented them from participating in the assessment were classified as "excluded."
Students not present when the assessment was administered, and not subsequently assessed in a make-up session, were classified as "absent."

Exhibit 5.14: Student Sample Sizes – TIMSS 2015 – Fourth Grade (Continued)

Country	Within-School Student Participation (Weighted Percentage)	Number of Sampled Students in Participating Schools	Number of Students Withdrawn from Class/School	Number of Students Excluded	Number of Eligible Students	Number of Students Absent	Number of Students Assessed
Lithuania	94%	5,034	12	175	4,847	318	4,529
Morocco (Combined)	99%	10,795	84	0	10,711	283	10,428
Numeracy	98%	5,581	43	0	5,538	178	5,360
TIMSS	99%	5,214	41	0	5,173	105	5,068
Netherlands	96%	4,791	77	20	4,694	179	4,515
New Zealand	94%	6,920	118	77	6,725	403	6,322
Northern Ireland	93%	3,388	17	2	3,369	253	3,116
Norway (5)	95%	4,764	27	166	4,571	242	4,329
Oman	99%	9,490	131	84	9,275	170	9,105
Poland	92%	5,346	49	118	5,179	432	4,747
Portugal	93%	5,391	33	295	5,063	370	4,693
Qatar	99%	5,484	116	113	5,255	61	5,194
Russian Federation	98%	5,145	24	87	5,034	113	4,921
Saudi Arabia	93%	4,759	74	2	4,683	346	4,337
Serbia	96%	4,310	21	80	4,209	173	4,036
Singapore	96%	6,800	26	0	6,774	257	6,517
Slovak Republic	97%	6,235	208	50	5,977	204	5,773
Slovenia	95%	4,790	13	77	4,700	255	4,445
South Africa (5)	98%	11,305	151	0	11,154	222	10,932
Spain	96%	8,353	40	302	8,011	247	7,764
Sweden	95%	4,505	29	126	4,350	208	4,142
Turkey	98%	6,892	217	90	6,585	129	6,456
United Arab Emirates	97%	22,249	110	275	21,864	687	21,177
United States	96%	11,267	147	648	10,472	443	10,029
Benchmarking Participants							
Buenos Aires, Argentina (Combined)	93%	7,464	54	16	7,180	745	6,435
Numeracy	93%	3,852	27	8	3,697	366	3,331
TIMSS	93%	3,612	27	8	3,483	379	3,104
Ontario, Canada	95%	4,938	52	59	4,827	253	4,574
Quebec, Canada	95%	3,012	13	54	2,945	147	2,798
Norway (4)	95%	4,583	27	149	4,407	243	4,164
Abu Dhabi, UAE	97%	5,281	32	64	5,185	184	5,001
Dubai, UAE	97%	7,906	35	153	7,718	265	7,453
Florida, US	95%	2,269	55	76	2,138	113	2,025

Exhibit 5.15: Student Sample Sizes – TIMSS 2015 – Eighth Grade

Country	Within-School Student Participation (Weighted Percentage)	Number of Sampled Students in Participating Schools	Number of Students Withdrawn from Class/School	Number of Students Excluded	Number of Eligible Students	Number of Students Absent	Number of Students Assessed
Australia	91%	11,968	312	88	11,568	1,230	10,338
Bahrain	97%	5,334	66	201	5,067	149	4,918
Botswana (9)	98%	6,192	66	12	6,114	150	5,964
Canada	93%	9,618	70	139	9,409	652	8,757
Chile	93%	5,285	67	21	5,197	348	4,849
Chinese Taipei	98%	5,915	53	50	5,812	101	5,711
Egypt	91%	8,897	273	0	8,624	802	7,822
England	95%	5,252	185	0	5,067	253	4,814
Georgia	98%	4,215	28	46	4,141	106	4,035
Hong Kong SAR	96%	4,363	24	13	4,326	171	4,155
Hungary	97%	5,190	20	112	5,058	165	4,893
Iran, Islamic Rep. of	98%	6,482	80	177	6,225	95	6,130
Ireland	92%	5,214	44	47	5,123	419	4,704
Israel	93%	6,079	41	102	5,936	424	5,512
Italy	95%	5,021	16	282	4,723	242	4,481
Japan	95%	5,037	8	12	5,017	272	4,745
Jordan	96%	8,617	441	0	8,176	311	7,865
Kazakhstan	98%	5,040	61	0	4,979	92	4,887
Korea, Rep. of	98%	5,526	35	55	5,436	127	5,309
Kuwait	90%	5,081	113	0	4,968	465	4,503
Lebanon	96%	4,044	24	0	4,020	147	3,873
Lithuania	93%	4,864	27	148	4,689	342	4,347
Malaysia	98%	10,092	171	41	9,880	154	9,726
Malta	96%	4,063	15	67	3,981	164	3,817
Morocco	95%	13,979	229	0	13,750	715	13,035
New Zealand	90%	9,119	93	47	8,979	837	8,142
Norway (9)	91%	5,354	37	128	5,189	492	4,697
Oman	99%	9,218	161	21	9,036	153	8,883
Qatar	98%	5,691	115	73	5,503	100	5,403
Russian Federation	97%	5,025	52	59	4,914	134	4,780
Saudi Arabia	97%	3,962	72	5	3,885	126	3,759
Singapore	97%	6,341	15	0	6,326	210	6,116
Slovenia	94%	4,654	17	76	4,561	304	4,257
South Africa (9)	96%	13,708	574	0	13,134	620	12,514

Students attending a sampled class at the time the sample was chosen but leaving the class before the assessment was administered were classified as "withdrawn."
Students with a disability or language barrier that prevented them from participating in the assessment were classified as "excluded."
Students not present when the assessment was administered, and not subsequently assessed in a make-up session, were classified as "absent."

Exhibit 5.15: Student Sample Sizes – TIMSS 2015 – Eighth Grade (Continued)

Country	Within-School Student Participation (Weighted Percentage)	Number of Sampled Students in Participating Schools	Number of Students Withdrawn from Class/School	Number of Students Excluded	Number of Eligible Students	Number of Students Absent	Number of Students Assessed
Sweden	94%	4,561	43	121	4,397	307	4,090
Thailand	99%	6,761	179	0	6,582	100	6,482
Turkey	98%	6,537	232	71	6,234	155	6,079
United Arab Emirates	97%	18,740	78	106	18,556	544	18,012
United States	94%	11,489	198	439	10,852	631	10,221
Benchmarking Participants							
Buenos Aires, Argentina	85%	3,839	81	0	3,758	505	3,253
Ontario, Canada	93%	4,883	18	24	4,841	321	4,520
Quebec, Canada	92%	4,403	48	92	4,263	313	3,950
Norway (8)	93%	5,339	17	143	5,179	384	4,795
Abu Dhabi, UAE	98%	5,021	26	20	4,975	137	4,838
Dubai, UAE	97%	6,435	24	67	6,344	195	6,149
Florida, US	93%	2,336	38	47	2,251	177	2,074

TIMSS 2015 Trends in Student Populations

Because an important goal of the TIMSS 2015 assessment was to measure changes in students' mathematics and science achievement across assessment cycles, it was important to track any changes over time in population composition and coverage that might be related to student achievement. Exhibits 5.16 and 5.17 present, for each country, trends across cycles (2015, 2011, 2007, 2003, 1995 at the fourth grade and 2015, 2011, 2007, 2003, 1999, and 1995 at the eighth grade) in four important characteristics of the assessment populations: number of years of formal schooling, average student age, percent of students in the national target population excluded from the assessment, and overall participation rates after using replacements. Most countries and benchmarking participants were very similar with regard to these characteristics across the four assessment cycles at the fourth grade and five cycles at the eighth grade, although there have been changes in some countries in the age and grade structure of the assessed populations, in the target population coverage and in the exclusion rate.

The Russian Federation and Slovenia have undergone structural changes in the age at which children enter schools that are reflected in their samples. In 2003, the Russian fourth grade sample contained third grade students from some regions and fourth grade students from others, whereas all students were in the fourth grade by 2007. At the eighth grade, there was still a mixture of seventh and eighth grade students in 2007, but by 2011 the sample was all eighth grade students,

with correspondingly a higher average age. By 2007, Slovenia had completed the transition towards having all children begin school at an earlier age so that they all would have four years of primary schooling at the fourth grade instead of three years, as was the case in 2003.

National coverage of the international target population was generally comprehensive for most countries and has not changed across assessments, with some exceptions. At the fourth grade, Kuwait assessed only students in public schools in 2011 but also tested students from the private schools in 2015. Therefore the 2015 trend population for Kuwait included only students from the public schools, which represents 60 percent of the 2015 target population. At the fourth and eighth grades, Lithuania tested students in Lithuanian, Russian, and Polish in 2015, while Lithuanian was the only test language used for the assessment in 2011. As a result, the 2015 trend population for Lithuania included only students taught in Lithuanian, which represent 91 percent and 93 percent, at the fourth and eighth grades, respectively.

In general, the exclusion rates do not exceed the TIMSS 2015 guidelines of 5 percent, and have not changed very much across assessments for most countries. A few countries saw a decrease in their overall exclusion rate. At the fourth grade, Belgium (Flemish) reduced their overall exclusion rate of 3.6 percent between 2011 and 2015 by assessing eligible students from special needs schools. From 2011 to 2015, Hong Kong SAR decreased its overall exclusion rate, at the fourth and eighth grades, by over 6 and close to 4 percentage points, respectively, by assessing students from their international schools. Finally, Florida decreased their exclusion rate at the fourth and eighth grades by more than 7 and 4 percentage points, respectively, by providing more precise guidelines on within-school exclusions of special needs students. On the other hand, the student exclusion rate was higher in 2015 than in 2011 at the fourth grade in Bahrain, Italy, Kuwait, Portugal, Serbia, Singapore, Slovenia, Sweden, and the benchmarking participants of Quebec, Canada, and Abu Dhabi, United Arab Emirates. At the eighth grade, those with higher exclusions since 2011 included Bahrain, Georgia, Hungary, Italy, Lithuania, Malaysia, Slovenia, Norway (eighth grade), and the benchmarking participants of and Abu Dhabi and Dubai of the United Arab Emirates.

Exhibit 5.16: Trends in Student Populations – TIMSS 2015 – Fourth Grade

Country	Years of Formal Schooling*					Average Age at Time of Testing				
	2015	2011	2007	2003	1995	2015	2011	2007	2003	1995
Australia	4	4	4	4	4	10.0	10.0	9.9	9.9	9.9
Bahrain	4	4				9.9	10.4			
Belgium (Flemish)	4	4		4		10.1	10.0		10.0	
Chile	4	4				10.2	10.1			
Chinese Taipei	4	4	4	4		10.2	10.2	10.2	10.2	
Croatia	4	4				10.6	10.7			
Cyprus	4			4	4	9.8			9.9	9.8
Czech Republic	4	4	4		4	10.4	10.4	10.3		10.4
Denmark	4	4	4			10.9	11.0	11.0		
England	5	5	5	5	5	10.1	10.2	10.2	10.3	10.0
Finland	4	4				10.8	10.8			
Georgia	4	4	4			9.7	10.0	10.1		
Germany	4	4	4			10.4	10.4	10.4		
Hong Kong SAR	4	4	4	4	4	10.1	10.1	10.2	10.2	10.1
Hungary	4	4	4	4	4	10.7	10.7	10.7	10.5	10.4
Iran, Islamic Rep. of	4	4	4	4	4	10.2	10.2	10.2	10.4	10.5
Ireland	4	4			4	10.4	10.3			10.3
Italy	4	4	4	4		9.7	9.7	9.8	9.8	
Japan	4	4	4	4	4	10.5	10.5	10.5	10.4	10.4
Kazakhstan	4	4				10.3	10.4			
Korea, Rep. of	4	4			4	10.5	10.4			10.3
Kuwait	4	4				9.7	9.7			
Lithuania	4	4	4	4		10.7	10.7	10.8	10.9	
Morocco	4	4				10.3	10.5			
Netherlands	4	4	4	4	4	10.0	10.2	10.2	10.2	10.3
New Zealand	4	4.5–5.5	4.5–5.5	4.5–5.5	4.5–5.5	10.0	9.9	10.0	10.0	10.0
Northern Ireland	4	4				10.4	10.4			
Oman	4	4				9.6	9.9			
Portugal	4	4			4	9.9	10.0			10.4
Qatar	4	4				10.1	10.0			
Russian Federation	4	4	4	3 or 4		10.8	10.8	10.8	10.6	
Saudi Arabia	4	4				10.0	10.0			

* Represents years of schooling counting from the first year of ISCED Level 1.

Georgian schools in South Ossetia and Abkhazia were excluded in 2011 due to lack of access and absence of official statistics. Abkhazia refugee schools in other territories of Georgia were included in the sample frame.

Bahrain in 2011, Korea in 2003, Lithuania in 1999, and Dubai (UAE) in 2007 tested the same cohort of students as other countries, but later in the assessment year. South Africa (9) tested one year later.

Trend results for Kuwait do not include private schools. Trend results for Lithuania do not include students taught in Polish or in Russian.

An empty cell indicates a country did not participate in that year's assessment. A dash (–) indicates comparable data not available.

Exhibit 5.16: Trends in Student Populations – TIMSS 2015 – Fourth Grade (Continued)

Country	Years of Formal Schooling*					Average Age at Time of Testing				
	2015	2011	2007	2003	1995	2015	2011	2007	2003	1995
Serbia	4	4				10.7	10.8			
Singapore	4	4	4	4	4	10.4	10.4	10.4	10.3	10.3
Slovak Republic	4	4	4			10.4	10.4	10.4		
Slovenia	4	4	4	3 or 4	3	9.8	9.9	9.8	9.8	9.9
Spain	4	4				9.9	9.8			
Sweden	4	4	4			10.8	10.7	10.8		
Turkey	4	4				9.9	10.1			
United Arab Emirates	4	4				9.8	9.8			
United States	4	4	4	4	4	10.2	10.2	10.3	10.2	10.2
Benchmarking Participants										
Ontario, Canada	4	4	4	4	4	9.8	9.8	9.8	9.9	9.8
Quebec, Canada	4	4	4	4	4	10.1	10.1	10.1	10.1	10.3
Norway (4)	4	4	4	3	3	9.7	9.7	9.8	9.8	9.9
Abu Dhabi, UAE	4	4				9.8	9.7			
Dubai, UAE	4	4	4			9.8	9.9	10.0		
Florida, US	4	4				10.4	10.4			

Exhibit 5.16: Trends in Student Populations – TIMSS 2015 – Fourth Grade (Continued)

Country	Overall Exclusions					Overall Participation (After Replacement)				
	2015	2011	2007	2003	1995	2015	2011	2007	2003	1995
Australia	4.2%	4.4%	4.0%	2.7%	2.0%	94%	93%	95%	85%	66%
Bahrain	5.6%	1.1%				99%	90%			
Belgium (Flemish)	1.4%	5.0%		6.3%		95%	92%		97%	
Chile	3.7%	3.7%				88%	95%			
Chinese Taipei	2.4%	1.4%	2.8%	3.1%		99%	99%	100%	99%	
Croatia	4.4%	7.9%				94%	95%			
Cyprus	4.6%			2.9%	3.0%	98%			97%	83%
Czech Republic	4.2%	5.1%	4.9%		4.0%	95%	94%	92%		86%
Denmark	7.5%	6.3%	4.1%			86%	87%	85%		
England	2.3%	2.0%	2.1%	1.9%	12.0%	96%	78%	84%	76%	83%
Finland	2.0%	3.1%				97%	96%			
Georgia	4.9%	4.9%	4.8%			98%	96%	98%		
Germany	2.7%	1.9%	1.3%			95%	95%	96%		
Hong Kong SAR	2.2%	8.6%	5.4%	3.8%	3.0%	76%	82%	81%	83%	83%
Hungary	4.8%	4.2%	4.4%	8.1%	4.0%	96%	96%	96%	93%	92%
Iran, Islamic Rep. of	4.0%	4.5%	3.0%	5.7%	1.0%	99%	99%	99%	98%	97%
Ireland	2.7%	2.5%			7.0%	96%	95%			90%
Italy	6.2%	3.7%	5.3%	4.2%		94%	95%	97%	97%	
Japan	2.9%	3.2%	1.1%	0.8%	3.0%	97%	96%	95%	97%	92%
Kazakhstan	3.9%	6.3%				97%	99%			
Korea, Rep. of	2.5%	2.5%			7.0%	97%	98%			95%
Kuwait	3.0%	0.3%				90%	91%			
Lithuania	6.1%	5.6%	5.4%	4.6%		94%	94%	94%	87%	
Morocco	1.5%	2.0%				99%	96%			
Netherlands	3.2%	4.0%	4.8%	5.2%	4.0%	83%	79%	91%	84%	59%
New Zealand	4.8%	4.9%	5.4%	4.0%	1.0%	90%	90%	96%	93%	95%
Northern Ireland	2.7%	3.5%				71%	79%			
Oman	0.8%	1.5%				97%	96%			
Portugal	6.5%	2.5%			7.0%	92%	92%			92%
Qatar	3.8%	6.2%				99%	99%			
Russian Federation	4.0%	5.3%	3.6%	6.8%		98%	98%	98%	97%	
Saudi Arabia	1.9%	1.6%				93%	99%			
Serbia	11.3%	9.4%				96%	97%			
Singapore	10.1%	6.3%	1.5%	0.0%	0.0%	96%	96%	96%	98%	98%
Slovak Republic	4.2%	4.6%	3.3%			97%	96%	97%		

Exhibit 5.16: Trends in Student Populations – TIMSS 2015 – Fourth Grade (Continued)

Country	Overall Exclusions					Overall Participation (After Replacement)				
	2015	2011	2007	2003	1995	2015	2011	2007	2003	1995
Slovenia	4.5%	2.6%	2.1%	1.3%	2.0%	93%	94%	93%	91%	76%
Spain	5.6%	5.3%				95%	97%			
Sweden	5.7%	4.1%	3.1%			95%	91%	97%		
Turkey	3.6%	2.5%				98%	98%			
United Arab Emirates	4.7%	3.3%				97%	97%			
United States	6.8%	7.0%	9.2%	5.1%	5.0%	81%	80%	84%	78%	80%
Benchmarking Participants										
Ontario, Canada	3.4%	5.3%	6.3%	4.8%	–	90%	94%	92%	90%	92%
Quebec, Canada	5.4%	3.7%	6.4%	3.6%	–	59%	91%	84%	91%	81%
Norway (4)	5.0%	4.3%	5.1%	4.4%	3.0%	89%	70%	92%	88%	91%
Abu Dhabi, UAE	5.8%	2.7%				97%	97%			
Dubai, UAE	5.3%	5.1%	5.4%			97%	96%	67%		
Florida, US	4.7%	12.1%				95%	91%			

Exhibit 5.17: Trends in Student Populations – TIMSS 2015 – Eighth Grade

Country	Years of Formal Schooling*						Average Age at Time of Testing					
	2015	2011	2007	2003	1999	1995	2015	2011	2007	2003	1999	1995
Australia	8	8	8	8		8	14.0	14.0	13.9	13.9		13.9
Bahrain	8	8	8	8			14.0	14.4	14.1	14.1		
Botswana (9)	9	9					15.6	15.8				
Chile	8	8		8	8		14.3	14.2		14.2	14.4	
Chinese Taipei	8	8	8	8	8		14.3	14.2	14.2	14.2	14.2	
Egypt	8		8	8			14.1		14.1	14.4		
England	9	9	9	9	9	9	14.1	14.2	14.2	14.3	14.2	14.0
Georgia	8	8	8				13.7	14.2	14.2			
Hong Kong SAR	8	8	8	8	8	8	14.2	14.2	14.4	14.4	14.2	14.2
Hungary	8	8	8	8	8	8	14.7	14.7	14.6	14.5	14.4	14.3
Iran, Islamic Rep. of	8	8	8	8	8	8	14.2	14.3	14.2	14.4	14.6	14.6
Ireland	8					8	14.4					14.4
Israel	8	8					14.0	14.0				
Italy	8	8	8	8	8		13.8	13.8	13.9	13.9	14.0	
Japan	8	8	8	8	8	8	14.5	14.5	14.5	14.4	14.4	14.4
Jordan	8	8	8	8	8		13.8	13.9	14.0	13.9	14.0	
Kazakhstan	8	8					14.3	14.6				
Korea, Rep. of	8	8	8	8	8	8	14.4	14.3	14.3	14.6	14.4	14.2
Kuwait	8		8				13.7		14.4			
Lebanon	8	8	8	8			14.2	14.3	14.4	14.6		
Lithuania	8	8	8	8	8.5	8	14.7	14.7	14.9	14.9	15.2	14.3
Malaysia	8	8	8	8	8		14.3	14.4	14.3	14.3	14.4	
Malta	8		9				13.8		14.0			
Morocco	8	8					14.5	14.7				
New Zealand	8	8.5–9.5		8.5–9.5	8.5–9.5	8.5–9.5	14.1	14.1		14.1	14.0	14.0
Oman	8	8	8				14.0	14.1	14.3			
Qatar	8	8					14.1	14.0				
Russian Federation	8	8	7 or 8	7 or 8	7 or 8	7 or 8	14.7	14.7	14.6	14.2	14.1	14.0
Saudi Arabia	8	8					14.1	14.1				
Singapore	8	8	8	8	8	8	14.4	14.4	14.4	14.3	14.4	14.5
Slovenia	8	8	7 or 8	7 or 8		7	13.8	13.9	13.8	13.8		13.8
South Africa (9)	9	9					15.7	16.0				

* Represents years of schooling counting from the first year of ISCED Level 1.

Georgian schools in South Ossetia and Abkhazia were excluded in 2011 due to lack of access and absence of official statistics. Abkhazia refugee schools in other territories of Georgia were included in the sample frame.

Bahrain in 2011, Korea in 2003, Lithuania in 1999, and Dubai (UAE) in 2007 tested the same cohort of students as other countries, but later in the assessment year. South Africa (9) tested one year later.

Trend results for Kuwait do not include private schools. Trend results for Lithuania do not include students taught in Polish or in Russian.

An empty cell indicates a country did not participate in that year's assessment. A dash (–) indicates comparable data not available.

Exhibit 5.17: Trends in Student Populations – TIMSS 2015 – Eighth Grade (Continued)

Country	Years of Formal Schooling*						Average Age at Time of Testing					
	2015	2011	2007	2003	1999	1995	2015	2011	2007	2003	1999	1995
Sweden	8	8	8	8		7	14.7	14.8	14.8	14.9		14.9
Thailand	8	8	8		8		14.4	14.3	14.3		14.5	
Turkey	8	8					13.9	14.0				
United Arab Emirates	8	8					13.9	13.9				
United States	8	8	8	8	8	8	14.2	14.2	14.3	14.2	14.2	14.2
Benchmarking Participants												
Ontario, Canada	8	8	8	8	8	8	13.8	13.8	13.8	13.8	13.9	14.0
Quebec, Canada	8	8	8	8	8	8	14.3	14.2	14.2	14.2	14.3	14.5
Norway (8)	8	8	8	7		7	13.7	13.7	13.8	13.8		13.9
Abu Dhabi, UAE	8	8					13.9	13.8				
Dubai, UAE	8	8	8				13.9	13.9	14.2			
Florida, US	8	8					14.4	14.4				

Exhibit 5.17: Trends in Student Populations – TIMSS 2015 – Eighth Grade (Continued)

Country	Overall Exclusions						Overall Participation (After Replacement)					
	2015	2011	2007	2003	1999	1995	2015	2011	2007	2003	1999	1995
Australia	3.5%	3.2%	1.9%	1.3%		1.0%	90%	88%	93%	83%		70%
Bahrain	3.8%	1.6%	1.5%	0.0%			97%	97%	97%	98%		
Botswana (9)	0.3%	0.0%					98%	98%				
Chile	1.9%	2.8%		2.2%	2.8%		85%	95%		99%	96%	
Chinese Taipei	1.7%	1.3%	3.3%	4.8%	1.6%		98%	99%	99%	99%	99%	
Egypt	0.1%		0.5%	3.4%			91%		98%	97%		
England	2.3%	2.2%	2.3%	2.1%	5.0%	11.0%	92%	70%	75%	46%	77%	77%
Georgia	6.0%	4.5%	3.9%				98%	97%	97%			
Hong Kong SAR	1.6%	5.3%	3.8%	3.4%	0.8%	2.0%	81%	75%	75%	80%	74%	81%
Hungary	5.4%	4.4%	3.9%	8.5%	4.3%	4.0%	96%	95%	96%	94%	93%	87%
Iran, Islamic Rep. of	2.2%	2.2%	0.5%	6.5%	4.4%	0.0%	98%	99%	98%	98%	98%	98%
Ireland	1.2%					0.0%	91%					81%
Israel	22.8%	22.6%					93%	92%				
Italy	6.1%	4.7%	5.0%	3.6%	6.7%		93%	93%	96%	97%	97%	
Japan	2.3%	2.8%	3.5%	0.6%	1.3%	1.0%	93%	87%	91%	93%	89%	90%
Jordan	1.0%	0.4%	2.0%	1.3%	3.0%		96%	96%	96%	96%	99%	
Kazakhstan	3.8%	5.1%					97%	98%				
Korea, Rep. of	2.1%	1.9%	1.6%	4.9%	4.0%	4.0%	98%	99%	99%	98%	100%	95%
Kuwait	3.3%		0.3%				85%		84%			
Lebanon	1.3%	1.4%	1.4%	1.4%			88%	94%	85%	91%		
Lithuania	7.0%	4.8%	4.2%	2.6%	4.5%	7.0%	93%	92%	90%	84%	89%	83%
Malaysia	4.3%	0.1%	3.3%	4.0%	4.6%		98%	98%	98%	98%	99%	
Malta	3.5%		2.9%				96%		94%			
Morocco	0.0%	0.1%					95%	94%				
New Zealand	3.1%	3.2%		4.4%	2.4%	2.0%	81%	88%		90%	91%	94%
Oman	0.4%	1.2%	1.2%				96%	97%	99%			
Qatar	3.2%	4.5%					96%	99%				
Russian Federation	3.7%	6.0%	2.3%	5.5%	1.7%	6.0%	97%	98%	97%	96%	97%	95%
Saudi Arabia	2.1%	1.2%					97%	98%				
Singapore	7.0%	6.0%	1.8%	0.0%	0.0%	5.0%	97%	95%	95%	97%	98%	95%
Slovenia	3.8%	2.3%	1.9%	1.4%		3.0%	92%	92%	92%	91%		77%
South Africa (9)	1.5%	1.4%					96%	95%				
Sweden	5.5%	5.1%	3.6%	2.8%		1.0%	94%	92%	94%	87%		90%
Thailand	0.2%	1.5%	3.4%		3.3%		99%	99%	99%		99%	

Exhibit 5.17: Trends in Student Populations – TIMSS 2015 – Eighth Grade (Continued)

Country	Overall Exclusions						Overall Participation (After Replacement)					
	2015	2011	2007	2003	1999	1995	2015	2011	2007	2003	1999	1995
Turkey	1.3%	1.5%					98%	97%				
United Arab Emirates	3.6%	2.8%					97%	97%				
United States	5.1%	7.2%	7.9%	4.9%	3.9%	2.0%	78%	81%	77%	73%	85%	78%
Benchmarking Participants												
Ontario, Canada	2.5%	5.6%	6.2%	6.0%	5.1%	–	87%	93%	89%	89%	93%	90%
Quebec, Canada	5.3%	4.9%	13.6%	4.8%	1.3%	–	58%	88%	77%	85%	92%	89%
Norway (8)	4.1%	1.9%	2.6%	2.3%		2.0%	87%	84%	86%	85%		93%
Abu Dhabi, UAE	4.1%	1.7%					98%	96%				
Dubai, UAE	5.2%	4.0%	5.0%				97%	95%	69%			
Florida, US	2.8%	6.9%					90%	84%				

Appendix 5A: Characteristics of National Samples

Australia

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5), non-mainstream schools, and very remote schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by state or territory (8)
- Implicit stratification by geographic location (metropolitan, provincial, remote), school type (catholic, government, independent), and socioeconomic index (low socioeconomic status, high socioeconomic status)
- Prior to class sampling within schools, all indigenous students were grouped into a single classroom and were selected with certainty. Other classroom was sampled using the standard procedure.
- No overlap between Grade 4 and Grade 8 school samples
- Schools were oversampled at the state/territory level

Allocation of School Sample in Australia, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Australian Capital Territory	30	0	30	0	0	0	0
New South Wales	45	0	45	0	0	0	0
Northern Territory	15	0	15	0	0	0	0
Queensland	45	1	43	0	0	1	0
South Australia	40	0	39	0	0	1	0
Tasmania	30	0	30	0	0	0	0
Victoria	45	0	43	1	1	0	0
Western Australia	40	0	40	0	0	0	0
Total	**290**	**1**	**285**	**1**	**1**	**2**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5), non-mainstream schools, and very remote schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by state or territory (8)
- Implicit stratification by geographic location (metropolitan, provincial, remote), school type (catholic, government, independent), and socioeconomic index (low socioeconomic status, high socioeconomic status)
- Within sampled schools, all indigenous students were regrouped into a single classroom that was sampled with certainty. When appropriate, classrooms were grouped according to the ability level of students prior to sampling and one classroom was sampled per class group.
- No overlap between Grade 4 and Grade 8 school samples
- Schools were oversampled at the state/territory level

Allocation of School Sample in Australia, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Australian Capital Territory	30	2	28	0	0	0	0
New South Wales	45	0	45	0	0	0	0
Northern Territory	15	1	13	0	0	1	0
Queensland	45	0	44	0	0	1	0
South Australia	40	0	40	0	0	0	0
Tasmania	30	0	30	0	0	0	0
Victoria	45	0	45	0	0	0	0
Western Australia	40	0	40	0	0	0	0
Total	**290**	**3**	**285**	**0**	**0**	**2**	**0**

Bahrain

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 1), special needs schools, students taught in French, and students taught in Japanese
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by governorate (5), and gender (girls, boys) within public schools
- No implicit stratification
- Sampled two classrooms per school
- No overlap between Grade 4 and Grade 8 school samples
- All schools were selected
- Schools or classes were used as variance estimation strata and classes or half classes were used to build jackknife replicates

Allocation of School Sample in Bahrain, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Public Muharraq - Girls	10	0	10	0	0	0	0
Public Muharraq - Boys	10	0	10	0	0	0	0
Public Capital - Girls	19	0	19	0	0	0	0
Public Capital - Boys	21	0	21	0	0	0	0
Public Northern - Girls	21	0	21	0	0	0	0
Public Northern - Boys	17	0	17	0	0	0	0
Public Southern - Girls	11	0	11	0	0	0	0
Public Southern - Boys	11	0	11	0	0	0	0
Private	62	0	62	0	0	0	0
Total	**182**	**0**	**182**	**0**	**0**	**0**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 1), students taught in French, and students taught in Japanese
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by governorate (5), and gender (girls, boys) within public schools
- No implicit stratification
- Sampled two classrooms per school
- No overlap between Grade 4 and Grade 8 school samples.
- All schools were selected
- Schools or classes were used as variance estimation strata and classes or half classes were used to build jackknife replicates

Allocation of School Sample in Bahrain, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Public Muharraq - Girls	6	0	6	0	0	0	0
Public Muharraq - Boys	6	0	6	0	0	0	0
Public Capital - Girls	8	0	8	0	0	0	0
Public Capital - Boys	8	0	8	0	0	0	0
Public Northern - Girls	8	0	8	0	0	0	0
Public Northern - Boys	9	0	9	0	0	0	0
Public Southern - Girls	6	0	6	0	0	0	0
Public Southern - Boys	8	0	8	0	0	0	0
Private	46	0	46	0	0	0	0
Total	**105**	**0**	**105**	**0**	**0**	**0**	**0**

Belgium (Flemish)

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5)
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by region (6), socioeconomic status (2), school type (official, private), and a stratum of eligible special education schools
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 35)
- TIMSS 2015 Main Data Collection and PIRLS 2016 Field Test school samples were selected simultaneously to avoid overlap

Allocation of School Sample in Belgium (Flemish), Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Antwerpen - High SES	16	0	12	2	1	1	0
Antwerpen - Low SES	24	0	14	7	2	1	0
Brussels Hoofdstedelijk Gewest - All SES	8	0	6	1	1	0	0
Limburg - High SES	10	0	6	3	1	0	0
Limburg - Low SES	10	0	8	2	0	0	0
Oost-Vlaanderen - High SES	16	0	13	1	1	1	0
Oost-Vlaanderen - Low SES	18	0	14	2	1	1	0
Vlaams-Brabant - High SES	11	0	9	2	0	0	1
Vlaams-Brabant - Low SES	12	0	8	1	3	0	0
West-Vlaanderen - High SES	16	0	14	0	2	0	0
West-Vlaanderen - Low SES	8	0	7	0	1	0	0
Special Education Schools	10	2	6	2	0	0	0
Total	**159**	**2**	**117**	**23**	**13**	**4**	**1**

Botswana

Ninth Grade

Coverage and Exclusions

- Coverage is 100 percent
- No school level exclusions
- Within-school exclusions consisted of students with intellectual disabilities, and students with functional disabilities

Sample Design

- Explicit stratification by school type (public, private), region (6), and socioeconomic status (medium to high socioeconomic status, low socioeconomic status)
- No implicit stratification
- Sampled one classroom except in private schools where two classrooms were sampled
- Census for private schools
- In census stratum, schools or classes were used as variance estimation strata and classes or half classes were used to build jackknife replicates

Allocation of School Sample in Botswana, Ninth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Central - Medium to High Mean SES	32	0	32	0	0	0	0
Central - Low Mean SES	18	0	18	0	0	0	0
Kweneng - Medium to High Mean SES	10	0	10	0	0	0	0
Kweneng - Low Mean SES	10	0	10	0	0	0	0
North East	10	0	10	0	0	0	0
North West - Medium to High Mean SES	8	0	8	0	0	0	0
North West - Low Mean SES	8	0	8	0	0	0	0
South - Medium to High Mean SES	8	0	8	0	0	0	0
South - Low Mean SES	14	0	14	0	0	0	0
South East	24	0	24	0	0	0	0
Private	17	0	17	0	0	0	0
Total	**159**	**0**	**159**	**0**	**0**	**0**	**0**

Bulgaria

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5) and special needs schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by school type (elementary, basic, general) and urbanization (capital, large cities, other)
- Implicit stratification by urbanization (city, village) within the basic schools found outside the larger cities
- Sampled two classrooms per school

Allocation of School Sample in Bulgaria, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Elementary School - Capital and Large Cities	8	0	8	0	0	0	0
Elementary School - Other	8	0	8	0	0	0	0
Basic School - Capital	10	0	10	0	0	0	0
Basic School - Large Cities	28	0	26	0	0	2	0
Basic School - Other	44	0	42	0	0	2	0
General School - Capital	14	1	12	0	1	0	0
General School - Large Cities	18	0	18	0	0	0	0
General School - Other	24	0	24	0	0	0	0
Total	**154**	**1**	**148**	**0**	**1**	**4**	**0**

Canada

Fourth Grade

Coverage and Exclusions

- Coverage is 78.9 percent. Coverage in Canada is restricted to students from the provinces of Alberta, Manitoba, Newfoundland, Ontario, and Quebec.
- School-level exclusions consisted of very small schools (measure of size < 10 in Quebec and measure of size < 6 in Ontario, Alberta, Manitoba, and Newfoundland), special needs schools, international schools (in Quebec), federal schools (in Quebec), school boards with special status (in Quebec), band-operated schools (First Nation and Native schools), French schools (in Newfoundland), public special needs schools (in Manitoba), as well as private and home schools (in Manitoba)
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by provinces (5). Within the province of Alberta, explicit stratification was done by school system (French, English), and school type (immersion, regular). Within the province of Ontario, explicit stratification was done by 'Grade 4'/'Grade 4 and Grade 8', language (English, French) and school type (private, Catholic, public). Within Quebec, explicit stratification was done by school type (public, private) and language (French, English).
- Implicit stratification by region (4) in public and Catholic explicit strata within Ontario. Postal code (6) in English school system strata within Alberta.
- Sampled two classrooms in large schools for Quebec, two classroom per school for Ontario and Alberta, and one classroom per school for the rest of Canada
- Grade 4 and Grade 8 school samples were selected separately, with the exception of Ontario where Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap
- All Alberta French schools were selected
- In Alberta French schools classes were used as variance estimation strata and half classes were used as jackknife replicates

Allocation of School Sample in Canada, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Manitoba - Grade 4 & Grade 8	7	0	7	0	0	0	1
Newfoundland - Grade 4 & Grade 8	8	0	8	0	0	0	0
Ontario - Grade 4 - Private	8	0	3	0	0	5	0
Ontario - Grade 4 - English - Catholic	8	0	8	0	0	0	0
Ontario - Grade 4 - English - Public	40	0	39	0	0	1	0
Ontario - Grade 4 - French - Catholic & Public	8	0	8	0	0	0	0
Ontario - Grade 4 & Grade 8 - English - Catholic	36	1	35	0	0	0	0
Ontario - Grade 4 & Grade 8 - English - Public	59	0	58	0	0	1	1
Quebec - Grade 4 - Private - English	8	0	8	0	0	0	0
Quebec - Grade 4 - Private - French	8	0	8	0	0	0	0
Quebec - Grade 4 - Public - English	40	0	38	1	0	1	2
Quebec - Grade 4 - Public - French	118	0	47	16	3	52	0
Alberta - Grade 4 - French System	27	0	26	0	0	1	0
Alberta - Grade 4 - English System - Immersion Schools	21	1	16	2	0	2	0
Alberta - Grade 4 - English System - Regular Schools	120	1	94	13	3	9	0
Total	**516**	**3**	**403**	**32**	**6**	**72**	**4**

Eighth Grade

Coverage and Exclusions

- Coverage is 67.3 percent. Coverage in Canada is restricted to students from the provinces of Manitoba, Newfoundland, Ontario, and Quebec.
- School-level exclusions consisted of very small schools (measure of size < 10 in Quebec and measure of size < 6 in Ontario, Manitoba, and Newfoundland), special needs schools, international schools (in Quebec), federal schools (in Quebec), school boards with special status (in Quebec), band-operated schools (First Nation and Native schools), and French schools (in Newfoundland)
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by Provinces (4). Within the province of Ontario, explicit stratification was done by 'Grade 8'/'Grade 4 and Grade 8', language (English, French) and school type (private, Catholic, public). Within the province of Quebec, explicit stratification was done by school type (public, private) and language (French, English).
- Implicit stratification by region (4) in public and Catholic explicit strata within Ontario. Achievement within Quebec (Used in all strata with the exception of private -English stratum).
- Sampled two classrooms in large schools for Quebec and Ontario, one classroom per school for the rest of Canada
- Grade 4 and Grade 8 school samples were selected separately, with the exception of Ontario where Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap

Allocation of School Sample in Canada, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Manitoba - Grade 4 & Grade 8	8	0	8	0	0	0	0
Newfoundland - Grade 4 & Grade 8	8	0	8	0	0	0	0
Ontario - Grade 8 - Private	8	0	0	2	1	5	0
Ontario - Grade 8 - English - Catholic	8	1	7	0	0	0	0
Ontario - Grade 8 - English - Public	32	0	30	0	0	2	0
Ontario - Grade 8 - French - Catholic & Public	8	0	7	0	0	1	0
Ontario - Grade 4 & Grade 8 - English - Catholic	36	1	34	0	0	1	0
Ontario - Grade 4 & Grade 8 - English - Public	59	2	57	0	0	0	1
Quebec - Grade 8 - Private - English	12	0	11	0	0	1	0
Quebec - Grade 8 - Private - French	26	1	25	0	0	0	0
Quebec - Grade 8 - Public - English	38	0	36	1	0	1	0
Quebec - Grade 8 - Public - French	100	1	30	19	0	50	0
Total	**343**	**6**	**253**	**22**	**1**	**61**	**1**

Chile

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5), special needs schools, and geographically inaccessible schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 4'/'Grade 4 and Grade 8' schools, school type (public, private subsidized, private paid), and urbanization (rural, urban)
- Sampled one classroom
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap
- Private paid schools were oversampled

Allocation of School Sample in Chile, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 4 - Rural	8	0	7	1	0	0	0
Grade 4 - Urban	8	0	7	0	1	0	0
Grade 4 & Grade 8 - Public - Rural	10	0	8	1	0	1	0
Grade 4 & Grade 8 - Public - Urban	48	1	38	1	0	8	0
Grade 4 & Grade 8 - Private Subsidized - Rural	8	0	7	1	0	0	0
Grade 4 & Grade 8 - Private Subsidized - Urban	68	0	63	5	0	0	0
Grade 4 & Grade 8 - Private Paid	40	0	31	7	1	1	0
Total	**190**	**1**	**161**	**16**	**2**	**10**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 9), special needs schools, and geographically inaccessible schools
- Within-school exclusions consisted of students with intellectual disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 8'/'Grade 4 and Grade 8' schools, school type (public, private subsidized, private paid), and urbanization (rural, urban)
- Sampled one classroom
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap.
- Private paid schools were oversampled

Allocation of School Sample in Chile, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 8	10	0	9	1	0	0	0
Grade 4 & Grade 8 - Public - Rural	10	0	8	1	0	1	0
Grade 4 & Grade 8 - Public - Urban	48	0	36	1	0	11	0
Grade 4 & Grade 8 - Private Subsidized - Rural	8	0	7	1	0	0	0
Grade 4 & Grade 8 - Private Subsidized - Urban	68	0	63	5	0	0	0
Grade 4 & Grade 8 - Private Paid	40	0	31	7	1	1	0
Total	**184**	**0**	**154**	**16**	**1**	**13**	**0**

Chinese Taipei

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools and newly founded schools without student information
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by urbanization (rural, city, metropolitan)
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 300)
- No overlap between Grade 4 and Grade 8 school samples

Allocation of School Sample in Chinese Taipei, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Rural	26	0	26	0	0	0	0
City	74	0	74	0	0	0	0
Metropolitan	50	0	49	1	0	0	0
Total	**150**	**0**	**149**	**1**	**0**	**0**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools and newly founded schools without student information
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by urbanization (rural, city, metropolitan), and school academic performance on Basic Competence Test (6)
- No implicit stratification
- Sampled one classroom per school
- No overlap between Grade 4 and Grade 8 school samples

Allocation of School Sample in Chinese Taipei, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Rural - Category D	8	0	8	0	0	0	0
Rural - Category T	24	0	24	0	0	0	0
Rural - Category Y	12	0	12	0	0	0	0
Rural - Other Categories	10	0	10	0	0	0	0
City - Category A	10	0	10	0	0	0	0
City - Category B	16	0	16	0	0	0	0
City - Category D	16	0	16	0	0	0	0
City - Category T	12	0	12	0	0	0	0
City - Category Y	16	0	16	0	0	0	0
City - Category Z	8	0	8	0	0	0	0
Metropolitan - Category A	20	0	20	0	0	0	0
Metropolitan - Category B	12	0	12	0	0	0	0
Metropolitan - Category D	10	0	10	0	0	0	0
Metropolitan - Category T	8	0	8	0	0	0	0
Metropolitan - Category Y	8	0	8	0	0	0	0
Total	**190**	**0**	**190**	**0**	**0**	**0**	**0**

Croatia

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 3), special needs schools, and private schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by school type (single, mother, satellite), urbanization (urban, rural), and grouped regions (6)
- No implicit stratification
- Sampled two classrooms in large schools (measure of size >60)

Allocation of School Sample in Croatia, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Single Building School - Urban - Central and East	12	0	12	0	0	0	0
Single Building School - Urban - South	10	0	10	0	0	0	0
Single Building School - Urban - North and West	10	0	10	0	0	0	0
Single Building School - Urban - City of Zagreb	24	0	24	0	0	0	0
Single Building School - Rural - Central and East	8	0	8	0	0	0	0
Single Building School - Rural - South, North and West	8	0	8	0	0	0	0
Mother School - Urban - Central and East	18	0	17	1	0	0	0
Mother School - Urban - South	10	0	10	0	0	0	0
Mother School - Urban - North, West and Zagreb	8	0	8	0	0	0	0
Mother School - Rural - Central and East	10	0	10	0	0	0	0
Mother School - Rural - South, North and West	12	0	12	0	0	0	0
Satellites - Urban - Central and East	8	1	7	0	0	0	0
Satellites - Urban - South, North, West and Zagreb	8	1	7	0	0	0	0
Satellites - Rural - Central and East	12	1	10	1	0	0	0
Satellites - Rural - South, North and West	10	2	8	0	0	0	0
Total	**168**	**5**	**161**	**2**	**0**	**0**	**0**

Cyprus

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5), special needs schools, French language, and Turkish Occupied Area
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by districts (4)
- Implicit stratification by urbanization (urban, rural)
- Sampled three classrooms whenever possible in large schools (measure of size > 46)

Allocation of School Sample in Cyprus, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Famagusta-Larnaca	37	0	37	0	0	0	0
Limassol	40	0	40	0	0	0	1
Nicosia	54	0	54	0	0	0	1
Paphos	17	0	17	0	0	0	0
Total	**148**	**0**	**148**	**0**	**0**	**0**	**2**

Czech Republic

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 4), special needs schools, and Polish language schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by region (14)
- No implicit stratification
- Sampled two classrooms per school

Allocation of School Sample in Czech Republic, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Praha	16	0	16	0	0	0	0
Stredoceský	18	0	18	0	0	0	0
Plzenský	8	1	7	0	0	0	0
Karlovarský	8	0	8	0	0	0	0
Ústecký	12	0	12	0	0	0	0
Jihoceský	8	0	8	0	0	0	0
Liberecký	10	0	10	0	0	0	0
Královéhradecký	8	0	8	0	0	0	0
Pardubický	10	0	10	0	0	0	0
Vysocina	8	0	8	0	0	0	0
Jihomoravský	20	0	20	0	0	0	0
Olomoucký	8	0	8	0	0	0	0
Moravskoslezský	16	0	16	0	0	0	0
Zlínský	10	0	10	0	0	0	0
Total	**160**	**1**	**159**	**0**	**0**	**0**	**0**

Denmark

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5), and special needs schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by school type (public, private)
- No implicit stratification
- Sampled one classroom per school

Allocation of School Sample in Denmark, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Private	30	0	11	9	4	6	0
Public	190	8	102	56	11	13	0
Total	**220**	**8**	**113**	**65**	**15**	**19**	**0**

Egypt

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 12)
- No within-school exclusions

Sample Design

- Explicit stratification by region (Capital, North, South), school type (5), urbanization (urban, rural) and school gender (boys, girls, mixed)
- No implicit stratification
- Sampled one classroom per school

Allocation of School Sample in Egypt, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Capital - Government - Boys	18	0	16	2	0	0	0
Capital - Government - Girls	18	0	16	2	0	0	0
Capital - Government - Mixed	14	0	13	1	0	0	0
North - Government - Urban - Boys	8	0	8	0	0	0	0
North - Government - Urban - Girls	8	0	8	0	0	0	0
North - Government - Urban - Mixed	8	0	6	2	0	0	0
North - Government - Rural - Boys/Girls	8	0	8	0	0	0	0
North - Government - Rural - Mixed	36	0	35	1	0	0	0
South - Government - Urban	12	0	11	1	0	0	0
South - Government - Rural - Boys/Girls	8	0	8	0	0	0	0
South - Government - Rural - Mixed	28	0	28	0	0	0	0
Private Funded (without fees)	8	0	7	1	0	0	0
Private (with fees)	20	0	20	0	0	0	0
Private Language Schools	20	0	13	4	0	3	0
Total	**214**	**0**	**197**	**14**	**0**	**3**	**0**

England

Fifth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 9), special needs schools, and international schools
- Within-school exclusions consisted of students with intellectual disabilities

Sample Design

- Explicit stratification by school type (state-funded, private), and attainment level (5)
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 90)
- Samples for Grade 4 and Grade 8 were drawn separately and no overlap between the two samples

Allocation of School Sample in England, Fifth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
State-Funded - Low	28	0	26	2	0	0	0
State-Funded - Low/Mid	28	0	26	2	0	0	0
State-Funded - Mid	28	0	27	0	0	1	0
State-Funded - Mid/High	28	0	27	0	0	1	0
State-Funded - High	30	0	28	1	0	1	0
Private	8	0	8	0	0	0	0
Total	**150**	**0**	**142**	**5**	**0**	**3**	**0**

Ninth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 9), special needs schools, and international schools
- Within-school exclusions consisted of students with intellectual disabilities

Sample Design

- Explicit stratification by school type (state-funded, private), and attainment level (5)

- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 200)
- Samples for Grade 4 and Grade 8 were drawn separately and no overlap between the two samples

Allocation of School Sample in England, Ninth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
State-Funded - Low	24	0	21	1	1	1	0
State-Funded - Low/Mid	28	0	24	3	0	1	0
State-Funded - Mid	28	0	25	1	0	2	0
State-Funded - Mid/High	30	0	28	1	0	1	0
State-Funded - High	30	0	30	0	0	0	0
Private	10	2	7	1	0	0	0
Total	**150**	**2**	**135**	**7**	**1**	**5**	**0**

Finland

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools, and instructional language other than Finnish or Sweden
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by region (6), and urbanization (urban and semi-urban, rural)
- No implicit stratification
- Sampled two classrooms per school

Allocation of School Sample in Finland, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Uusimaa	38	0	38	0	0	0	0
Southern Urban & Semi-Urban	22	0	21	1	0	0	0
Southern Rural	8	0	8	0	0	0	0
Western Urban & Semi-Urban	30	0	30	0	0	0	0
Western Rural	8	1	7	0	0	0	0
Eastern Urban & Semi-Urban	12	0	12	0	0	0	0
Eastern Rural	8	1	7	0	0	0	0
Northern Urban & Semi-Urban	16	0	16	0	0	0	0
Northern Rural	8	0	8	0	0	0	0
Swedish Schools	10	0	10	0	0	0	0
Total	**160**	**2**	**157**	**1**	**0**	**0**	**0**

France

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 3), overseas territories, Reunion and Mayotte Islands, Guyana (Southern Hemisphere), private schools without contract, specialized schools, and French schools in foreign countries
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by school type (public–priority education zone, public–other, private)
- No implicit stratification
- Sampled two classrooms per school
- TIMSS 2015 samples and PIRLS 2016 samples were selected simultaneously to avoid overlap between the two studies

Allocation of School Sample in France, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Public-priority education zone	44	0	43	1	0	0	0
Public-other	100	1	97	2	0	0	0
Private	22	0	19	2	0	1	0
Total	**166**	**1**	**159**	**5**	**0**	**1**	**0**

Georgia

Fourth Grade

Coverage and Exclusions

- Coverage is 90.4 percent. Coverage in Georgia is restricted to students taught in Georgian.
- School-level exclusions consisted of very small schools (measure of size < 5)
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 4'/'Grade 4 and Grade 8' schools, region (4), and Mathematics average score (low, medium, high)
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 90)
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap

Allocation of School Sample in Georgia, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 4	8	1	7	0	0	0	0
Grade 4 & Grade 8 - aWara - Low Average Math Score	8	2	6	0	0	0	0
Grade 4 & Grade 8 - aWara - Medium Average Math Score	8	0	8	0	0	0	0
Grade 4 & Grade 8 - aWara - High Average Math Score	8	0	7	1	0	0	0
Grade 4 & Grade 8 - dasavleTi - Low Average Math Score	12	0	12	0	0	0	0
Grade 4 & Grade 8 - dasavleTi - Medium Average Math Score	14	0	14	0	0	0	0
Grade 4 & Grade 8 - dasavleTi - High Average Math Score	12	0	12	0	0	0	0
Grade 4 & Grade 8 - aRmosavleTi - Low Average Math Score	12	2	10	0	0	0	0
Grade 4 & Grade 8 - aRmosavleTi - Medium Average Math Score	14	2	12	0	0	0	0
Grade 4 & Grade 8 - aRmosavleTi - High Average Math Score	12	0	12	0	0	0	0
Grade 4 & Grade 8 - Tbilisi - Low Average Math Score	14	0	14	0	0	0	0
Grade 4 & Grade 8 - Tbilisi - Medium Average Math Score	18	0	18	0	0	0	0
Grade 4 & Grade 8 - Tbilisi - High Average Math Score	14	0	13	1	0	0	0
Grade 4 & Grade 8 - All but aRmosavleTi - Missing Math Score	7	1	6	0	0	0	1
Total	**161**	**8**	**151**	**2**	**0**	**0**	**1**

Eighth Grade

Coverage and Exclusions

- Coverage is 89.6 percent. Coverage in Georgia is restricted to students taught in Georgian.
- School-level exclusions consisted of very small schools (measure of size < 5)
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 8'/'Grade 4 and Grade 8' schools, region (4), and Mathematics average score (low, medium, high)
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 80)
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap

Allocation of School Sample in Georgia, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 8	7	1	6	0	0	0	1
Grade 4 & Grade 8 - aWara - Low Average Math Score	8	1	7	0	0	0	0
Grade 4 & Grade 8 - aWara - Medium Average Math Score	8	0	8	0	0	0	0
Grade 4 & Grade 8 - aWara - High Average Math Score	8	0	7	1	0	0	0
Grade 4 & Grade 8 - dasavleTi - Low Average Math Score	12	0	12	0	0	0	0
Grade 4 & Grade 8 - dasavleTi - Medium Average Math Score	14	0	14	0	0	0	0
Grade 4 & Grade 8 - dasavleTi - High Average Math Score	12	0	12	0	0	0	0
Grade 4 & Grade 8 - aRmosavleTi - Low Average Math Score	12	2	10	0	0	0	0
Grade 4 & Grade 8 - aRmosavleTi - Medium Average Math Score	14	2	12	0	0	0	0
Grade 4 & Grade 8 - aRmosavleTi - High Average Math Score	12	0	12	0	0	0	0
Grade 4 & Grade 8 - Tbilisi - Low Average Math Score	14	0	14	0	0	0	0
Grade 4 & Grade 8 - Tbilisi - Medium Average Math Score	18	0	18	0	0	0	0
Grade 4 & Grade 8 - Tbilisi - High Average Math Score	14	0	13	1	0	0	0
Grade 4 & Grade 8 - All but aRmosavleTi - Missing Math Score	7	1	6	0	0	0	1
Total	**160**	**7**	**151**	**2**	**0**	**0**	**2**

Germany

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by immigration status (4) and school type (regular, special education needs)
- No implicit stratification
- Sampled one classroom per school

Allocation of School Sample in Germany, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Regular Schools - Very low percentage of immigrants	62	0	58	3	0	1	0
Regular Schools - Low percentage of immigrants	94	2	90	2	0	0	0
Regular Schools - Medium percentage of immigrants	28	0	28	0	0	0	0
Regular Schools - High percentage of immigrants	16	0	16	0	0	0	0
SEN Schools - None	10	0	7	0	0	3	0
Total	**210**	**2**	**199**	**5**	**0**	**4**	**0**

Hong Kong

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools and schools teaching in Japanese
- Within-school exclusions consisted of students with intellectual disabilities and students with functional disabilities

Sample Design

- Explicit stratification by school finance type (5)
- No implicit stratification
- Sampled one classroom per school
- No overlap between Grade 4 and Grade 8 school samples

Allocation of School Sample in Hong Kong, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Aided	122	0	97	5	4	16	0
Direct Subsidy	8	0	8	0	0	0	0
Government	10	0	9	0	0	1	0
Non-Local	10	0	3	0	0	7	0
Private	10	0	6	0	0	4	0
Total	**160**	**0**	**123**	**5**	**4**	**28**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools and schools teaching in Japanese
- Within-school exclusions consisted of students with intellectual disabilities and students with functional disabilities

Sample Design

- Explicit stratification by school finance type (4)
- Implicit stratification by other school characteristic (3)
- Sampled one classroom per school
- No overlap between Grade 4 and Grade 8 school samples
- Systematic sampling selection with equal probabilities is used for sampling

Allocation of School Sample in Hong Kong, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Aided	118	0	96	6	1	15	0
Direct Subsidy	22	0	13	0	2	7	0
Government	10	0	9	0	0	1	0
Non-Local	8	0	5	0	1	2	0
Total	**158**	**0**	**123**	**6**	**4**	**25**	**0**

Hungary

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools and students taught in foreign language
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 4'/'Grade 4 and Grade 8' schools, national assessment score (below or above average performance), and type of community (capital and county town, town, rural area) within 'Grade 4 and Grade 8' stratum
- No implicit stratification
- Sampled two classrooms per school
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap

Allocation of School Sample in Hungary, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 4	22	1	21	0	0	0	0
Grade 4 & Grade 8 - Above Average Performance - Capital & County Town	36	2	34	0	0	0	0
Grade 4 & Grade 8 - Above Average Performance - Town	25	0	25	0	0	0	0
Grade 4 & Grade 8 - Above Average Performance - Rural Area	14	0	13	0	1	0	0
Grade 4 & Grade 8 - Below Average or Unknown Performance - Capital & County Town	9	1	7	0	0	1	0
Grade 4 & Grade 8 - Below Average or Unknown Performance - Town	21	1	20	0	0	0	0
Grade 4 & Grade 8 - Below Average or Unknown Performance - Rural Area	23	0	23	0	0	0	0
Total	**150**	**5**	**143**	**0**	**1**	**1**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools and students taught in foreign language
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 8'/'Grade 4 and Grade 8', national assessment score (below or above average performance), and type of community (capital and county town, town, rural area) within 'Grade 4 and Grade 8' stratum
- No implicit stratification
- Sampled two classrooms per school
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap

Allocation of School Sample in Hungary, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 8 - Above Average Performance	15	0	13	2	0	0	0
Grade 8 - Below Average or Unknown Performance	7	0	6	1	0	0	0
Grade 4 & Grade 8 - Above Average Performance - Capital & County Town	36	2	34	0	0	0	0
Grade 4 & Grade 8 - Above Average Performance - Town	25	0	25	0	0	0	0
Grade 4 & Grade 8 - Above Average Performance - Rural Area	14	0	13	0	1	0	0
Grade 4 & Grade 8 - Below Average or Unknown Performance - Capital & County Town	9	1	7	0	0	1	0
Grade 4 & Grade 8 - Below Average or Unknown Performance - Town	21	1	20	0	0	0	0
Grade 4 & Grade 8 - Below Average or Unknown Performance - Rural Area	23	1	22	0	0	0	0
Total	**150**	**5**	**140**	**3**	**1**	**1**	**0**

Indonesia

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 4) and remote areas
- No within-school exclusions

Sample Design

- Explicit stratification by performance (good, moderate, poor), school type (general, Madrasah) and school status (private, public)
- No implicit stratification
- Sampled two classrooms per school

Allocation of School Sample in Indonesia, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Good - General - Private	8	0	8	0	0	0	0
Good - General - Public	44	0	44	0	0	0	0
Good - Madrasah	8	0	8	0	0	0	0
Moderate - General - Private	8	0	8	0	0	0	0
Moderate - General - Public	86	0	86	0	0	0	0
Moderate - Madrasah	12	0	12	0	0	0	0
Poor - General - Private	8	0	8	0	0	0	0
Poor - General - Public	48	0	48	0	0	0	0
Poor - Madrasah	8	0	8	0	0	0	0
Total	**230**	**0**	**230**	**0**	**0**	**0**	**0**

Iran

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5), special needs schools, and geographically inaccessible schools
- Within-school exclusions consisted of students with functional disabilities

Sample Design

- Explicit stratification by school type (public, private), gender (mixed, girls, boys), region group (1, 2, 3), province or grouped provinces (6), and gender (boys, girls) within 'other' gender public schools
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 108)
- Grade 4 and Grade 8 school samples were selected simultaneously with no overlap
- TIMSS and TIMSS Numeracy booklets were rotated within classes

Allocation of School Sample in Iran, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Private	16	0	16	0	0	0	0
Public - Mixed - Region group 1	10	0	10	0	0	0	0
Public - Mixed - Region group 2	8	0	8	0	0	0	0
Public - Mixed - Region group 3	8	0	8	0	0	0	0
Public - Girls - Region group 1 - Khozestan	12	1	11	0	0	0	0
Public - Girls - Region group 1 - All Others	12	0	12	0	0	0	0
Public - Girls - Region group 2 - Razavi Khorasan	12	0	12	0	0	0	0
Public - Girls - Region group 2 - Tehran Province	12	0	12	0	0	0	0
Public - Girls - Region group 2 - All Others	10	0	10	0	0	0	0

Allocation of School Sample in Iran, Fourth Grade (Continued)

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Public - Girls - Region group 3 - Esfahan	12	0	12	0	0	0	0
Public - Girls - Region group 3 - Fars	12	0	12	0	0	0	0
Public - Girls - Region group 3 - Tehran City	12	0	12	0	0	0	0
Public - Girls - Region group 3 - All Others	10	0	10	0	0	0	0
Public - Boys - Region group 1 - Khozestan	12	0	12	0	0	0	0
Public - Boys - Region group 1 - All Others	12	0	12	0	0	0	0
Public - Boys - Region group 2 - Razavi Khorasan	12	0	12	0	0	0	0
Public - Boys - Region group 2 - Tehran Province	12	0	12	0	0	0	0
Public - Boys - Region group 2 - All Others	10	0	10	0	0	0	0
Public - Boys - Region group 3 - Esfahan	12	0	12	0	0	0	0
Public - Boys - Region group 3 - Fars	12	0	12	0	0	0	0
Public - Boys - Region group 3 - Tehran City	12	0	12	0	0	0	0
Public - Boys - Region group 3 - All Others	10	1	9	0	0	0	0
Total	**250**	**2**	**248**	**0**	**0**	**0**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5), special needs schools, and geographically inaccessible schools
- Within-school exclusions consisted of students with functional disabilities and non-native language speakers

Sample Design

- Explicit stratification by school type (public, private), gender (mixed, girls, boys), region group (1, 2, 3), province or grouped provinces (6), and gender (boys, girls) within 'other' gender public schools
- No implicit stratification
- Sampled one classroom per school
- Grade 4 and Grade 8 school samples were selected simultaneously with no overlap

Allocation of School Sample in Iran, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Private	14	0	14	0	0	0	0
Public - Mixed	8	0	8	0	0	0	0
Public - Girls - Region group 1 - Khozestan	12	0	12	0	0	0	0
Public - Girls - Region group 1 - All Others	16	0	16	0	0	0	0
Public - Girls - Region group 2 - Razavi Khorasan	12	0	12	0	0	0	0
Public - Girls - Region group 2 - Tehran Province	12	0	12	0	0	0	0
Public - Girls - Region group 2 - All Others	12	0	12	0	0	0	0
Public - Girls - Region group 3 - Esfahan	12	0	12	0	0	0	0

Allocation of School Sample in Iran, Eighth Grade (Continued)

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Public - Girls - Region group 3 - Fars	12	0	12	0	0	0	0
Public - Girls - Region group 3 - Tehran City	12	0	12	0	0	0	0
Public - Girls - Region group 3 - All Others	14	0	14	0	0	0	0
Public - Boys - Region group 1 - Khozestan	12	0	12	0	0	0	0
Public - Boys - Region group 1 - All Others	16	0	16	0	0	0	0
Public - Boys - Region group 2 - Razavi Khorasan	12	0	12	0	0	0	0
Public - Boys - Region group 2 - Tehran Province	12	0	12	0	0	0	0
Public - Boys - Region group 2 - All Others	12	0	12	0	0	0	0
Public - Boys - Region group 3 - Esfahan	12	0	12	0	0	0	0
Public - Boys - Region group 3 - Fars	12	0	12	0	0	0	0
Public - Boys - Region group 3 - Tehran City	12	0	12	0	0	0	0
Public - Boys - Region group 3 - All Others	14	0	14	0	0	0	0
Total	**250**	**0**	**250**	**0**	**0**	**0**	**0**

Ireland

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5)
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by school level socioeconomic status DEIS (urban band 1, urban band 2, rural), language of instruction (Gaelscoil, Gaeltacht, ordinary), and gender (boys, girls, mixed)
- Implicit stratification by location (cities, rural)
- Sampled two classrooms per school
- The school sample for TIMSS at Grade 4 was selected by controlling for the overlap with another National Study sample using the Chowdhury approach. No overlap between Grade 4 and Grade 8 samples.

Allocation of School Sample in Ireland, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Gaelscoil	10	0	10	0	0	0	0
Gaeltacht Schools	8	0	8	0	0	0	0
Non-DEIS - Ordinary - Boys	12	0	12	0	0	0	0
Non-DEIS - Ordinary - Girls	10	0	10	0	0	0	0
Non-DEIS - Ordinary - Mixed	77	0	77	0	0	0	0
DEIS Rural - Ordinary	10	0	10	0	0	0	0
DEIS Urban Band 1 - Ordinary	12	0	12	0	0	0	0
DEIS Urban Band 2 - Ordinary	10	0	10	0	0	0	0
Total	**149**	**0**	**149**	**0**	**0**	**0**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 15)

- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by school sector (community/comprehensive, secondary, vocational), socioeconomic status (high, medium, low) and gender (boys, girls, mixed)
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 147)
- No overlap between Grade 4 and Grade 8 samples

Allocation of School Sample in Ireland, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Community/ comprehensive – High SES	8	0	8	0	0	0	0
Community/ comprehensive - Low SES	8	0	8	0	0	0	0
Community/ comprehensive - Med SES	10	0	10	0	0	0	0
Secondary - High SES - Boys	12	0	11	0	0	1	0
Secondary - High SES - Girls	16	0	16	0	0	0	0
Secondary - High SES - Mixed	12	0	12	0	0	0	0
Secondary - Low SES	12	0	12	0	0	0	0
Secondary - Med SES - Boys	10	0	10	0	0	0	0
Secondary - Med SES - Girls	12	0	12	0	0	0	0
Secondary - Med SES - Mixed	10	0	10	0	0	0	0
Vocational - High SES	10	0	10	0	0	0	0
Vocational - Low SES	18	0	18	0	0	0	0
Vocational - Med SES	12	0	12	0	0	0	0
Total	**150**	**0**	**149**	**0**	**0**	**1**	**0**

Israel

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5), special needs schools, English or French schools, and Ultra-Orthodox schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by school sector (4), socioeconomic status (high, medium, low) and subgroups within Arab sector (Arab/Druze, Bedouin)
- No implicit stratification
- Sampled one classroom per school

Allocation of School Sample in Israel, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Hebrew-Secular - High SES	52	0	48	2	2	0	0
Hebrew-Secular - Medium SES	42	0	35	5	2	0	0
Hebrew-Secular - Low SES	12	0	10	2	0	0	0
Hebrew-Religious - High SES	10	0	9	0	1	0	0
Hebrew-Religious - Medium SES	16	0	15	1	0	0	0
Hebrew-Religious - Low SES	10	0	9	1	0	0	0
Arabic-Arab/Druze-Medium SES	14	0	14	0	0	0	0
Arabic-Arab/Druze-Low SES	30	0	28	1	1	0	0
Arabic - Bedouin	14	0	14	0	0	0	0
Total	**200**	**0**	**182**	**12**	**6**	**0**	**0**

Italy

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5), Slovenian language schools, Ladin language schools, and German language schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by school type (private, public), region (6) within public schools. A census of schools was taken in Bolzano.
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 110)
- The school sample for TIMSS at Grade 8 was selected by controlling for the overlap with the sample at Grade 4 using the Chowdhury approach
- In Bolzano schools or class were used as variance estimation strata and classes or half classes were used to build jackknife replicates. Two classrooms selected within these schools whenever possible.

Allocation of School Sample in Italy, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Private	10	0	8	1	1	1	0
Public - Center	26	0	20	4	1	1	0
Public - South and Islands	22	0	17	5	0	0	0
Public - North East (without Bolzano)	26	0	21	5	0	0	0
Public - North West	36	0	30	5	1	0	0
Public - South	28	0	23	5	0	0	0
Bolzano	18	0	17	0	0	1	0
Total	**166**	**0**	**136**	**25**	**3**	**2**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5), Slovenian language schools, Ladin language schools, and German language schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by school type (private, public), region (6) within public schools. A census of schools was taken in Bolzano.
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 130)
- The school sample for TIMSS at Grade 8 was selected by controlling for the overlap with the sample at Grade 4 using the Chowdhury approach
- In Bolzano schools or class were used as variance estimation strata and classes or half classes were used to build jackknife replicates. Two classrooms selected within these schools whenever possible.

Allocation of School Sample in Italy, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Private	8	0	8	0	0	0	0
Public - Center	22	0	15	6	0	1	0
Public - South and Islands	23	0	16	4	1	2	0
Public - North East (without Bolzano)	26	0	21	5	0	0	0
Public - North West	34	0	29	4	1	0	0
Public - South	34	0	27	7	0	0	0
Bolzano	18	0	17	0	0	1	0
Total	**165**	**0**	**133**	**26**	**2**	**4**	**0**

Japan

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by urbanization (4)
- No implicit stratification
- Sampled one classroom per school
- No overlap between grade 4 and grade 8 school samples

Allocation of School Sample in Japan, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Very Large City	37	0	35	1	0	1	0
Large City	25	0	23	2	0	0	0
Small City	72	1	70	1	0	0	0
Non-City Area	16	0	15	1	0	0	0
Total	**150**	**1**	**143**	**5**	**0**	**1**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by urbanization (4) and school type (public junior high school, other)
- No implicit stratification
- Sampled one classroom per school
- No overlap between Grade 4 and Grade 8 school samples

Allocation of School Sample in Japan, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Public Junior High School - Very Large City	31	0	30	1	0	0	0
Public Junior High School - Large City	24	0	23	1	0	0	0
Public Junior High School - Small City	67	1	66	0	0	0	0
Public Junior High School - Non-City Area	14	0	13	1	0	0	0
National School, Private School or Public Combined Junior and Senior High School	14	0	10	2	0	2	0
Total	**150**	**1**	**142**	**5**	**0**	**2**	**0**

Jordan

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- No school level exclusions
- Within-school exclusions consisted of students with functional disabilities, and students with intellectual disabilities

Sample Design

- Explicit stratification by school type (6) and achievement (6)
- Implicit stratification by gender
- Sampled two classrooms in the strata where all schools were taken
- The school sample for TIMSS Numeracy at Grade 4 was selected by controlling for the overlap with the sample at Grade 8 using the Chowdhury approach
- In census strata, schools or classes were used as variance estimation strata and classes or half classes were used to build jackknife replicates

Allocation of School Sample in Jordan, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Madrasiti	41	0	41	0	0	0	0
Public	73	1	72	0	0	0	0
Discovery	38	2	36	0	0	0	0
ERSP	44	0	44	0	0	0	0
UNRWA	24	0	24	0	0	0	0
Private	37	0	37	0	0	0	0
Total	**257**	**3**	**254**	**0**	**0**	**0**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- No school level exclusions
- Within-school exclusions consisted of students with functional disabilities and students with intellectual disabilities

Sample Design

- Explicit stratification by school type (6) and achievement (6)
- Implicit stratification by region or grouped regions
- Sampled two classrooms in the strata where all schools were taken
- The school sample for TIMSS Numeracy at Grade 4 was selected by controlling for the overlap with the sample at Grade 8 using the Chowdhury approach
- In census strata, schools or classes were used as variance estimation strata and classes or half classes were used to build jackknife replicates

Allocation of School Sample in Jordan, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Madrasiti	47	1	46	0	0	0	0
Public	80	4	76	0	0	0	0
Discovery	36	2	34	0	0	0	0
ERSP	43	1	42	0	0	0	0
UNRWA	26	0	26	0	0	0	0
Private	28	0	28	0	0	0	0
Total	**260**	**8**	**252**	**0**	**0**	**0**	**0**

Kazakhstan

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 4), special needs schools, and Uzbek, Uighur, Tadjik only schools
- No within-school exclusions

Sample Design

- Explicit stratification by 'Grade 4'/'Grade 4 and Grade 8' schools, region (4), urbanization (urban, rural), and language (Kazakh, Russian, both languages, other languages)
- No implicit stratification
- Sampled two classrooms in certain strata
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap

Allocation of School Sample in Kazakhstan, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 4	8	1	5	1	1	0	0
Grade 4 & Grade 8 - Region A - Urban - Kazakh and Russian	8	0	8	0	0	0	0
Grade 4 & Grade 8 - Region A - Rural - Kazakh	16	0	14	1	1	0	0
Grade 4 & Grade 8 - Region B - Urban - Kazakh and Russian	8	0	8	0	0	0	0
Grade 4 & Grade 8 - Region B - Rural - Kazakh	8	0	8	0	0	0	0
Grade 4 & Grade 8 - Region C - Urban - Kazakh	10	0	10	0	0	0	0
Grade 4 & Grade 8 - Region C - Urban - Kazakh and Russian	12	0	12	0	0	0	0
Grade 4 & Grade 8 - Region C - Rural - Kazakh	8	0	7	1	0	0	0

Allocation of School Sample in Kazakhstan, Fourth Grade (Continued)

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 4 & Grade 8 - Region C - Rural - Kazakh and Russian	8	0	8	0	0	0	0
Grade 4 & Grade 8 - Region D - Urban - Kazakh	8	0	8	0	0	0	0
Grade 4 & Grade 8 - Region D - Urban - Kazakh and Russian	8	0	8	0	0	0	0
Grade 4 & Grade 8 - Region D - Rural - Kazakh	8	0	8	0	0	0	0
Grade 4 & Grade 8 - Region D - Rural - Kazakh and Russian	8	0	7	0	1	0	0
Grade 4 & Grade 8 - All Regions - Urban - Russian	16	0	16	0	0	0	0
Grade 4 & Grade 8 - All Regions - Rural - Russian	8	0	8	0	0	0	0
Grade 4 & Grade 8 - All Regions - Other Languages	8	0	4	0	0	4	0
Grade 4 & Grade 8 - Regions A and B - Urban - Kazakh	12	0	12	0	0	0	0
Grade 4 & Grade 8 - Regions A and B - Rural - Kazakh and Russian	14	0	14	0	0	0	0
Total	**176**	**1**	**165**	**3**	**3**	**4**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 4), special needs schools, and Uzbek, Uighur, Tadjik only schools
- No within-school exclusions

Sample Design

- Explicit stratification by 'Grade 8'/'Grade 4 and Grade 8' schools, region (4), urbanization (urban, rural), and language (Kazakh, Russian, both languages, other languages)
- No implicit stratification
- Sampled two classrooms in certain strata
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap

Allocation of School Sample in Kazakhstan, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 8	8	0	8	0	0	0	0
Grade 4 & Grade 8 - Region A - Urban - Kazakh and Russian	8	0	8	0	0	0	0
Grade 4 & Grade 8 - Region A - Rural - Kazakh	16	0	14	1	1	0	0
Grade 4 & Grade 8 - Region B - Urban - Kazakh and Russian	8	0	8	0	0	0	0
Grade 4 & Grade 8 - Region B - Rural - Kazakh	8	0	8	0	0	0	0
Grade 4 & Grade 8 - Region C - Urban - Kazakh	10	0	10	0	0	0	0
Grade 4 & Grade 8 - Region C - Urban - Kazakh and Russian	12	0	12	0	0	0	0
Grade 4 & Grade 8 - Region C - Rural - Kazakh	8	0	7	1	0	0	0
Grade 4 & Grade 8 - Region C - Rural - Kazakh and Russian	8	0	8	0	0	0	0
Grade 4 & Grade 8 - Region D - Urban - Kazakh	8	0	8	0	0	0	0
Grade 4 & Grade 8 - Region D - Urban - Kazakh and Russian	8	0	8	0	0	0	0

Allocation of School Sample in Kazakhstan, Eighth Grade (Continued)

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 4 & Grade 8 - Region D - Rural - Kazakh	8	0	8	0	0	0	0
Grade 4 & Grade 8 - Region D - Rural - Kazakh and Russian	8	0	7	0	1	0	0
Grade 4 & Grade 8 - All Regions - Urban - Russian	16	0	16	0	0	0	0
Grade 4 & Grade 8 - All Regions - Rural - Russian	8	0	8	0	0	0	0
Grade 4 & Grade 8 - All Regions - Other Languages	8	0	4	0	0	4	0
Grade 4 & Grade 8 - Regions A and B - Urban - Kazakh	12	0	12	0	0	0	0
Grade 4 & Grade 8 - Regions A and B - Rural - Kazakh and Russian	14	0	14	0	0	0	0
Total	**176**	**0**	**168**	**2**	**2**	**4**	**0**

Korea

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5), remote schools, and special needs schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by urbanization (urban, suburban, rural)
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 180)
- No overlap between Grade 4 and Grade 8 school samples

Allocation of School Sample in Korea, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Urban	62	0	62	0	0	0	0
Suburban	64	0	64	0	0	0	0
Rural	24	1	23	0	0	0	0
Total	**150**	**1**	**149**	**0**	**0**	**0**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5), remote schools, special needs schools, and physical education middle school
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by urbanization (urban, suburban, rural), and school gender (boys, girls, mixed)
- No implicit stratification
- Sampled one classroom per school
- No overlap between Grade 4 and Grade 8 school samples

Allocation of School Sample in Korea, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Urban - Boys	10	0	10	0	0	0	0
Urban - Girls	10	0	10	0	0	0	0
Urban - Mixed	35	0	35	0	0	0	0
Suburban - Boys	10	0	10	0	0	0	0
Suburban - Girls	10	0	10	0	0	0	0
Suburban - Mixed	35	0	35	0	0	0	0
Rural - Boys	10	0	10	0	0	0	0
Rural - Girls	10	0	10	0	0	0	0
Rural - Mixed	20	0	20	0	0	0	0
Total	**150**	**0**	**150**	**0**	**0**	**0**	**0**

Kuwait

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools and minority language schools
- Within-school exclusions consisted of students with intellectual disabilities

Sample Design

- Explicit stratification by school type (public, private), region (6), and gender (girls, boys) within public schools, and language (Arabic, foreign, bilingual) within private schools
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 80)
- Samples for TIMSS Main Data Collection and samples for PIRLS Field Test and Main Data Collection were drawn simultaneously to avoid overlap

Allocation of School Sample in Kuwait, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Public - Asema - Girls	10	0	10	0	0	0	0
Public - Asema - Boys	11	0	11	0	0	0	0
Public - Hawally - Girls	8	0	8	0	0	0	0
Public - Hawally - Boys	8	0	8	0	0	0	0
Public - Farwaniya - Girls	11	0	11	0	0	0	0
Public - Farwaniya - Boys	12	0	12	0	0	0	0
Public - Ahmadi - Girls	12	0	12	0	0	0	0
Public - Ahmadi - Boys	13	0	13	0	0	0	0
Public - Jahra - Girls	10	0	10	0	0	0	0
Public - Jahra - Boys	10	0	10	0	0	0	0
Public - Mubarak Alkabeer - Girls	8	0	8	0	0	0	0
Public - Mubarak Alkabeer - Boys	7	0	7	0	0	0	0
Private - Arabic	18	1	17	0	0	0	0
Private - Foreign	29	0	20	0	0	9	0
Private - Bilingual	9	0	9	0	0	0	0
Total	**176**	**1**	**166**	**0**	**0**	**9**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools and minority language schools
- No within-school exclusions

Sample Design

- Explicit stratification by school type (public, private), region (6), and gender (girls, boys) within public schools and language (Arabic, foreign and bilingual) within private schools
- No implicit stratification
- Sampled one classroom per school except for the census strata where two classrooms were selected
- No overlap between Grade 4 and Grade 8 school samples
- Census in public Mubarek Alkabeer schools (girls and boys)
- In census strata, classes were used to build jackknife replicates for variance estimation. Two classrooms selected within these schools

Allocation of School Sample in Kuwait, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Public - Asema - Girls	10	0	10	0	0	0	0
Public - Asema - Boys	10	0	10	0	0	0	0
Public - Hawally - Girls	10	0	10	0	0	0	0
Public - Hawally - Boys	10	0	10	0	0	0	0
Public - Farwaniya - Girls	10	0	10	0	0	0	0
Public - Farwaniya - Boys	10	0	10	0	0	0	0
Public - Ahmadi - Girls	12	0	12	0	0	0	0
Public - Ahmadi - Boys	12	0	12	0	0	0	0
Public - Jahra - Girls	10	0	10	0	0	0	0
Public - Jahra - Boys	10	0	10	0	0	0	0
Private - Arabic	30	1	29	0	0	0	0
Public - Mubarek Alkabeer - Male	11	0	11	0	0	0	0
Public - Mubarek Alkabeer - BoysGirls	11	0	11	0	0	0	0
Private - Foreign and Bilingual	22	0	13	0	0	9	0
Total	**178**	**1**	**168**	**0**	**0**	**9**	**0**

Lebanon

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 8)
- No within-school exclusions

Sample Design

- Explicit stratification school type (public, private, unknown) and by performance level (higher, lower)
- Implicit stratification by region (7)
- Sampled two classrooms in large schools (measure of size > 90)

Allocation of School Sample in Lebanon, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Public	44	0	44	0	0	0	0
Private	94	0	62	18	3	11	0
Unknown	12	0	10	1	0	1	0
Total	**150**	**0**	**116**	**19**	**3**	**12**	**0**

Lithuania

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5), special needs schools, and language of instruction other than Lithuanian, Russian, or Polish
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 4' / 'Grade 4 and Grade 8' schools, and language (5)
- Implicit stratification by urbanization (Capital, other major cities, cities, small cities, and villages)
- Sampled two classrooms whenever possible
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap
- Census in Russian, Polish, and bilingual schools
- In census strata, schools or classes were used as variance estimation strata and classes or half classes were used to build jackknife replicates. Class group option was used in bilingual schools.

Allocation of School Sample in Lithuania, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 4 - Lithuanian	30	0	30	0	0	0	0
Grade 4 - Russian	5	0	5	0	0	0	0
Grade 4 - Polish	8	1	7	0	0	0	0
Grade 4 - Bilingual with Lithuanian	3	1	2	0	0	0	0
Grade 4 - Bilingual with Russian and Polish	1	0	1	0	0	0	0
Grade 4 & Grade 8 - Lithuanian	120	1	117	2	0	0	0
Grade 4 & Grade 8 - Russian	23	1	22	0	0	0	0
Grade 4 & Grade 8 - Polish	23	1	22	0	0	0	1
Grade 4 & Grade 8 - Bilingual with Lithuanian	6	0	6	0	0	0	0
Grade 4 & Grade 8 - Bilingual with Russian and Polish	11	0	11	0	0	0	0
Total	**230**	**5**	**223**	**2**	**0**	**0**	**1**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 7), special needs schools, and language of instruction other than Lithuanian, Russian, or Polish
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 8' / 'Grade 4 and Grade 8' schools, and language (5)
- Implicit stratification by urbanization (Capital, other major cities, cities, small cities, and villages)
- Sampled two classrooms whenever possible
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap.
- Census in Russian, Polish, and bilingual schools
- In census strata, schools or classes were used as variance estimation strata and classes or half classes were used to build jackknife replicates. Class group option was used in bilingual schools.

Allocation of School Sample in Lithuania, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 8 - Lithuanian	16	0	14	2	0	0	0
Grade 8 - Russian	3	0	3	0	0	0	0
Grade 8 - Polish	7	2	5	0	0	0	0
Grade 8 - Bilingual with Lithuanian	1	0	1	0	0	0	0
Grade 4 & Grade 8 - Lithuanian	120	0	118	2	0	0	0
Grade 4 & Grade 8 - Russian	23	1	22	0	0	0	0
Grade 4 & Grade 8 - Polish	24	0	24	0	0	0	0
Grade 4 & Grade 8 - Bilingual with Lithuanian	6	0	6	0	0	0	0
Grade 4 & Grade 8 - Bilingual with Russian and Polish	11	0	11	0	0	0	0
Total	**211**	**3**	**204**	**4**	**0**	**0**	**0**

Malaysia

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 15), special needs schools, schools located in remote area, and schools that do not follow national curriculum
- Within-school exclusions consisted of students with intellectual disabilities and students with functional disabilities

Sample Design

- Explicit stratification by school type (6), score level (6), and urbanization (rural, urban)
- No implicit stratification
- Sampled two classrooms in Ministry of Education daily schools
- Ministry of Education fully residential schools were oversampled

Allocation of School Sample in Malaysia, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
MOE Daily School - Very Low	1	0	1	0	0	0	0
MOE Daily School - Low - Rural	18	0	18	0	0	0	0
MOE Daily School - Low - Urban	12	0	12	0	0	0	0
MOE Daily School - Mid-Low - Rural	14	0	14	0	0	0	0
MOE Daily School - Mid-Low - Urban	12	0	12	0	0	0	0
MOE Daily School - Mid-High - Rural	12	0	12	0	0	0	0
MOE Daily School - Mid-High - Urban	16	0	16	0	0	0	0
MOE Daily School - High	14	0	14	0	0	0	0
MOE Daily School - Very High	20	0	20	0	0	0	0
MOE Fully Residential School - Mid-High	8	0	8	0	0	0	0
MOE Fully Residential School - High	53	0	53	0	0	0	0
MOE Religious School	8	0	8	0	0	0	0
MARA Junior Science College	8	0	8	0	0	0	0
Non-Moe Religious School	8	0	8	0	0	0	0
Private School	3	0	3	0	0	0	5
Total	**207**	**0**	**207**	**0**	**0**	**0**	**5**

Malta

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 8), special needs schools, and language schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- No explicit stratification
- Implicit stratification by school type (state, church, independent) and gender (male, female, co-educational)
- All classrooms were sampled
- All schools and all students at Grade 8 (Year 9) were selected
- Classes were used as variance estimation strata and half classes were used to build jackknife replicates. All classrooms selected within schools.

Allocation of School Sample in Malta, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
None	48	0	48	0	0	0	0
Total	**48**	**0**	**48**	**0**	**0**	**0**	**0**

Morocco

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 6)
- No within-school exclusions

Sample Design

- Explicit stratification by school type (private, public) and region (16)
- Implicit stratification by urbanization (urban, rural) within public sector
- Sampled two classrooms in public schools from the region of Oued eddahab Lagouira
- No overlap between Grade 4 and Grade 8 school samples
- Schools at the regional level were oversampled. Census in the region of Oued eddahab Lagouira.
- In census strata, schools or classes were used as variance estimation strata and classes or half classes were used to build jackknife replicates

Allocation of School Sample in Morocco, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Private - Grand Casablanca	12	0	12	0	0	0	0
Private - All Other Regions	28	0	28	0	0	0	0
Public - Chaouia Ouardigha	20	1	19	0	0	0	0
Public - Doukkala Abda	20	0	20	0	0	0	0
Public - Fes Boulmane	20	0	20	0	0	0	0
Public - Gharb Chrarda Beni Hssein	20	0	20	0	0	0	0
Public - Goulmim Smara	20	0	20	0	0	0	0
Public - Grand Casablanca	20	0	20	0	0	0	0
Public - Laayoune Boujdour Sakia Hamra	20	0	20	0	0	0	0
Public - Marrakech Tansift Haouz	20	0	20	0	0	0	0
Public - Meknes Tafilalt	20	0	20	0	0	0	0
Public - Oued Eddahab Lagouira	21	0	20	0	0	1	0
Public - Rabat Salé Zemmour Zaer	20	0	20	0	0	0	0
Public - Région Est	20	0	20	0	0	0	0
Public - Souss Massa Draa	20	0	20	0	0	0	0
Public - Tadla Azilal	20	0	20	0	0	0	0
Public - Tanger Tetouan	20	0	20	0	0	0	0
Public - Taza Hoceima Taounate	20	1	19	0	0	0	0
Total	**361**	**2**	**358**	**0**	**0**	**1**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 10)
- No within-school exclusions

Sample Design

- Explicit stratification by school type (private, public) and region (16)
- Implicit stratification by urbanization (urban, rural) within public sector
- Sampled two classrooms in public schools from the region of Oued eddahab Lagouira and Laayoune Boujdour Sakia Hamra
- No overlap between Grade 4 and Grade 8 school samples
- Schools at the regional level were oversampled. Census in the region of Oued eddahab Lagouira and Laayoune Boujdour Sakia Hamra.
- In census strata, schools or classes were used as variance estimation strata, and classes or half classes were used to build jackknife replicates

Allocation of School Sample in Morocco, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Private - Grand Casablanca	12	2	10	0	0	0	0
Private - All Other Regions	28	4	24	0	0	0	0
Public - Chaouia Ouardigha	20	0	20	0	0	0	0
Public - Doukkala Abda	20	1	19	0	0	0	0
Public - Fes Boulmane	20	0	20	0	0	0	0
Public - Gharb Chrarda Beni Hssein	20	0	20	0	0	0	0
Public - Goulmim Smara	20	0	20	0	0	0	0
Public - Grand Casablanca	20	0	20	0	0	0	0
Public - Laayoune Boujdour Sakia Hamra	24	0	24	0	0	0	0
Public - Marrakech Tansift Haouz	20	0	20	0	0	0	0
Public - Meknes Tafilalt	20	0	20	0	0	0	0
Public - Oued Eddahab Lagouira	9	0	9	0	0	0	0
Public - Rabat Salé Zemmour Zaer	20	0	20	0	0	0	0
Public - Région Est	20	1	19	0	0	0	0
Public - Souss Massa Draa	20	0	20	0	0	0	0
Public - Tadla Azilal	20	0	20	0	0	0	0
Public - Tanger Tetouan	20	0	20	0	0	0	0
Public - Taza Hoceima Taounate	20	0	20	0	0	0	0
Total	**353**	**8**	**345**	**0**	**0**	**0**	**0**

Netherlands

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 6) and special needs schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by Combinations of TIMSS and PIRLS socioeconomic status (5), and urbanization (5)
- No implicit stratification
- All classrooms were sampled
- TIMSS 2015 samples and PIRLS 2016 samples were selected simultaneously to avoid overlap

Allocation of School Sample in Netherlands, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
TIMSS & PIRLS High Mean SES - Very High Population Density	8	0	6	0	1	1	0
TIMSS & PIRLS High Mean SES - High Population Density	14	0	5	4	1	4	0
TIMSS & PIRLS High Mean SES - Moderate Population Density	16	0	11	3	1	1	0
TIMSS & PIRLS High Mean SES - Low Population Density	16	0	7	5	2	2	0
TIMSS & PIRLS High Mean SES - Very Low Population Density	16	0	10	3	2	1	0
TIMSS High & PIRLS Medium Mean SES - High to Very High Population Density	10	0	3	2	2	3	0
TIMSS High & PIRLS Medium Mean SES - Low to Moderate Population Density	14	0	8	6	0	0	0
TIMSS & PIRLS Medium Mean SES - High to Very High Population Density	10	0	4	0	3	3	0
TIMSS & PIRLS Medium Mean SES - Low to Moderate Population Density	12	0	8	3	0	1	0
TIMSS Medium & PIRLS Low Mean SES - High to Very High Population Density	14	1	4	7	1	1	0
TIMSS Medium & PIRLS Low Mean SES - Low to Moderate Population Density	10	0	4	4	2	0	0
TIMSS & PIRLS Low Mean SES	10	1	4	1	2	2	0
Total	**150**	**2**	**74**	**38**	**17**	**19**	**0**

New Zealand

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 4), special needs schools, correspondence schools, Maori-medium Level 1 immersion schools, and mostly students in Level 1-2 immersion units schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by school type (state, independent), socioeconomic status (low, moderately low, moderately high, high), and urbanisation (major urban centers, smaller centers)
- No implicit stratification
- Sampled two classrooms per school
- The school sample for TIMSS at Grade 8 was selected by controlling for the overlap with the sample at Grade 4 using the Chowdhury approach

Allocation of School Sample in New Zealand, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Independent schools	9	0	8	0	0	1	0
Low SES schools - from major urban centers	24	0	16	5	1	2	0
Low SES schools - from smaller centers	8	0	5	2	0	1	0
Moderately low SES schools - from major urban centers	26	0	21	3	2	0	0
Moderately low SES schools - from smaller centers	16	0	14	1	0	1	0
Moderately high SES schools - from major urban centers	32	0	27	3	1	1	0
Moderately high SES schools - from smaller centers	18	0	13	3	0	2	0
High SES schools - from major urban centers	41	0	35	5	1	0	0
High SES schools - from smaller centers	8	0	8	0	0	0	0
Total	**182**	**0**	**147**	**22**	**5**	**8**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 4), special needs schools, correspondence schools, Maori-medium Level 1 immersion schools, and mostly students in Level 1-2 immersion units schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by school type (state, independent), socioeconomic status (low, moderately low, moderately high, high), urbanisation (major urban centers, smaller centers), and gender (boys, girls, co-educational)
- No implicit stratification

- Sampled two classrooms per school
- The school sample for TIMSS at Grade 8 was selected by controlling for the overlap with the sample at Grade 4 using the Chowdhury approach
- Within schools, classes were stratified by performance level and one class from each level was selected

Allocation of School Sample in New Zealand, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Independent schools	8	0	8	0	0	0	0
Low SES schools - from major urban centers	12	0	9	3	0	0	0
Low SES schools - from smaller centers	8	0	6	1	0	1	0
Moderately low SES schools - from major urban centers - Coed	20	0	12	4	0	4	0
Moderately low SES schools - from major urban centers - Others	8	0	6	1	0	1	0
Moderately low SES schools - from smaller centers -	12	0	12	0	0	0	0
Moderately high SES schools - from major urban centers - Coed	26	0	18	5	0	3	0
Moderately high SES schools - from major urban centers - Boys	10	0	7	1	0	2	0
Moderately high SES schools - from major urban centers - Girls	8	0	6	2	0	0	0
Moderately high SES schools - from smaller centers -	16	0	14	2	0	0	0
High SES schools - Coed	18	0	11	3	0	4	0
High SES schools - Boys	8	0	5	1	0	2	0
High SES schools - Girls	8	0	6	2	0	0	0
Total	**162**	**0**	**120**	**25**	**0**	**17**	**0**

Northern Ireland

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 6) and special needs schools
- Within-school exclusions consisted of students with intellectual disabilities

Sample Design

- Explicit stratification by region (5) and deprivation (5)
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 58)
- TIMSS 2015 sample and PIRLS 2016 samples were drawn simultaneously to avoid overlap

Allocation of School Sample in Northern Ireland, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Belfast - Lower Deprivation	10	0	4	1	0	5	0
Belfast - Highest Deprivation	12	0	5	1	1	5	0
Western - Lower Deprivation	10	0	8	1	1	0	0
Western - Moderate to High Deprivation	10	0	8	0	0	2	0
Western - Highest Deprivation	8	0	5	1	0	2	0
North Eastern - Lowest Deprivation	8	0	6	1	1	0	0
North Eastern - Low to Moderate Deprivation	12	0	8	0	0	4	0
North Eastern - Higher Deprivation	14	0	10	1	0	3	0
South Eastern - Lowest Deprivation	12	0	8	0	0	4	0
South Eastern - Low to Moderate Deprivation	8	0	4	0	1	3	0
South Eastern - Higher Deprivation	14	0	9	1	1	3	0
Southern - Lower Deprivation	12	0	7	2	1	2	0
Southern - Moderate Deprivation	12	0	11	1	0	0	0
Southern - Higher Deprivation	12	0	7	2	0	3	0
Total	**154**	**0**	**100**	**12**	**6**	**36**	**0**

Norway (5 and 9)

Fifth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 4), Sami language schools, international schools, and remote schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 5' / 'Grade 5 and Grade 9' schools, language (Bokmål, Nynorsk), and municipality size (small, medium, large)
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 35)
- Grade 5 and Grade 9 school samples were selected simultaneously with minimum overlap

Allocation of School Sample in Norway, Fifth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 5 - Bokmål - Small Municipalities	8	0	8	0	0	0	0
Grade 5 - Bokmål - Medium Municipalities	28	0	26	0	0	2	0
Grade 5 - Bokmål - Large Municipalities	66	0	63	0	0	3	0
Grade 5 - Nynorsk	14	0	13	0	0	1	0
Grade 5 & Grade 9 - Bokmål - Small Municipalities	8	0	8	0	0	0	0
Grade 5 & Grade 9 - Bokmål - Medium Municipalities	8	0	7	0	0	1	0
Grade 5 & Grade 9 - Bokmål - Large Municipalities	10	0	8	0	0	2	0
Grade 5 & Grade 9 - Nynorsk	8	0	7	0	0	1	0
Total	**150**	**0**	**140**	**0**	**0**	**10**	**0**

Ninth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 6), Sami language schools, international schools, and remote schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 9' / 'Grade 5 and Grade 9' schools, language (Bokmål, Nynorsk) and municipality size (small, medium, large)
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 90)
- Grade 5 and Grade 9 school samples were selected simultaneously with minimum overlap

Allocation of School Sample in Norway, Ninth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 9 - Bokmål - Small Municipalities	8	0	7	0	0	1	0
Grade 9 - Bokmål - Medium Municipalities	26	0	26	0	0	0	0
Grade 9 - Bokmål - Large Municipalities	64	0	61	0	0	3	0
Grade 9 - Nynorsk	12	0	11	0	0	1	0
Grade 5 & Grade 9 - Bokmål - Small Municipalities	8	0	8	0	0	0	0
Grade 5 & Grade 9 - Bokmål - Medium Municipalities	8	0	6	0	0	2	0
Grade 5 & Grade 9 - Bokmål - Large Municipalities	16	0	16	0	0	0	0
Grade 5 & Grade 9 - Nynorsk	8	0	8	0	0	0	0
Total	**150**	**0**	**143**	**0**	**0**	**7**	**0**

Oman

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 4) and special needs schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by governorates (11) and school type (government, private, international)
- No implicit stratification
- Sampled two classrooms in census strata or in large schools from other strata
- The school sample for TIMSS at Grade 8 was selected by controlling for the overlap with the sample at Grade 4 using the Chowdhury approach
- Census in AL Buraimi, Musandam, and Al Wusta Governorate strata
- In census strata schools or classes were used as variance estimation strata and classes or half classes were used to build jackknife replicates. Two classrooms selected within these schools.

Allocation of School Sample in Oman, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Ad Dakhliyah Governorate	26	0	26	0	0	0	0
Adh Dhahirah Governorate	26	0	26	0	0	0	0
Al Batinah North Governorate	30	0	30	0	0	0	0
Al Batinah South Governorate	26	0	26	0	0	0	0
Al Buraimi Governorate	15	0	15	0	0	0	0
Al Wusta Governorate	20	0	20	0	0	0	0
Ash Sharqiyah North Governorate	26	2	24	0	0	0	0
Ash Sharqiyah South Governorate	26	0	26	0	0	0	0
Dhofar Governorate	26	0	26	0	0	0	0
Musandam Governorate	7	0	7	0	0	0	0
Muscat Governorate	28	0	28	0	0	0	0
Private Schools	26	1	24	1	0	0	0
International Schools	26	0	18	2	1	5	0
Total	**308**	**3**	**296**	**3**	**1**	**5**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 4) and special needs schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by governorates (11), and special school type (government, private, international)
- Implicit stratification by gender (3)
- Sampled two classrooms in census strata or in large schools from other strata

- The school sample for TIMSS at Grade 8 was selected by controlling for the overlap with the sample at Grade 4 using the Chowdhury approach
- Census in AL Buraimi, Musandam, and Al Wusta Governorate strata
- In census strata schools or classes were used as variance estimation strata and classes or half classes were used to build jackknife replicates. Two classrooms selected within these schools.

Allocation of School Sample in Oman, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Ad Dakhliyah Governorate	24	0	24	0	0	0	0
Adh Dhahirah Governorate	25	0	25	0	0	0	0
Al Batinah North Governorate	30	0	30	0	0	0	0
Al Batinah South Governorate	26	0	26	0	0	0	0
Al Buraimi Governorate	13	0	13	0	0	0	0
Al Wusta Governorate	22	0	22	0	0	0	0
Ash Sharqiyah North Governorate	26	1	25	0	0	0	0
Ash Sharqiyah South Governorate	26	0	26	0	0	0	0
Dhofar Governorate	26	0	26	0	0	0	0
Musandam Governorate	12	0	12	0	0	0	0
Muscat Governorate	27	1	26	0	0	0	0
Private Schools	27	0	27	0	0	0	0
International Schools	26	0	18	1	0	7	0
Total	**310**	**2**	**300**	**1**	**0**	**7**	**0**

Poland

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5), special needs schools, and language of instruction other than Polish
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by urbanization (4) and school performance level (5)
- No implicit stratification
- Sampled two classrooms per school

Allocation of School Sample in Poland, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Village - Low Performance	14	0	14	0	0	0	0
Village - Medium-Low Performance	10	0	10	0	0	0	0
Village - Medium Performance	10	0	10	0	0	0	0
Village - Medium-High Performance	10	0	10	0	0	0	0
Village - High Performance	12	0	11	1	0	0	0
Town (Up to 20 Thousand Inhabitants) - Medium-Low Performance	8	0	7	1	0	0	0
Town (Up to 20 Thousand Inhabitants) - Medium-High Performance	10	0	9	1	0	0	0
City (20 to 100 Thousand Inhabitants) - Low Performance	10	0	9	1	0	0	0
City (20 to 100 Thousand Inhabitants) - Medium-Low Performance	8	0	7	1	0	0	0
City (20 to 100 Thousand Inhabitants) - Medium-High Performance	8	0	7	1	0	0	0
City (20 to 100 Thousand Inhabitants) - High Performance	10	0	9	1	0	0	0
City (Above 100 Thousand Inhabitants) - Low Performance	10	0	9	1	0	0	0
City (Above 100 Thousand Inhabitants) - Medium-Low Performance	10	0	10	0	0	0	0
City (Above 100 Thousand Inhabitants) - Medium-High Performance	10	0	7	2	1	0	0
City (Above 100 Thousand Inhabitants) - High Performance	10	0	8	2	0	0	0
Total	**150**	**0**	**137**	**12**	**1**	**0**	**0**

Portugal

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 6), special needs schools, and minority language schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by region (7) and school type (public, private)
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 140)
- No overlap between TIMSS 2015 and PIRLS 2016 main data collection samples except in the 6 smallest strata where all schools are sampled
- Probability proportional to (school) size systematic sampling was used in the 3 largest explicit strata, and systematic sampling selection with equal probabilities was used in all other strata

Allocation of School Sample in Portugal, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Private - Lisboa	8	1	5	2	0	0	0
Private - All Other Regions	12	0	8	3	1	0	0
Public - Alentejo	30	0	28	1	0	1	0
Public - Algarve	8	0	7	1	0	0	0
Public - Centro	48	0	47	1	0	0	0
Public - Lisboa	36	0	31	4	1	0	0
Public - Norte	64	0	57	5	0	2	0
Public - R. A. Açores	8	0	4	1	2	1	0
Public - R. A. Madeira	8	0	6	1	1	0	0
Total	**222**	**1**	**193**	**19**	**5**	**4**	**0**

Qatar

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of instruction not in English or Arabic
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 4'/ 'Grade 4 and Grade 8'
- Implicit stratification by school type (private SEC, independent, community, private foreign) and gender (boys, girls, other)
- Sampled two classrooms in large schools (measure of size > 170)
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap
- Census of schools. Schools having Grade 4 and Grade 8 participated in TIMSS Main Data Collection for both grades.
- Schools or classrooms or half classrooms were used to build jackknife replicates for variance estimation

Allocation of School Sample in Qatar, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 4	134	5	129	0	0	0	0
Grade 4 & Grade 8	83	1	82	0	0	0	3
Total	**217**	**6**	**211**	**0**	**0**	**0**	**3**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of instruction not in English or Arabic
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 8' / 'Grade 4 and Grade 8'

- Implicit stratification by school type (private SEC, independent, community, private foreign) and gender (boys, girls, other)
- Sampled two classrooms whenever possible
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap
- Census of schools. Schools having Grade 4 and Grade 8 participated in TIMSS Main Data Collection for both grades.
- Schools or classrooms or half classrooms were used to build jackknife replicates for variance estimation

Allocation of School Sample in Qatar, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 8	51	0	51	0	0	0	0
Grade 4 & Grade 8	85	2	80	0	0	3	0
Total	**136**	**2**	**131**	**0**	**0**	**3**	**0**

Russian Federation

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 4) and special needs schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by region (42)
- No implicit stratification
- Sampled one classroom per school
- No overlap between Grade 4 and Grade 8 school samples
- An extra sampling stage (regions) was required prior to sampling schools. 28 of 69 regions were selected with probability proportional to the region size and 14 bigger regions were selected with certainty. While each certainty region itself is an explicit stratum, the other sampled regions make one large explicit stratum. In the large explicit stratum, a sample of schools is selected within each region.
- Within regions, schools were selected with probability proportional to (school) size systematic sampling. Schools were sorted (serpentine) by location (up to 7 levels) before being sorted by school size.
- Within the certainty regions, schools were paired for variance calculation purposes. Otherwise, selected regions were paired for variance calculation purposes.

Allocation of School Sample in Russian Federation, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Sankt-Petersburg*	6	0	6	0	0	0	0
Moscow*	14	0	14	0	0	0	0
Moscow region*	10	0	10	0	0	0	0
Nizhni Novgorod region*	4	0	4	0	0	0	0
Perm territory*	4	0	4	0	0	0	0
Samara region*	4	0	4	0	0	0	0
Republic of Tatarstan*	6	0	6	0	0	0	0
Republic of Bashkortostan*	8	0	8	0	0	0	0
Krasnodar territory*	8	0	8	0	0	0	0
Rostov region*	6	0	6	0	0	0	0
Chelyabinsk region*	6	0	6	0	0	0	0
Sverdlovsk region*	8	0	8	0	0	0	0
Krasnoyarsk territory*	4	0	4	0	0	0	0
Republic of Dagestan*	6	0	6	0	0	0	0
Novgorod region	4	0	4	0	0	0	0
Kaliningrad region	4	0	4	0	0	0	0
Vologda region	4	0	4	0	0	0	0
Voronezh region	4	0	4	0	0	0	0
Vladimir region	4	0	4	0	0	0	0
Tula region	4	0	4	0	0	0	0
Bryansk region	4	0	4	0	0	0	0
Ryazan region	4	0	4	0	0	0	0
Kaluga region	4	0	4	0	0	0	0
Republic of Marij El	4	0	4	0	0	0	0
Ulyanovsk region	4	0	4	0	0	0	0
Chuvashi republic	4	0	4	0	0	0	0
Orenburg region	4	0	4	0	0	0	0
Saratov region	4	0	4	0	0	0	0
Astrakhan region	4	0	4	0	0	0	0
Kurgan region	4	0	4	0	0	0	0
Khanty-Mansijsk AD	4	0	4	0	0	0	0

* Certainty Regions

Allocation of School Sample in Russian Federation, Fourth Grade (Continued)

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Irkutsk region	4	0	4	0	0	0	0
Kemerovo region	4	0	4	0	0	0	0
Novosibirsk region	4	0	4	0	0	0	0
Altai territory	4	0	4	0	0	0	0
Zabaikalsk territory	4	0	4	0	0	0	0
Tomsk region	4	0	4	0	0	0	0
Sakhalin region	4	0	4	0	0	0	0
Republic of Sakha (Yakutia)	4	0	4	0	0	0	0
Primorski territory	4	0	4	0	0	0	0
Stravropol territory	4	0	4	0	0	0	0
Kabardino-Balkarian Republic	6	0	6	0	0	0	0
Total	**208**	**0**	**208**	**0**	**0**	**0**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 4), special needs schools, and evening schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by region (42)
- No implicit stratification
- Sampled one classroom per school
- No overlap between Grade 4 and Grade 8 school samples
- An extra sampling stage (regions) was required prior to sampling schools. 28 of 69 regions were selected with probability proportional to the region size and 14 bigger regions were selected with certainty. While each certainty region itself is an explicit stratum, the other sampled regions make one large explicit stratum. In the large explicit stratum, a sample of schools is selected within each region.
- Within regions, schools were selected with probability proportional to (school) size systematic sampling. Schools were sorted (serpentine) by location (up to 7 levels) before being sorted by school size.
- Within the certainty regions, schools were paired for variance calculation purposes. Otherwise, selected regions were paired for variance calculation purposes.

Allocation of School Sample in Russian Federation, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Sankt-Petersburg*	6	0	6	0	0	0	0
Moscow*	12	0	12	0	0	0	0
Moscow region*	10	0	10	0	0	0	0
Perm territory*	4	0	4	0	0	0	0
Samara region*	4	0	4	0	0	0	0
Nizhni Novgorod region*	4	0	4	0	0	0	0
Republic of Tatarstan*	6	0	6	0	0	0	0
Republic of Bashkortostan*	8	0	8	0	0	0	0
Krasnodar territory*	8	0	8	0	0	0	0
Rostov region*	6	0	6	0	0	0	0
Chelyabinsk region*	6	0	6	0	0	0	0
Sverdlovsk region*	6	0	6	0	0	0	0
Krasnoyarsk territory*	4	0	4	0	0	0	0
Republic of Dagestan*	6	0	6	0	0	0	0
Novgorod region	4	0	4	0	0	0	0
Kaliningrad region	4	0	4	0	0	0	0
Arkhangelsk region	4	0	4	0	0	0	0
Voronezh region	4	0	4	0	0	0	0
Belgorod region	4	0	4	0	0	0	0
Vladimir region	4	0	4	0	0	0	0
Lipetzk region	4	0	4	0	0	0	0
Yaroslavl region	4	0	4	0	0	0	0
Kaluga region	4	0	4	0	0	0	0
Kostroma region	4	0	4	0	0	0	0
Ulyanovsk region	4	0	4	0	0	0	0
Chuvashi republic	4	0	4	0	0	0	0
Orenburg region	4	0	4	0	0	0	0
Saratov region	4	0	4	0	0	0	0
Volgograd region	4	0	4	0	0	0	0
Yamalo-Nenets autonomous district	4	0	4	0	0	0	0
Tyumen region	4	0	4	0	0	0	0
Irkutsk region	4	0	4	0	0	0	0

* Certainty Regions

Allocation of School Sample in Russian Federation, Eighth Grade (Continued)

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Kemerovo region	4	0	4	0	0	0	0
Novosibirsk region	4	0	4	0	0	0	0
Altai territory	4	0	4	0	0	0	0
Omsk region	4	0	4	0	0	0	0
Tomsk region	4	0	4	0	0	0	0
Kamchatka territory	4	0	4	0	0	0	0
Khabarovsk territory	4	0	4	0	0	0	0
Primorski territory	4	0	4	0	0	0	0
Stravropol territory	4	0	4	0	0	0	0
Kabardino-Balkarian Republic	6	0	6	0	0	0	0
Total	**204**	**0**	**204**	**0**	**0**	**0**	**0**

Saudi Arabia

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 6) and special needs schools
- Within-school exclusions consisted of students with intellectual disabilities and non-native language speakers

Sample Design

- Explicit stratification by gender (boys, girls), education type (religious, non-religious) and school type (government, non-government) within non-religious schools
- No implicit stratification
- Sampled one classroom per school
- No overlap between Grade 4 and Grade 8 school samples

Allocation of School Sample in Saudi Arabia, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Government - General - Boys	78	2	69	6	1	0	0
Government - General - Girls	78	6	69	2	1	0	0
Non Government - Non-Religious - Boys	12	0	12	0	0	0	0
Non Government - Non-Religious - Girls	10	0	10	0	0	0	0
Other - Religious - Boys	10	0	10	0	0	0	0
Other - Religious - Girls	10	1	8	1	0	0	0
Total	**198**	**9**	**178**	**9**	**2**	**0**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 10) and special needs schools

- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by gender (boys, girls), education type (religious, non-religious) and school type (government, non-government) within non-religious schools
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 215)
- No overlap between Grade 4 and Grade 8 school samples

Allocation of School Sample in Saudi Arabia, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Government - General - Boys	60	6	51	2	1	0	0
Government - General - Girls	60	3	57	0	0	0	0
Non Government - Non-Religious - Boys	10	0	10	0	0	0	0
Non Government - Non-Religious - Girls	8	0	8	0	0	0	0
Other - Religious - Boys	8	2	6	0	0	0	0
Other - Religious - Girls	8	0	8	0	0	0	0
Total	**154**	**11**	**140**	**2**	**1**	**0**	**0**

Serbia

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools, language other than Serbian, and less than 4 children taught in Serbian
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by region (Belgrade, Vojvodina, Central Serbia), urbanization (city, other) and school type (main, branch department)
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 130)

Allocation of School Sample in Serbia, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Belgrade - City	30	0	30	0	0	0	0
Belgrade - Other	8	0	8	0	0	0	0
Vojvodina - City	24	0	23	1	0	0	0
Vojvodina - Other	16	0	16	0	0	0	0
Central Serbia - City	50	0	49	0	1	0	0
Central Serbia - Other - Main Schools	16	0	16	0	0	0	0
Central Serbia - Other - Branch Department Schools	16	0	16	0	0	0	0
Total	**160**	**0**	**158**	**1**	**1**	**0**	**0**

Singapore

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools and private schools
- No within-school exclusions
- For TIMSS 2015, like in all previous cycles, Singapore took a census of all public schools with Grade 4 or Grade 8 students. The sampling frame excluded private schools, which are largely foreign-system schools operating in Singapore and which serve predominantly international students. These foreign-system schools are fundamentally different from the public schools in many respects (e.g., language of instruction; school-calendar year).

Sample Design

- No explicit stratification
- No implicit stratification
- Sampled two classrooms per school
- No overlap between Grade 4 and Grade 8 school samples
- Census of all schools. Within schools, two half classrooms were sampled with probability proportional to the size of the classroom. Within selected classrooms, 19 students were randomly sampled.
- Schools or classes were used as variance estimation strata and classes or half classes were used to build jackknife replicates

Allocation of School Sample in Singapore, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
None	179	0	179	0	0	0	0
Total	**179**	**0**	**179**	**0**	**0**	**0**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools and private schools
- No within-school exclusions

- For TIMSS 2015, like in all previous cycles, Singapore took a census of all public schools with Grade 4 or Grade 8 students. The sampling frame excluded private schools, which are largely foreign-system schools operating in Singapore and which serve predominantly international students. These foreign-system schools are fundamentally different from the public schools in many respects (e.g., language of instruction; school-calendar year).

Sample Design

- No explicit stratification
- No implicit stratification
- Sampled two classrooms per school
- No overlap between Grade 4 and Grade 8 school samples
- Census of all schools. Within schools, two half classrooms were sampled with probability proportional to the size of the classroom. Within selected classrooms, 19 students were randomly sampled.
- Schools or classes were used as variance estimation strata and classes or half classes were used to build jackknife replicates

Allocation of School Sample in Singapore, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
None	167	0	167	0	0	0	0
Total	**167**	**0**	**167**	**0**	**0**	**0**	**0**

Slovakia

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 4), special needs schools, and schools where language of instruction is not Slovak or Hungarian
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by language (Slovak, Hungarian), socioeconomic status (4), and area (5)
- No implicit stratification
- Sampled two classrooms per school

Allocation of School Sample in Slovakia, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Slovak - High Mean SES - Bratislavský	16	0	14	2	0	0	0
Slovak - High Mean SES - North Area	22	1	20	1	0	0	0
Slovak - High Mean SES - South Area	12	0	12	0	0	0	0
Slovak - Low to Medium Mean SES - Bratislavský	10	0	9	0	0	1	0
Slovak - Medium Mean SES - North Area	46	0	46	0	0	0	0
Slovak - Medium Mean SES - South Area	26	0	26	0	0	0	0
Slovak - Low Mean SES - North Area	18	0	18	0	0	0	0
Slovak - Low Mean SES - South Area	28	0	28	0	0	0	0
Hungarian - Košický	10	0	8	0	2	0	0
Hungarian - Other	12	0	12	0	0	0	0
Total	**200**	**1**	**193**	**3**	**2**	**1**	**0**

Slovenia

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools, Italian schools, Waldorf schools, and Montessori schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by performance level (4)
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 50)
- Grade 4 and Grade 8 school samples were selected simultaneously with full overlap

Allocation of School Sample in Slovenia, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Very low math scores	14	0	14	0	0	0	0
Low math scores	46	0	44	1	0	1	0
Medium math scores	46	0	43	3	0	0	0
High math scores	44	0	43	0	0	1	0
Total	**150**	**0**	**144**	**4**	**0**	**2**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools, Italian schools, and Waldorf schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by performance level (4)
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 50)
- Grade 4 and Grade 8 school samples were selected simultaneously with full overlap

Allocation of School Sample in Slovenia, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Very low math scores	14	0	14	0	0	0	0
Low math scores	46	0	44	1	0	1	0
Medium math scores	46	0	43	3	0	0	0
High math scores	44	0	43	0	0	1	0
Total	**150**	**0**	**144**	**4**	**0**	**2**	**0**

South Africa

Fifth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 8) and special needs schools
- No within-school exclusions

Sample Design

- Explicit stratification by school type (independent, public), province (9) within public schools and socioeconomic status (low, medium/high) within independent schools
- Implicit stratification by performance level (lower quintiles, mid quintiles, higher quintiles) and province (GT, other)
- Sampled one classroom per school
- No overlap between Grade 5 and Grade 9 school samples

Allocation of School Sample in South Africa, Fifth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Independent schools - Low fee	27	0	25	2	0	0	1
Independent schools - Med-High fee	12	0	11	1	0	0	0
Public- EC	29	0	29	0	0	0	1
Public- FS	28	0	28	0	0	0	0
Public- GT	28	0	28	0	0	0	0
Public- KZ	30	0	30	0	0	0	0
Public- LP	30	0	30	0	0	0	0
Public- MP	28	0	28	0	0	0	0
Public- NC	28	0	28	0	0	0	0
Public- NW	28	0	28	0	0	0	0
Public- WC	30	1	28	0	1	0	0
Total	**298**	**1**	**293**	**3**	**1**	**0**	**2**

Ninth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 15) and special needs schools
- No within-school exclusions

Sample Design

- Explicit stratification by school type (independent, public), province (9), language (English, Afrikaans, bilingual) and socioeconomic status (low, medium/high)
- Implicit stratification by performance level (lower quintiles, first quintiles, second quintiles, higher quintiles, and other quintiles) and province (GT/WC, other)
- Sampled two classrooms in dual language schools with one class for each language group
- No overlap between Grade 5 and Grade 9 school samples

Allocation of School Sample in South Africa, Ninth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Independent schools - Low fee	26	0	26	0	0	0	0
Independent schools - Med-High fee	12	0	6	4	2	0	0
Public- EC - English	24	3	21	0	0	0	0
Public- FS - English	26	0	26	0	0	0	0
Public- GT - English	22	0	22	0	0	0	0
Public- KZ - English	28	1	26	1	0	0	0
Public- LP - English	28	0	27	1	0	0	0
Public- MP - English	26	0	26	0	0	0	0
Public- NC - Afrikaans	12	0	12	0	0	0	0
Public- NC - Bilingual	8	0	8	0	0	0	0
Public- NC - English	8	0	8	0	0	0	0
Public- NW - English	26	3	23	0	0	0	0
Public- WC - Afrikaans	8	0	8	0	0	0	0
Public- WC - Bilingual	10	0	10	0	0	0	0
Public- WC - English	10	1	9	0	0	0	0
Public- EC, FS, GT, KZ, LP, MP, NW - Afrikaans	12	0	10	2	0	0	0
Public- EC, FS, GT, KZ, LP, MP, NW - Bilingual	14	0	14	0	0	0	0
Total	**300**	**8**	**282**	**8**	**2**	**0**	**0**

Spain

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 4), special needs schools, and international schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by region (7) and school type (public, private)
- No implicit stratification
- Sampled one classroom per school except for the private schools in La Rioja where two classrooms were sampled whenever possible
- Oversampled in Asturias, La Rioja, Castile and Leon, Catalonia, Andalusia and Madrid in order to get better estimates. In La Rioja-private stratum all schools were taken.
- In La Rioja- private stratum, schools or classrooms were used as variance estimation strata and classrooms or half classrooms were used to build jackknife replicates. Two classrooms selected within these schools whenever possible.

Allocation of School Sample in Spain, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Andalusia - Public	30	0	30	0	0	0	0
Andalusia - Private	20	0	20	0	0	0	0
Asturias - Public	30	0	30	0	0	0	0
Asturias - Private	20	0	20	0	0	0	0
Castile and Leon - Public	30	0	26	0	0	4	0
Castile and Leon - Private	20	0	20	0	0	0	0
Catalonia - Public	30	0	30	0	0	0	0
Catalonia - Private	20	0	20	0	0	0	0
La Rioja - Public	27	0	27	0	0	0	0
La Rioja - Private	23	0	23	0	0	0	0
Madrid - Public	26	1	25	0	0	0	0
Madrid - Private	24	0	24	0	0	0	0
Other - Public	44	0	43	0	0	1	0
Other - Private	20	0	19	1	0	0	0
Total	**364**	**1**	**357**	**1**	**0**	**5**	**0**

Sweden

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5), international schools, and special education schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 4' / 'Grade 4 and Grade 8' schools and average achievement for the grade (low, high, missing)
- Implicit stratification by school type (public, private, all)
- Sampled two classrooms in large schools (measure of size > 45)
- The school sample for TIMSS at Grade 4 was selected by controlling for the overlap with the sample at Grade 8 using the Chowdhury approach

Allocation of School Sample in Sweden, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 4	99	4	95	0	0	0	1
Grade 4 & Grade 8 - Missing	10	0	10	0	0	0	0
Grade 4 & Grade 8 - Low	16	1	15	0	0	0	0
Grade 4 & Grade 8 - High	24	0	24	0	0	0	0
Total	**149**	**5**	**144**	**0**	**0**	**0**	**1**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5), international schools, and special education schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by average achievement for the grade (7)
- Implicit stratification by 'Grade 8' / 'Grade 4 and Grade 8' schools
- Sampled two classrooms in large schools (measure of size > 110)
- The school sample for TIMSS at Grade 4 was selected by controlling for the overlap with the sample at Grade 8 using the Chowdhury approach

Allocation of School Sample in Sweden, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Missing	22	2	19	1	0	0	0
Low	26	2	24	0	0	0	0
Low-Medium	26	0	26	0	0	0	0
Medium	28	0	28	0	0	0	0
Medium-High	18	0	18	0	0	0	0
High	16	0	16	0	0	0	0
Very High	18	0	18	0	0	0	0
Total	**154**	**4**	**149**	**1**	**0**	**0**	**0**

Thailand

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 5) and special needs schools
- No within-school exclusions

Sample Design

- Explicit stratification by jurisdiction (7) and region (Bangkok, Central, other) within OBEC2 jurisdiction
- No implicit stratification
- Sampled one classroom per school

Allocation of School Sample in Thailand, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
OBEC1	42	0	41	1	0	0	0
OBEC2 - Bangkok	10	0	9	1	0	0	0
OBEC2 - Central	10	0	10	0	0	0	0
OBEC2 - Other Regions	78	0	78	0	0	0	0
OPEC	22	0	20	1	1	0	0
BMA	10	0	10	0	0	0	0
DLA	12	0	12	0	0	0	0
OHEC	10	0	10	0	0	0	0
SCISCH	10	0	10	0	0	0	0
Total	**204**	**0**	**200**	**3**	**1**	**0**	**0**

Turkey

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools, geographically inaccessible schools, very small schools, and schools with different structure/curriculum
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by urbanization (urban, rural) and statistical regions (12) within urban
- No implicit stratification
- Sampled one classroom per school
- No overlap between Grade 4 and Grade 8 samples

Allocation of School Sample in Turkey, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Rural	40	3	37	0	0	0	0
Urban - TR1-Istanbul	36	4	32	0	0	0	0
Urban - TR2-West Marmara	10	3	7	0	0	0	0
Urban - TR3-Aegean	26	0	26	0	0	0	0
Urban - TR4-East Marmara	16	4	12	0	0	0	0
Urban - TR5-West Anatolia	16	1	15	0	0	0	0
Urban - TR6-Mediterranean	30	0	30	0	0	0	0
Urban - TR7-Central Anatolia	10	1	9	0	0	0	0
Urban - TR8-West Black Sea	10	0	10	0	0	0	0
Urban - TR9-East Black Sea	10	0	10	0	0	0	0
Urban - TRA-Northeast Anatolia	10	0	10	0	0	0	0
Urban - TRB-Centraleast Anatolia	14	1	13	0	0	0	0
Urban - TRC-Southeast Anatolia	32	1	31	0	0	0	0
Total	**260**	**18**	**242**	**0**	**0**	**0**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools, geographically inaccessible schools, very small schools, and schools with different structure/curriculum
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by urbanization (urban, rural) and statistical regions (12) within urban
- No implicit stratification
- Sampled one classroom per school
- No overlap between Grade 4 and Grade 8 samples

Allocation of School Sample in Turkey, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Rural	34	1	33	0	0	0	0
Urban - TR1-Istanbul	30	3	27	0	0	0	0
Urban - TR2-West Marmara	10	3	7	0	0	0	0
Urban - TR3-Aegean	24	1	23	0	0	0	0
Urban - TR4-East Marmara	22	2	20	0	0	0	0
Urban - TR5-West Anatolia	16	4	12	0	0	0	0
Urban - TR6-Mediterranean	20	0	20	0	0	0	0
Urban - TR7-Central Anatolia	10	0	10	0	0	0	0
Urban - TR8-West Black Sea	10	2	8	0	0	0	0
Urban - TR9-East Black Sea	10	0	10	0	0	0	0
Urban - TRA-Northeast Anatolia	10	1	9	0	0	0	0
Urban - TRB-Centraleast Anatolia	14	1	13	0	0	0	0
Urban - TRC-Southeast Anatolia	30	4	26	0	0	0	0
Total	**240**	**22**	**218**	**0**	**0**	**0**	**0**

United Arab Emirates

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 15) in Abu Dhabi and other Emirates, (measure of size < 10) in Dubai, instruction language other than English or Arabic, and geographically inaccessible schools in Emirates other than Dubai and Abu Dhabi
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 4' / 'Grade 4 and Grade 8' schools, Emirates (7), national assessment score (4) and curriculum (Ministry of Education, UK/US/CAD, other). School type (public, private) within Dubai. Region (Abu Dhabi, Al Ain, Western region), school type (public, private), and performance level (low, medium, high) within Abu Dhabi.
- Implicit stratification by educational zones (Ajman, Fujairah, Ras Al Khaimah, Sharjah, Umm Al Quwain) and language of test (Arabic, English, French)
- Sampled two classrooms in schools from the western region, from 'Grade 4' schools in Abu Dhabi, from Dubai and from regions other than Sharjah
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap
- All schools were sampled in all regions except Sharjah, in Western region of Abu Dhabi and in Dubai
- The United Arab Emirates was divided into three large districts: Abu Dhabi (Abu Dhabi, Al Ain, and West region), Dubai, and the rest of the Emirates. All three districts were oversampled.
- In census strata, classes or half classes were used to build jackknife replicates for variance estimation. Two classrooms selected within these schools.

Allocation of School Sample in United Arab Emirates, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 4 - Abu Dhabi - Public - Low Performance	10	0	10	0	0	0	0
Grade 4 - Abu Dhabi - Public - Medium Performance	10	0	10	0	0	0	0
Grade 4 - Abu Dhabi - Public - High Performance	10	0	10	0	0	0	0
Grade 4 - Abu Dhabi - Private	10	1	9	0	0	0	0
Grade 4 - Al Ain - Public - Low Performance	12	0	12	0	0	0	0
Grade 4 - Al Ain - Public - High Performance	10	1	9	0	0	0	0
Grade 4 - Western Region	12	0	12	0	0	0	0
Grade 4 - Dubai - Private	37	0	37	0	0	0	0
Grade 4 - Dubai - Public	25	0	25	0	0	0	0
Grade 4 - Sharjah - No Assessment Score	8	0	8	0	0	0	0
Grade 4 - Sharjah - Low Assessment Score	8	0	8	0	0	0	0
Grade 4 - Sharjah - MediumAssessment Score	8	0	8	0	0	0	0
Grade 4 - Sharjah - High Assessment Score	8	0	8	0	0	0	0
Grade 4 - Other Zones	85	1	84	0	0	0	0
Grade 4 & Grade 8 - Abu Dhabi - Ministry of Education	14	1	13	0	0	0	0
Grade 4 & Grade 8 - Abu Dhabi - UK/ US/CAD	22	2	20	0	0	0	0
Grade 4 & Grade 8 - Abu Dhabi - Other	22	5	17	0	0	0	0

Allocation of School Sample in United Arab Emirates, Fourth Grade (Continued)

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 4 & Grade 8 - Al Ain - UK/US/CAD	12	0	12	0	0	0	0
Grade 4 & Grade 8 - Al Ain - Other	14	0	14	0	0	0	0
Grade 4 & Grade 8 - Western Region	15	0	15	0	0	0	0
Grade 4 & Grade 8 - Dubai - Private	105	2	103	0	0	0	0
Grade 4 & Grade 8 - Dubai - Public	3	0	3	0	0	0	0
Grade 4 & Grade 8 - Sharjah - No Assessment Score - UK/US/Australian	18	0	18	0	0	0	0
Grade 4 & Grade 8 - Sharjah - No Assessment Score - Other	20	0	20	0	0	0	0
Grade 4 & Grade 8 - Sharjah - Medium Assessment Score - Ministry of Education	8	0	8	0	0	0	0
Grade 4 & Grade 8 - Sharjah - High Assessment Score - Ministry of Education	8	1	7	0	0	0	0
Grade 4 & Grade 8 - Other Zones	59	1	58	0	0	0	0
Total	**573**	**15**	**558**	**0**	**0**	**0**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 15) in Abu Dhabi and other Emirates, very small schools (measure of size < 10) in Dubai, special needs and geographically inaccessible schools in Emirates other than Dubai and Abu Dhabi, and language of instruction other than English or Arabic
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 8' / 'Grade 4 and Grade 8' schools, Emirates (7), national assessment score (4) and curriculum (Ministry of Education, UK/US/CAD, other). School type (public, private) within Dubai. Region (Abu Dhabi, Al Ain, Western region), school type (public, private), and performance level (low, medium, high) within Abu Dhabi.
- Implicit stratification by educational zones (Ajman, Fujairah, Ras Al Khaimah, Umm Al Quwain) and language of test (Arabic, English, French)
- Sampled two classrooms in schools from the western region, from 'Grade 8' schools in Abu Dhabi, from Dubai and from regions other than Sharjah
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap
- All schools were sampled in all regions except Sharjah, in Western region of Abu Dhabi and in Dubai.
- In census strata, classes or half classes were used to build jackknife replicates for variance estimation. Two classrooms selected within these schools.

Allocation of School Sample in United Arab Emirates, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 8 - Abu Dhabi - Public - Low Performance	15	0	15	0	0	0	0
Grade 8 - Abu Dhabi - Public - High Performance	16	0	16	0	0	0	0
Grade 8 - Al Ain - Public - Low Performance	10	0	10	0	0	0	0
Grade 8 - Al Ain - Public - High Performance	15	1	14	0	0	0	0
Grade 8 - Western Region	10	0	10	0	0	0	0
Grade 8 - Dubai - Private	7	1	6	0	0	0	0
Grade 8 - Dubai - Public	22	0	22	0	0	0	0
Grade 8 - Sharjah - Low Assessment Score	8	0	8	0	0	0	0

Allocation of School Sample in United Arab Emirates, Eighth Grade (Continued)

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 8 - Sharjah - High Assessment Score	8	0	8	0	0	0	0
Grade 8 - Other Zones	58	0	58	0	0	0	0
Grade 4 & Grade 8 - Abu Dhabi - Ministry of Education	14	0	14	0	0	0	0
Grade 4 & Grade 8 - Abu Dhabi - UK/US/CAD	22	2	20	0	0	0	0
Grade 4 & Grade 8 - Abu Dhabi - Other	22	5	17	0	0	0	0
Grade 4 & Grade 8 - Al Ain - UK/US/CAD	12	0	12	0	0	0	0
Grade 4 & Grade 8 - Al Ain - Other	14	0	14	0	0	0	0
Grade 4 & Grade 8 - Western Region	15	1	14	0	0	0	0
Grade 4 & Grade 8 - Dubai - Private	105	1	104	0	0	0	0
Grade 4 & Grade 8 - Dubai - Public	3	0	3	0	0	0	0
Grade 4 & Grade 8 - Sharjah - No Assessment Score - UK/US/Australian	18	0	18	0	0	0	0
Grade 4 & Grade 8 - Sharjah - No Assessment Score - Other	20	0	20	0	0	0	0
Grade 4 & Grade 8 - Sharjah - Medium Assessment Score - Ministry of Education	8	0	8	0	0	0	0
Grade 4 & Grade 8 - Sharjah - High Assessment Score - Ministry of Education	8	0	8	0	0	0	0
Grade 4 & Grade 8 - Other Zones	59	1	58	0	0	0	0
Total	**489**	**12**	**477**	**0**	**0**	**0**	**0**

United States

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- No school level exclusions
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by poverty level (high, low), school type (public, private), and census region (4)
- Implicit stratification by urbanization (city, suburb, town, rural) and ethnicity status (above 15% non-White students in a school, below 15% non-White students in a school)
- Sampled two classrooms per school
- No overlap between Grade 4 and Grade 8 school samples

Allocation of School Sample in United States, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
High poverty - Public - Census region 1	17	0	10	0	0	7	0
High poverty - Public - Census region 2	26	1	21	3	0	1	0
High poverty - Public - Census region 3	68	2	61	3	0	2	0
High poverty - Public - Census region 4	37	0	29	0	0	8	0
Low poverty - Private - Census region 1	6	0	3	1	0	2	0
Low poverty - Private - Census region 2	6	0	4	1	0	1	0
Low poverty - Private - Census region 3	9	0	5	2	0	2	0
Low poverty - Private - Census region 4	5	0	1	2	0	2	0
Low poverty - Public - Census region 1	26	0	13	4	0	9	0
Low poverty - Public - Census region 2	31	0	25	3	0	3	0
Low poverty - Public - Census region 3	39	0	35	2	0	2	0
Low poverty - Public - Census region 4	29	1	21	1	0	6	1
Total	**299**	**4**	**228**	**22**	**0**	**45**	**1**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- No school level exclusions
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by poverty level (high, low), school type (public, private) and census region (4)
- Implicit stratification by urbanization (city, suburb, town, rural) and ethnicity status (above 15% non-White students in a school, below 15% non-White students in a school)
- Sampled two classrooms per school
- No overlap between Grade 4 and Grade 8 school samples

Allocation of School Sample in United States, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
High poverty - Public - Census region 1	15	0	11	1	0	3	0
High poverty - Public - Census region 2	23	1	18	0	0	4	0
High poverty - Public - Census region 3	63	2	54	4	0	3	0
High poverty - Public - Census region 4	34	0	29	0	0	5	0
Low poverty - Private - Census region 1	6	0	3	3	0	0	0
Low poverty - Private - Census region 2	6	0	5	0	0	1	0
Low poverty - Private - Census region 3	8	0	6	1	0	1	0
Low poverty - Private - Census region 4	5	2	2	1	0	0	0
Low poverty - Public - Census region 1	29	0	18	0	0	11	0
Low poverty - Public - Census region 2	36	0	28	4	0	4	0
Low poverty - Public - Census region 3	43	0	36	3	0	4	0
Low poverty - Public - Census region 4	32	2	19	0	0	11	0
Total	**300**	**7**	**229**	**17**	**0**	**47**	**0**

Characteristics of Benchmarking Participants

Buenos Aires, Argentina

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools, and federal government schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 4' / 'Grade 4 and Grade 8' schools (2), school type (public, private) and socioeconomic status (low, medium, high)
- No implicit stratification
- Sampled all classrooms
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap

Allocation of School Sample in Buenos Aires, Argentina, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 4 - Private - Low Mean SES	8	0	7	0	0	1	0
Grade 4 - Private - Medium Mean SES	8	0	4	1	0	3	0
Grade 4 - Private - High Mean SES	8	0	7	1	0	0	0
Grade 4 - Public - Low Mean SES	28	0	22	2	1	3	0
Grade 4 - Public - Medium Mean SES	28	0	22	2	0	4	0
Grade 4 - Public - High Mean SES	12	0	12	0	0	0	0
Grade 4 & Grade 8 - Private - Low Mean SES	12	0	12	0	0	0	0
Grade 4 & Grade 8 - Private - Medium Mean SES	20	0	16	2	0	2	0
Grade 4 & Grade 8 - Private - High Mean SES	18	0	17	0	0	1	0
Grade 4 & Grade 8 - Public - All Mean SESs	8	0	8	0	0	0	0
Total	**150**	**0**	**127**	**8**	**1**	**14**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of special needs schools and federal government schools
- No within-school exclusions

Sample Design

- Explicit stratification by 'Grade 8' / 'Grade 4 and Grade 8' schools (2), school type (public, private), and socioeconomic status (low, medium, high)
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 280)
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap

Allocation of School Sample in Buenos Aires, Argentina, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 8 - Private - Low Mean SES	8	0	7	1	0	0	0
Grade 8 - Private - Medium Mean SES	8	0	7	0	0	1	0
Grade 8 - Private - High Mean SES	8	0	8	0	0	0	0
Grade 8 - Public - Low Mean SES	26	0	19	1	0	6	0
Grade 8 - Public - Medium Mean SES	26	0	19	2	0	5	0
Grade 8 - Public - High Mean SES	16	0	12	1	0	3	0
Grade 4 & Grade 8 - Private - Low Mean SES	12	0	11	0	0	1	0
Grade 4 & Grade 8 - Private - Medium Mean SES	20	0	17	1	0	2	0
Grade 4 & Grade 8 - Private - High Mean SES	18	0	16	0	0	2	0
Grade 4 & Grade 8 - Public - All Mean SESs	8	0	6	0	0	2	0
Total	**150**	**0**	**122**	**6**	**0**	**22**	**0**

Ontario, Canada

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 6), special needs schools, and First Nations schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 4' / 'Grade 4 and Grade 8' schools, language (French, English), and school type (public, Catholic, private)
- Implicit stratification by regional office (Thunder Bay/Sudbury/London, Barrie/Ottawa, Toronto and Area)
- Sampled two classrooms per school
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap

Allocation of School Sample in Ontario, Canada, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 4 - Private	8	0	3	0	0	5	0
Grade 4 - English - Catholic	8	0	8	0	0	0	0
Grade 4 - English - Public	40	0	39	0	0	1	0
Grade 4 - French - Catholic & Public	8	0	8	0	0	0	0
Grade 4 & Grade 8 - English - Catholic	36	1	35	0	0	0	0
Grade 4 & Grade 8 - English - Public	59	0	58	0	0	1	1
Total	**159**	**1**	**151**	**0**	**0**	**7**	**1**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 6), special needs schools, and First Nations schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 8' / 'Grade 4 and Grade 8' schools, language (French, English), and school type (public, Catholic, private)
- Implicit stratification by regional office (Thunder Bay/Sudbury/London, Barrie/Ottawa, Toronto and Area)
- Sampled two classrooms in large schools (measure of size > 50)
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap

Allocation of School Sample in Ontario, Canada, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 8 - Private	8	0	0	2	1	5	0
Grade 8 - English - Catholic	8	1	7	0	0	0	0
Grade 8 - English - Public	32	0	30	0	0	2	0
Grade 8 - French - Catholic & Public	8	0	7	0	0	1	0
Grade 4 & Grade 8 - English - Catholic	36	1	34	0	0	1	0
Grade 4 & Grade 8 - English - Public	59	2	57	0	0	0	1
Total	**151**	**4**	**135**	**2**	**1**	**9**	**1**

Quebec, Canada

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 10), special needs schools, international schools, federal schools, and school boards with special status
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by school type (private, public) and language (English, French)
- Implicit stratification by Mathematics average score (3)
- Sampled two classrooms in large schools (measure of size > 80)
- Grade 4 and Grade 8 school samples were selected separately

Allocation of School Sample in Quebec, Canada, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Private - English	8	0	8	0	0	0	0
Private - French	8	0	8	0	0	0	0
Public - English	40	0	38	1	0	1	2
Public - French	118	0	47	16	3	52	0
Total	**174**	**0**	**101**	**17**	**3**	**53**	**2**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 10), special needs schools, international schools, federal schools, and school boards with special status
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by school type (private, public) and language (English, French)
- Implicit stratification by Mathematics average score (3)
- Sampled two classrooms in large schools (measure of size > 450)
- Grade 4 and Grade 8 school samples were selected separately

Allocation of School Sample in Quebec, Canada, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Private - English	12	0	11	0	0	1	0
Private - French	26	1	25	0	0	0	0
Public - English	38	0	36	1	0	1	0
Public - French	100	1	30	19	0	50	0
Total	**176**	**2**	**102**	**20**	**0**	**52**	**0**

Norway (4 and 8)

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 4), language other than Bokmal and Nynorsk, international schools, and remote schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 5' / 'Grade 5 and Grade 9' / 'Grade 4 only' schools, language (Bokmål, Nynorsk), and municipality size (small, medium, large)
- No implicit stratification
- Grade 4 school sample corresponds to the Grade 5 school sample, with an additional sample selected from the Grade 4 only schools stratum
- Grade 4 and Grade 8 school samples were selected simultaneously with minimum overlap

Allocation of School Sample in Norway (4 and 8), Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 5 - Bokmål - Small Municipalities	8	0	8	0	0	0	0
Grade 5 - Bokmål - Medium Municipalities	28	0	26	0	0	2	0
Grade 5 - Bokmål - Large Municipalities	66	1	63	0	0	2	0
Grade 5 - Nynorsk	14	1	12	0	0	1	0
Grade 5 & Grade 9 - Bokmål - Small Municipalities	8	0	8	0	0	0	0
Grade 5 & Grade 9 - Bokmål - Medium Municipalities	8	1	6	0	0	1	0
Grade 5 & Grade 9 - Bokmål - Large Municipalities	10	0	8	0	0	2	0
Grade 5 & Grade 9 - Nynorsk	8	1	6	0	0	1	0
Grade 4	2	0	2	0	0	0	0
Total	**152**	**4**	**139**	**0**	**0**	**9**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 6), Sami language schools, international schools, remote schools, and Grade 8 only schools
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 9' / 'Grade 5 and Grade 9' schools, language (Bokmål, Nynorsk), and municipality size (small, medium, large)
- No implicit stratification
- Sampled two classrooms in large schools (measure of size > 90)
- Grade 8 school sample corresponds to the Grade 9 school sample. Grade 8 only schools were scarce and as a result were excluded prior to school sampling.
- Grade 4 and Grade 8 school samples were selected simultaneously with minimum overlap

Allocation of School Sample in Norway (4 and 8), Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 9 - Bokmål - Small Municipalities	8	0	7	0	0	1	0
Grade 9 - Bokmål - Medium Municipalities	26	0	26	0	0	0	0
Grade 9 - Bokmål - Large Municipalities	64	0	61	0	0	3	0
Grade 9 - Nynorsk	12	0	10	0	0	2	0
Grade 5 & Grade 9 - Bokmål - Small Municipalities	8	0	8	0	0	0	0
Grade 5 & Grade 9 - Bokmål - Medium Municipalities	8	0	6	0	0	2	0
Grade 5 & Grade 9 - Bokmål - Large Municipalities	16	0	16	0	0	0	0
Grade 5 & Grade 9 - Nynorsk	8	0	8	0	0	0	0
Total	**150**	**0**	**142**	**0**	**0**	**8**	**0**

Abu Dhabi, United Arab Emirates

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 15), and language of instruction other than Arabic and English
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 4' / 'Grade 4 and Grade 8' schools, region (Abu Dhabi, Al Ain, Western region), school type (public, private), and performance level (low, medium, high) within 'Grade 4' schools, and curriculum (Ministry of Education, UK/US/CAD, other) within 'Grade 4 and Grade 8' schools.
- No implicit stratification
- Sampled two classrooms in Western region and in Grade 4 schools
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap
- All schools were sampled in Western region
- In census strata (Western region), classes or half classes were used to build jackknife replicates for variance estimation. Two classrooms selected within these schools.

Allocation of School Sample in Abu Dhabi, United Arab Emirates, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 4 - Abu Dhabi - Public - Low Performance	10	0	10	0	0	0	0
Grade 4 - Abu Dhabi - Public - Medium Performance	10	0	10	0	0	0	0
Grade 4 - Abu Dhabi - Public - High Performance	10	0	10	0	0	0	0
Grade 4 - Abu Dhabi - Private	10	1	9	0	0	0	0
Grade 4 - Al Ain - Public - Low Performance	12	0	12	0	0	0	0
Grade 4 - Al Ain - Public - High Performance	10	1	9	0	0	0	0
Grade 4 - Western Region	12	0	12	0	0	0	0
Grade 4 & Grade 8 - Abu Dhabi - Ministry of Education	14	1	13	0	0	0	0
Grade 4 & Grade 8 - Abu Dhabi - UK/US/CAD	22	2	20	0	0	0	0
Grade 4 & Grade 8 - Abu Dhabi - Other	22	5	17	0	0	0	0
Grade 4 & Grade 8 - Al Ain - UK/US/CAD	12	0	12	0	0	0	0
Grade 4 & Grade 8 - Al Ain - Other	14	0	14	0	0	0	0
Grade 4 & Grade 8 - Western Region	15	0	15	0	0	0	0
Total	**173**	**10**	**163**	**0**	**0**	**0**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 15) and language of instruction other than Arabic and English
- Within-school exclusions consisted of students with intellectual disabilities and students with functional disabilities

Sample Design

- Explicit stratification by 'Grade 8' / 'Grade 4 and Grade 8' schools, region (Abu Dhabi, Al Ain, Western region), school type (public, private), and performance level (low, medium, high)
- No implicit stratification
- Sampled two classrooms in Western region and in Grade 8 schools
- Grade 4 and grade 8 school samples were selected simultaneously with maximum overlap
- All schools were sampled in Western region
- In census strata (Western region) classes or half classes were used to build jackknife replicates for variance estimation. Two classrooms selected within these schools.

Allocation of School Sample in Abu Dhabi, United Arab Emirates, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 8 - Abu Dhabi - Public - Low Performance	15	0	15	0	0	0	0
Grade 8 - Abu Dhabi - Public - High Performance	16	0	16	0	0	0	0
Grade 8 - Al Ain - Public - Low Performance	10	0	10	0	0	0	0
Grade 8 - Al Ain - Public - High Performance	15	1	14	0	0	0	0
Grade 8 - Western Region	10	0	10	0	0	0	0
Grade 4 & Grade 8 - Abu Dhabi - Ministry of Education	14	0	14	0	0	0	0
Grade 4 & Grade 8 - Abu Dhabi - UK/US/CAD	22	2	20	0	0	0	0
Grade 4 & Grade 8 - Abu Dhabi - Other	22	5	17	0	0	0	0
Grade 4 & Grade 8 - Al Ain - UK/US/CAD	12	0	12	0	0	0	0
Grade 4 & Grade 8 - Al Ain - Other	14	0	14	0	0	0	0
Grade 4 & Grade 8 - Western Region	15	1	14	0	0	0	0
Total	**165**	**9**	**156**	**0**	**0**	**0**	**0**

Dubai, United Arab Emirates

Fourth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 10), and instruction language other than English or Arabic
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 4'/ 'Grade 4 and Grade 8' schools, and school type (public, private)
- Implicit stratification by language of test (Arabic, English, French)
- Sampled two classrooms per school
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap
- Census of all schools
- Schools or classes were used as variance estimation strata and classes or half classes were used to build jackknife replicates. Some schools are paired together within explicit stratum when there is only one class participating.

Allocation of School Sample in Dubai, United Arab Emirates, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 4 - Private	37	0	37	0	0	0	0
Grade 4 - Public	25	0	25	0	0	0	0
Grade 4 & Grade 8 - Private	105	2	103	0	0	0	0
Grade 4 & Grade 8 - Public	3	0	3	0	0	0	0
Total	**170**	**2**	**168**	**0**	**0**	**0**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 100 percent
- School-level exclusions consisted of very small schools (measure of size < 10) and instruction language other than English or Arabic
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by 'Grade 8' / 'Grade 4 and Grade 8' schools and school type (public, private)
- Implicit stratification by language of test (Arabic, English, French)
- Sampled two classrooms per school
- Grade 4 and Grade 8 school samples were selected simultaneously with maximum overlap
- Census of all schools
- Schools or classes were used as variance estimation strata and classes or half classes were used to build jackknife replicates. Some schools are paired together within explicit stratum when there is only one class participating

Allocation of School Sample in Dubai, United Arab Emirates, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
Grade 8 - Private	7	1	6	0	0	0	0
Grade 8 - Public	22	0	22	0	0	0	0
Grade 4 & Grade 8 - Private	105	1	104	0	0	0	0
Grade 4 & Grade 8 - Public	3	0	3	0	0	0	0
Total	**137**	**2**	**135**	**0**	**0**	**0**	**0**

Florida, United States

Fourth Grade

Coverage and Exclusions

- Coverage is 89.8 percent. Coverage in USA Florida is restricted to students from public schools.
- No school level exclusions
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by poverty level (high, low)
- Implicit stratification by location (city, suburb, town, rural) and ethnicity status (above 15% non-White students in a school, below 15% non-White students in a school)
- Sampled one classroom per school
- TIMSS sample was selected using the Chowdhury method to minimize overlap with the TIMSS USA sample and the Alpha and the Beta NAEP samples
- No overlap between Grade 4 and Grade 8 school samples

Allocation of School Sample in Florida, United States, Fourth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
High poverty	37	1	36	0	0	0	0
Low poverty	17	0	17	0	0	0	0
Total	**54**	**1**	**53**	**0**	**0**	**0**	**0**

Eighth Grade

Coverage and Exclusions

- Coverage is 90.1 percent. Coverage in USA Florida is restricted to students from public schools.
- No school level exclusions
- Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities, and non-native language speakers

Sample Design

- Explicit stratification by poverty level (high, low)
- Implicit stratification by location (city, suburb, town, rural) and ethnicity status (above 15% non-White students in a school, below 15% non-White students in a school)
- Sampled one classroom per school
- TIMSS sample was selected using the Chowdhury method to minimize overlap with the TIMSS USA sample, the Alpha and the Beta NAEP samples.
- No overlap between Grade 4 and Grade 8 school samples

Allocation of School Sample in Florida, United States, Eighth Grade

			Participating Schools				
Explicit Strata	Total Sampled Schools	Ineligible Schools	Original Schools	1st Replacements	2nd Replacements	Refusal Schools	Excluded Schools
High poverty	36	0	35	0	0	1	0
Low poverty	18	0	18	0	0	0	0
Total	**54**	**0**	**53**	**0**	**0**	**1**	**0**

CHAPTER 6

Survey Operations Procedures in TIMSS 2015

Ieva Johansone

Overview

As data-based indicators of countries' student achievement profiles and learning contexts, TIMSS assessments are crucially dependent on the quality of the data collected by each participant. Whereas the development of the assessments is an intensely collaborative process involving all of the partners in the enterprise, the process of administering the assessments and collecting the data is uniquely the responsibility of each individual country or benchmarking participant.

To ensure the consistency and uniformity of approach necessary for high-quality, internationally comparable data, all participants are expected to follow a set of standardized operations procedures. These procedures have been developed over successive cycles of TIMSS through a partnership involving the TIMSS & PIRLS International Study Center, the IEA Data Processing and Research Center (IEA DPC), the IEA Secretariat, Statistics Canada, and National Research Coordinators (NRCs). With each new assessment cycle, the operations procedures are updated to enhance efficiency and accuracy and reduce burden, making use of developments in information technology to automate routine activities wherever possible.

In each country or benchmarking entity, the National Research Coordinator was responsible for the implementation of TIMSS 2015. Internationally, National Research Coordinators provided the country's perspective in all international discussions, represented the country at international meetings, and were the responsible contact persons for all project activities. Locally, National Research Coordinators were responsible for implementing all the internationally agreed-upon procedures and facilitating all of the national decisions regarding TIMSS, including any adaptations for the national context.

The daily tasks of the NRCs varied over the course of the TIMSS 2015 cycle. In the initial phases, National Research Coordinators participated in the TIMSS 2015 framework and assessment development process (see Developing the TIMSS 2015 Achievement Items), and collaborated with

Statistics Canada and the IEA DPC to develop a plan to implement the TIMSS 2015 sampling design within the country or benchmarking entity (see Sample Implementation).

Following the development of the draft achievement items and context questionnaires, all countries conducted a full-scale field test of all instruments and operational procedures in March-April 2014 in preparation for the TIMSS 2015 data collection, which took place in October-December 2014 in Southern Hemisphere countries and in March-May 2015 in Northern Hemisphere countries. The field test allowed the National Research Coordinators and their staff to become acquainted with the operational activities, and the feedback they provided was used to improve the procedures for the data collection. As expected, the field test resulted in some enhancements to survey operations procedures and most definitely contributed to ensuring the successful execution of TIMSS 2015.

As part of ongoing efforts to improve TIMSS operations, the National Research Coordinators were asked to complete a Survey Activities Questionnaire (SAQ), which sought feedback on all aspects of their experience conducting TIMSS 2015. The feedback solicited in the SAQ included an evaluation of the quality of the assessment materials and the effectiveness of the operations procedures and documentation. The results of the TIMSS 2015 Survey Activities Questionnaire are presented in the final section of this chapter.

TIMSS 2015 Survey Operations Units, Manuals, and Software

To support the National Research Coordinators in conducting TIMSS 2015, the TIMSS & PIRLS International Study Center provided step-by-step documentation of all operational activities. Organized into a series of units, the *Survey Operations Procedures* were made available at critical junctures of the project to ensure that NRCs had all the tools and information necessary to discharge their responsibilities.

The *Procedures Units* were accompanied by a series of manuals for use by School Coordinators and Test Administrators that National Research Coordinators could translate and adapt to their local situations. Consistent with the goal of automating and streamlining procedures wherever possible, the IEA DPC provided NRCs with a range of custom-built software products to support activities, including sampling and tracking classes and students, administering school, teacher, and home questionnaires, documenting scoring reliability, and creating and checking data files. The TIMSS & PIRLS International Study Center and the IEA DPC also provided NRCs and their staff with intensive training in constructed response item scoring and data management.

The *Survey Operations Procedures* units were crucial resources for the National Research Coordinators as the units described in detail the tasks the NRCs were responsible for conducting. In the event that some of these tasks were contracted out to other people or organizations, the units ensured that the NRCs had sufficient knowledge of these matters to supervise the activities of the people who helped conduct the assessment in their countries.

The following units, manuals, and software systems were provided for administering TIMSS 2015:

- *TIMSS 2015 Survey Operations Procedures Unit 1: Sampling Schools and Obtaining their Cooperation*
- *TIMSS 2015 Survey Operations Procedures Unit 2: Preparing for and Conducting the TIMSS 2015 Field Test*. Unit 2 consisted of the following four sections: Sampling Classes and Field Test Administration, Preparing Achievement Booklets and Background Questionnaires, Scoring the Constructed Response Items, and Creating the Databases. Unit 2 was accompanied by field test versions of the School Coordinator Manual, Test Administrator Manual, National Quality Control Monitor Manual, and three software systems (WinW3S, IEA DME, and IEA OSS – described below).
- *TIMSS 2015 Survey Operations Procedures Unit 3: Contacting Schools and Sampling Classes for the Data Collection*. Unit 3 was accompanied by the School Coordinator Manual and the Windows® Within-school Sampling Software (WinW3S) and its manual. The WinW3S software enabled TIMSS 2015 participants to randomly select classes in each sampled school and document in detail the class selection process. The software also was used to track school, teacher, student, and student-teacher linkage information; prepare the survey tracking forms (described later in this chapter); and assign test instruments to students, including printing labels for all the test booklets and questionnaires.
- *TIMSS 2015 Survey Operations Procedures Unit 4: Preparing Achievement Booklets and Context Questionnaires*. Unit 4 was accompanied by the IEA Online SurveySystem (OSS) and its manual. The IEA Online SurveySystem supported the online administration of the school, teacher, and home (Early Learning Survey for TIMSS at Grade 4) questionnaires.
- *TIMSS 2015 Survey Operations Procedures Unit 5: Conducting the Data Collection*. Unit 5 was accompanied by the Test Administrator Manual, National Quality Control Monitor Manual, and the International Quality Control Monitor Manual.
- *TIMSS 2015 Survey Operations Procedures Unit 6: Scoring the Constructed Response Items*. Unit 6 was accompanied by the TIMSS 2015 Scoring Guides, the IEA Coding Expert Software, the Trend Reliability Scoring Manual, and the Cross-country Reliability Scoring Manual. The IEA Coding Expert Software was used to facilitate the trend and cross-country reliability scoring tasks.
- *TIMSS 2015 Survey Operations Procedures Unit 7: Creating the Databases*. Unit 7 was accompanied by the IEA Data Management Expert (DME) software, its manual, and codebooks that specified information on the IEA DME data fields in each of the data files. The IEA DME software is used for data entry and data verification.

TIMSS 2015 Survey Tracking Forms

TIMSS uses a series of tracking forms to document class sampling procedures, assign assessment instruments, and track school, teacher, and student information, including the participation status of the respondents. The tracking forms also facilitate the data collection and data verification process. Five different tracking forms were used for TIMSS 2015:

- Class Listing Form: This form was completed for each sampled school, listing the eligible classes and providing details about the classes, such as the class stream (if applicable), the number of students, and the names of teachers.
- Student-Teacher Linkage Form: This form was completed for each class sampled, listing the names of the students and their teachers, student birth dates, gender, exclusion codes, and linking the students to their teachers.
- Student Listing Form (participants in TIMSS Numeracy only): This form was completed for each class sampled, listing the names of the students, student birth dates, gender, and exclusion codes.
- Student Tracking Form: This form was created for each class assessed and was completed by the Test Administrators during test administration. The Test Administrators used this form to verify the assignment of survey instruments to students and to indicate student participation.
- Teacher Tracking Form: This form was completed for each sampled school to indicate the completion of the Teacher Questionnaires.

Operations for Data Collection

The following sections describe the major operational activities coordinated by the National Research Coordinators.

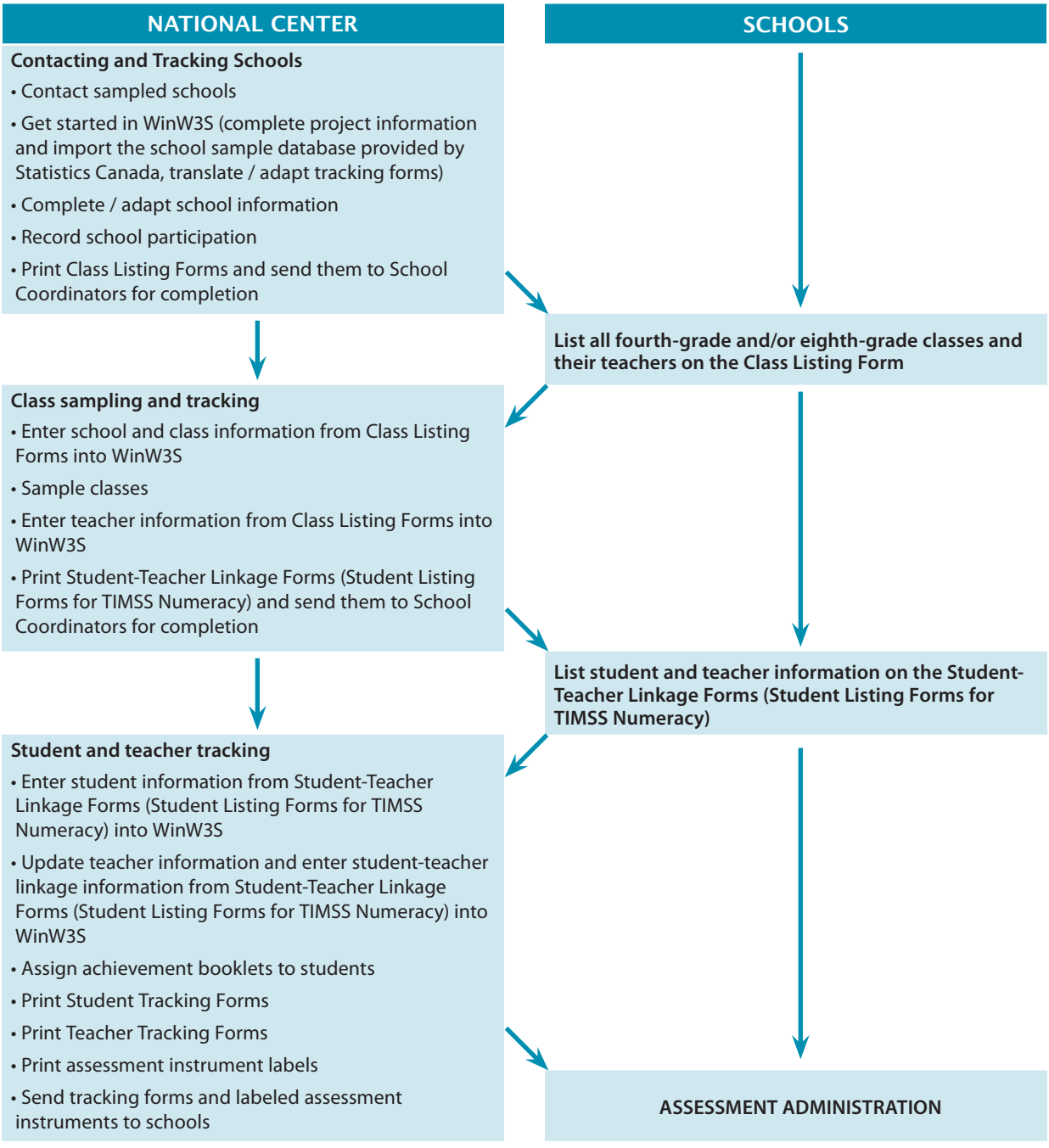
- Contacting schools and sampling classes
- Overseeing translation and preparing assessment instruments
- Managing the administration of the TIMSS 2015 assessments
- Scoring of the constructed response items
- Creating the TIMSS 2015 data files

Three other major TIMSS 2015 operational activities—sampling schools, translation and translation verification of the assessment instruments, and layout verification of the assessment instruments—are described in separate sections of the *Methods and Procedures in TIMSS 2015* publication (see the Sample Design, Translation and Translation Verification, and Layout Verification chapters).

Contacting Schools and Sampling Classes

Exhibit 6.1 illustrates the major steps of working with schools to sample classes and prepare for the TIMSS 2015 assessment administration. Once the school samples were drawn, National Research Coordinators were tasked with contacting schools and encouraging them to take part in the assessment. Depending on the national context, this could involve obtaining support from national or regional educational authorities. *Survey Operations Procedures Unit 1* outlines suggestions on ways to encourage schools to participate in the assessment.

Exhibit 6.1: Diagram of the Sampling Procedures and Preparations for the Assessment Administration Implemented by National Centers and Schools



In cooperation with school principals, National Research Coordinators were responsible for identifying and training School Coordinators for all participating schools. A School Coordinator could be a teacher or guidance counselor in the school, or NRCs could appoint a member of the national center to fill this role. In some countries, a School Coordinator from the national center was responsible for several schools in an area. Each School Coordinator was provided with a School Coordinator Manual, which describes their responsibilities. The School Coordinator Manual was prepared by the TIMSS & PIRLS International Study Center and translated/adapted by National Research Coordinator staff, as necessary.

The responsibilities of the School Coordinator included providing the national center with information on the school; coordinating the date, time, and place for testing; identifying and training a Test Administrator to administer the assessment; coordinating the completion of the TIMSS 2015 tracking forms; distributing questionnaires; and obtaining parental permission (if necessary). School Coordinators also confirmed receipt of all assessment materials, oversaw the security of the assessment materials, and ensured the return of the assessment materials to the national center following the administration of the assessment.

School Coordinators also played a critical role in providing information for the sampling process, providing the national center with data on eligible classes in the school. With this information, the national centers used the Within-school Sampling Software (WinW3S) to sample class(es) within the school. WinW3S tracked school, teacher, and student information, and the software generated the necessary tracking forms and instrument labels facilitating the assessment administration process as well as data checking during the data cleaning process.

As TIMSS samples intact classes, one of the roles of the School Coordinator was to ensure that every student in the school was listed in one and only one class (course). This was necessary to ensure that the sample of classes results in a representative sample of students, and every student at the target grade has a chance of being selected. At fourth grade in most countries, students are taught mathematics and science in the same classroom, and therefore the fourth grade classroom was designated as the sampling unit. At the eighth grade, however, in many countries students are grouped differently for mathematics and science instruction. In other words, a student may take mathematics with one group of students and science with a different group of students. As the sampling required one set of students who could be considered a classroom, eighth grade classrooms usually were defined on the basis of mathematics instruction for the purposes of sampling.

Overseeing Translation and Preparing Assessment Instruments

National Research Coordinators also were responsible for preparing the assessment instruments (achievement booklets and context questionnaires) for their countries—a process that included overseeing the translation of the assessment instruments. The overarching goal of assessment instrument preparation is to create internationally comparable achievement booklets and context questionnaires that are appropriately adapted for the national context.

Each student was assigned one of 14 TIMSS achievement booklets (see the *TIMSS 2015 Assessment Frameworks* for more information on the matrix sampling design). The achievement booklets are composed of blocks of assessment items, with each block appearing in two booklets. From an operational perspective, each block needed to be translated only once, even though it was included in two different booklets. Adobe®InDesign® software is used by countries to link the translated and adapted assessment blocks to the appropriate booklets. Automating this process through Adobe®InDesign® decreased the chances of human error in the production process.

Twelve new assessment blocks at each grade level were developed for TIMSS 2015 (six mathematics and six science). The new assessment blocks replaced the ones released at the end of the previous assessment cycle. Also, eight new mathematics assessment blocks were developed for TIMSS Numeracy 2015. The new assessment items were tried out through the field test in order to investigate the psychometric characteristics of the achievement items and make well-informed decisions about the best items. Similarly, the context questionnaires were evaluated following the field test to gauge the validity and reliability of the various questionnaire scales.

TIMSS field tests around twice the number of items needed to fill the new assessment blocks. All participating countries and benchmarking entities translated and/or adapted the newly developed items into the test administration language(s) and did the same for the questionnaires. After the field test, the best assessment items were chosen for the main data collection and some edits were applied to both items and the questionnaires.

National Research Coordinators were responsible for applying these changes to the translated assessment items and questionnaires. Countries taking TIMSS at the fourth and/or eighth grade that did not participate in TIMSS 2011 or TIMSS 2007 had to translate and/or adapt the assessment blocks used in previous assessments (trend blocks) into their language(s) in preparation for the 2015 assessment administration. Countries that had participated in TIMSS 2007 and/or TIMSS 2011 were required to use the same translations they used in those cycles.

For both the field test and main data collection, the participating countries received the international version (English) of the achievement booklets and context questionnaires with all the necessary instrument production files, including fonts and graphics files. Instructions on how to use the materials to produce high-quality, standardized instruments, were included in the corresponding *Survey Operations Procedures* unit. The IEA Secretariat and the TIMSS & PIRLS International Study Center also provided a generic Arabic source version of the TIMSS 2015 assessment booklets and context questionnaires. Individual countries adapted the generic source version to local usage.

Once translated and/or adapted, first for the field test and then again for the main data collection, the achievement items and context questionnaires were submitted to the IEA Secretariat for translation verification. The IEA Secretariat worked with independent translators to evaluate each country's translations and when deemed necessary suggested changes to the text.

After the translations and adaptations had been verified by the IEA Secretariat, National Research Coordinators assembled the achievement booklets and context questionnaires using Adobe® InDesign® software, and print-ready copies of the instruments were sent to the TIMSS & PIRLS International Study Center for layout verification and a final review of national adaptations. This review checked that each booklet and questionnaire conformed to the international format and that any adaptations made to the instruments did not unduly influence their international comparability.

National Adaptations Forms (NAFs)

While preparing national achievement booklets and context questionnaires, countries sometimes by necessity made adaptations to the international versions. All national adaptations to the international assessment instruments, other than direct translation, were documented using the National Adaptations Forms. There is a separate set of NAFs for the achievement booklets and for the context questionnaires (per grade/assessment). During the translation verification and layout review, the verifiers checked whether the national adaptations were likely to influence the ability to produce internationally comparable data for the items involved. Any questions raised were directed to the NRC for consideration via the NAFs.

The NAFs were completed and reviewed at various stages of preparing national assessment instruments. Version I of the forms was completed during the internal translation and review process and sent along with the rest of the materials for international translation verification. After translation verification, the forms (Version II) were updated in response to the translation verifier's comments and reflecting any changes resulting from the verification, and sent along with the national assessment instruments for layout verification. Following layout verification, the national instruments and NAFs were finalized (Version III) and submitted to the IEA Secretariat, the TIMSS & PIRLS International Study Center, and the IEA DPC as the final documentation of the national adaptations.

Managing the Administration of the TIMSS 2015 Assessments

Printing assessment materials and distributing them to the participating schools required careful organization and planning on the part of the National Research Coordinator. Each student was assigned one of 14 achievement booklets according to a systematic distribution plan implemented by the WinW3S sampling software. This process is facilitated by the tracking forms and labels generated by WinW3S.

Each student also was assigned a Student Questionnaire, which was labeled so that it could be linked to the achievement booklet. For TIMSS at the fourth grade and for TIMSS Numeracy, the student's parents were assigned the Early Learning Survey, which also was linked to the achievement booklet. In addition, an individually labeled Teacher Questionnaire was sent to each teacher listed on the Teacher Tracking Form and a School Questionnaire was sent to the principal. These materials were packaged and sent to the School Coordinators prior to the testing date, giving

ample time for the School Coordinators to confirm the receipt and correctness of the materials. The School Questionnaire and Teacher Questionnaires were then distributed, while the other instruments were kept in a secure room until the testing date.

Each sampled class was assigned a Test Administrator who followed procedures described in the Test Administrator Manual to administer the achievement booklets and Student Questionnaire. This person was chosen and trained by the School Coordinator. In many cases, the School Coordinator doubled as the Test Administrator. The Test Administrator was responsible for distributing materials to the appropriate students, reading to the students the instructions provided in the Test Administrator's manual, and timing the sessions.

The Test Administrator documented the timing of the testing sessions on the Test Administration Form. The Test Administration Form also solicited information about anything out of the ordinary that took place during assessment administration.

The achievement booklets contained two sections, and the time allotted for each section of the assessment was standardized and strictly enforced by the Test Administrator. There was a required break in between the two sections of the assessment administration, and this break was not to exceed 30 minutes. To complete each part of the TIMSS achievement test, fourth grade students were allowed 36 minutes and eighth grade students were allowed 45 minutes. If a student completed part 1 or part 2 of the assessment before the allotted time, the student was not allowed to leave the testing room. Students completing the assessments early were asked to review their answers or read quietly, and some test administrators provided an activities sheet for the student.

To complete the Student Questionnaire, students were given at least 30 minutes, but extra time was given when necessary. Also, for fourth grade students, the Test Administrator was permitted to read the questionnaire items aloud together with the students.

The Test Administrator was required to use the Student Tracking Form and labels to distribute the booklets to the correct students and to document student participation. If the participation rate was below 90 percent in any class, it was the School Coordinator's responsibility to hold a makeup session for the absent students before returning all of the testing materials to the national center.

Linking Students to their Teachers and Classes

Exhibit 6.2 illustrates the hierarchical identification system codes that are used to link the data among schools, classes, students, and teachers. The school, class, and student IDs are strictly hierarchical, with classes nested within schools and students nested within classes.

Exhibit 6.2: Hierarchical Identification System Codes Used to Link Schools, Classes, Students, and Teachers

Participant	ID Components	ID Structure	Numeric Example
School	School	CCCC	0001
Class	School + Class within the school	CCCCKK	000101 000102
Student	School + Class within the school + Student within the class	CCCCKKSS	00010101 00010201
Teacher	School + Teacher within the school + Linkage number to the sampled class	CCCCTTLL	00010101 00010201

Each teacher is assigned a teacher identification number consisting of the four-digit school number followed by a two-digit teacher number. Since a teacher could be teaching mathematics and/or science to some or all of the students in a class, it is necessary to have a unique identification number for each teacher linked to a class and to certain students within the class. This is achieved by adding a two-digit link number to the six digits of the teacher identification number to create a unique eight-digit identification number.

Online Administration of the School, Teacher, and Home Questionnaires

Countries could choose to administer the school, teacher, and/or home questionnaires online. The benefits of administering the questionnaires online included saving money and time in printing, and improving the efficiency of questionnaire distribution, data entry, and data cleaning.

For the online administration of the questionnaires, the IEA DPC provided its IEA Online SurveySystem software that incorporates design, presentation, and monitoring components.

The design component, known as the Designer, supports the preparation of the online surveys, data management, and data output to the IEA DPC. Through the IEA Online SurveySystem Designer component, national centers could tailor the online questionnaires to their national language. To facilitate translation and adaptation, the Designer concurrently stored the original English question text and the translations and/or national adaptations. It also stored the variable names and data validation rules. If a national center decided not to administer a particular international question or option, it could be disabled in the Designer and would not be administered during the online questionnaire administration. The Designer also included an integrated preview function to allow for a visual side-by-side comparison of the paper/PDF and online versions of the questionnaires, facilitating the layout verification process.

For the online presentation, the Web Component presents the questionnaires to the respondents. The navigation capabilities of the Web Component are designed to allow respondents to pick and choose their order of response. Buttons marked "next" and "previous" facilitated navigation between adjacent pages, so users could browse through the questionnaire in the same way that they flip through the pages of the paper questionnaire. A hyperlinked interactive "table

of contents" allowed the respondents to fluidly navigate to specific questions. Overall, these two functions permitted the respondents to answer questions in the order of their choosing, and skip questions just as they could do if they were answering the paper questionnaire. Also, the online questionnaires could be accessed through any standard Internet browser on all standard operating systems without the user needing any additional software.

Finally, the Web-based Monitor component allows for monitoring the survey responses in real time. Many national centers made extensive use of the Web-based Monitor to follow-up with non-respondents.

The IEA Data Processing and Research Center followed a stringent set of procedures in order to safeguard the confidentiality of the respondents and maintain the integrity of the data. Each respondent received a statement of confidentiality, and information on how to access the online questionnaire. For most countries, the online questionnaire administration was hosted on the IEA DPC's customized high-performance server. The IEA DPC server allowed for the 24-hour availability of the questionnaires during the data-collection period, and it also ensured backup and recovery provisions for the data.

Scoring the Constructed Response Items

Constructed response items represent a substantial portion of the TIMSS assessments, and because reliable and valid scoring of these items is critical to the assessment results, the TIMSS & PIRLS International Study Center provided explicit scoring guides and extensive training in their use. Also, the *Survey Operations Procedures* units specified a procedure for efficiently organizing and implementing the scoring activity.

International scoring training sessions (one for the field test and two for the main data collection—one for Southern Hemisphere countries and another for Northern Hemisphere countries) were conducted where all National Research Coordinators (or country representatives appointed by the NRCs) were trained to score each of the constructed response items. At these training sessions, the scoring guide for each item was reviewed and applied to a sample set of example student responses that had already been scored. These example papers were actual student answers from pilot testing in several English-speaking countries and were chosen to represent a range of response types and to demonstrate the guides as clearly as possible. Following the example papers, the training participants applied the scoring guides to a different set of student responses that had not yet been scored. The scores to these practice papers were then shared with the group and any discrepancies were discussed.

Following the international scoring training, national centers trained their scoring staff on how to apply the scoring guides for the constructed response items. National Research Coordinators were encouraged to create additional example papers and practice papers from student responses collected in their country.

Documenting Scoring Reliability

Because reliable scoring of the constructed response items is essential for high quality TIMSS data, it is important to document the reliability of the scoring process. A high degree of scorer agreement is evidence that scorers have applied the scoring guides in the same way. The procedure for scoring the TIMSS 2015 constructed response items provided for documenting scoring reliability within each country (within-country reliability scoring), across countries (cross-country reliability scoring), and over time (trend reliability scoring).

The method for establishing the reliability of the scoring within each country was for two independent scorers to score a random sample of 200 responses for each constructed response item. The degree of agreement between the scores assigned by the two scorers is a measure of the reliability of the scoring process. In collecting the within-country reliability data, it was vital that the scorers independently scored the items assigned to them, and each scorer did not have prior knowledge of the scores assigned by the other scorer. The within-country reliability scoring was integrated within the main scoring procedure and ongoing throughout the scoring process.

The purpose of the trend reliability scoring was to measure the reliability of the scoring from one assessment cycle to the next (i.e., from TIMSS 2011 to TIMSS 2015). The trend reliability scoring required scorers of the current assessment to score student responses collected in the previous cycle. The scores of the current cycle were then compared with the scores awarded in the previous assessment cycle. Trend reliability scoring was conducted using the IEA Coding Expert Software provided by the IEA DPC.

Trend reliability scoring for TIMSS 2015 involved eight secured item blocks. Student responses included in the trend reliability scoring (150-200 responses per item) were actual student responses collected during the previous assessment cycle in each country and benchmarking entity. These responses were scanned and provided for each participating country and benchmarking entity along with the IEA Coding Expert Software. All scorers who scored the trend assessment blocks in 2015 were required to participate in the trend reliability scoring. If all scorers were trained to score all trend items, the software divided the student responses equally among the scorers. If scorers were trained to score specific item blocks, National Research Coordinators were able to specify within the software which scorers would score particular item blocks, and the software allocated the student responses accordingly. Similar to the within-country reliability scoring, the trend reliability scoring had to be integrated within the main scoring procedure.

Finally, cross-country reliability scoring gave an indication about how consistently the scoring guides were applied from one country to the next. The cross-country reliability scoring also was conducted using IEA Coding Expert Software. To begin the process, the IEA DPC compiled actual responses of students from English speaking countries participating in the previous TIMSS cycle. Cross-country reliability scoring included 21 items at the fourth grade and 26 items at the eighth grade. Two hundred student responses for each item were scanned by the IEA DPC and provided to

countries and benchmarking entities along with the IEA Coding Expert Software. All scorers who could score student responses written in English were required to participate in the cross-country reliability scoring, and the student responses were equally divided among the participating scorers in each country. The scoring exercise was completed immediately after all other scoring activities.

Creating the TIMSS 2015 Databases

The data entry process took place March-May 2014 for the field test, from December 2014–March 2015 following data collection in the Southern Hemisphere and June–September 2015 following data collection in the Northern Hemisphere. The procedure for creating the TIMSS 2015 databases included entering sampling and assessment administration information into the WinW3S database and adding responses from the context questionnaires and achievement booklets using the IEA Data Management Expert (DME) software.

The IEA DPC provided DME software to accommodate keyboard data entry and data verification. The DME software also offers data and file management capabilities, a convenient checking and editing mechanism, interactive error detection, and quality-control procedures. For the TIMSS 2015 context questionnaires administered online on the IEA DPC's server, the data were directly accessible by the IEA DPC and no further data entry was required.

Along with the DME software, the IEA DPC provided international codebooks describing all variables and their characteristics, thus ensuring that the data files met the internationally defined rules and standards for data entry. The files within the DME database for entering the TIMSS 2015 data were based on these codebooks. However, the codebooks had to match exactly the national assessment instruments so that the answers of the respondents could be entered properly. Therefore, any adaptations to the international instruments also required adaptations to the international codebooks. The adapted national codebooks then were used to create the TIMSS 2015 data files in each country, with the responses to the context questionnaires, achievement booklets, and Reliability Scoring Sheets keyed into the DME database.

Quality control throughout the data entry process was essential to maintain accurate data. Therefore, National Research Coordinators were responsible for performing periodic reliability checks during data entry and for applying a series of data verification checks provided by both WinW3S and DME software prior to submitting the databases to the IEA DPC. To ensure the reliability of the data entry process, the data-entry staff was required to double enter at least 5 percent of each instrument type. An error rate of 1 percent or less was acceptable for the background files. An error rate of 0.1 percent or less was required for the student achievement files and the reliability scoring files. If the required agreement was not reached, retraining of the key punchers was required.

Additionally, the data verification module of WinW3S and DME identified a range of problems, such as inconsistencies of identification codes and out-of-range or otherwise invalid

codes. The data quality control procedures also verified the integrity of the linkage between the students, teachers, and schools entered into the DME database and tracking of information for those specified in WinW3S.

When all data files had passed the quality control checks, they were submitted to the IEA DPC, along with data documentation, for further checking and processing. For information on data processing at the IEA DPC, please refer to the Creating the International Databases chapter of this publication.

TIMSS 2015 Survey Activities Questionnaire

The Survey Activities Questionnaire was designed to elicit information about NRCs' experiences in preparing for and conducting the TIMSS 2015 data collection. The questionnaire was composed of six sections and focused on the following:

- Sampling schools and classes
- Preparing assessment instruments
- Administering the assessments
- Implementing the National Quality Control Program
- Preparing for and scoring the constructed response items
- Creating the databases

All items in the Survey Activities Questionnaire included accompanying comment fields, in which NRC respondents were encouraged to explain their responses, provide additional information, and suggest improvements in the process.

The *TIMSS 2015 Survey Activities Questionnaire* was administered online via the IEA's Online SurveySystem and was completed by a total of 59 NRCs. The following sections summarize information gathered from the Survey Activities Questionnaire, reflecting the quality of the TIMSS 2015 survey materials and procedures in the participating countries.

Sampling Schools and Classes

The first section of the Survey Activities Questionnaire asked NRCs about the *Survey Operations Procedures* for sampling both schools and classes within the sampled schools. As shown in Exhibit 6.3, all of the countries considered that *Survey Operations Procedures* Units 1 and 3 were clear and sufficient. Seven countries reported deviating from the basic TIMSS sampling design. Their reasons for these modifications to the sampling procedures included allowing for census participation, oversampling certain regions, and changing the target grade from previous cycles. One country reported selecting their TIMSS 2015 school sample at the national center in collaboration with Statistics Canada. Statistics Canada in cooperation with the IEA DPC selected the school samples for all other countries.

Exhibit 6.3: Survey Activities Questionnaire, Section One—Sampling (Numbers of NRC Responses)

Question	Yes	No	Not Answered
Was the information provided in the "TIMSS 2015 Survey Operations Procedures Unit 1 – Sampling Schools and Obtaining their Cooperation" clear and sufficient?	58	0	1
Were there any conditions or organizational constraints that necessitated deviations from the basic TIMSS sampling design described in the "Survey Operations Procedures Unit 1"?	7	51	1
Did you use the Within-school Sampling Software (WinW3S) to sample classes?	57	0	2
Did you experience any problems or inconveniences when using the WinW3S software?	16	40	2
Was the information provided in the "TIMSS 2015 Survey Operations Procedures Unit 3 – Contacting Schools and Sampling Classes for the Data Collection" clear and sufficient?	58	0	1
Did you follow the procedures outlined in "Survey Operations Procedures Unit 3" for working with the schools to sample classes (e.g., using the appropriate tracking forms in the proposed order to obtain information from School Coordinators)?	47	10	2

All countries selected classes within the sampled schools using the Windows® Within-school Sampling Software (WinW3S), provided by the IEA Data Processing and Research Center. Countries administering both the TIMSS fourth grade and TIMSS Numeracy achievement booklets encountered some organizational constraints in their systems that necessitated a modification to the sample design, and these countries also experienced some problems using the WinW3S software. Countries also noted that the WinW3S software was slow at times.

Ten NRCs applied some modifications to the procedures outlined in the *Survey Operations Procedures Unit 3*. For example, some NRCs did not use the Class Listing Forms because all classes at the target grade were tested or because a class level database was available at the ministry, and a number of countries did not use the fourth grade Teacher Tracking Forms because there was only one teacher per class. All modifications were reviewed and approved by the TIMSS & PIRLS International Study Center.

Translating, Adapting, and Producing Assessment Instruments

The second section of the Survey Activities Questionnaire asked NRCs about translating, adapting, assembling, and printing the test materials, as well as issues related to checking the materials and securely storing them. In the majority of cases, NRCs reported applying corrections to their survey instruments as suggested by the external translation verifier or the layout verifier.

As reported in Exhibit 6.4, all of the NRCs answered that they were able to assemble the test booklets and questionnaires according to the instructions provided. However, 10 countries reported

experiencing some problems using the survey instrument production materials. These problems mostly included the following: issues with fonts and special characters (e.g., for Cyrillic alphabet), difficulty fitting longer national text in the context questionnaires, and some problems with the layout style of tables. All of the identified problems were resolved either by specialists at the national center or with assistance from the TIMSS & PIRLS International Study Center.

Exhibit 6.4: Survey Activities Questionnaire, Section Two—Translating, Adapting, and Producing Assessment Instruments (Numbers of NRC Responses)

Question	Yes	No	Not Answered
Was the information provided in the "TIMSS 2015 Survey Operations Procedures Unit 4 – Preparing Achievement Booklets and Context Questionnaires" clear and sufficient?	55	3	1
Did you encounter any major problems using the assessment instrument production materials (e.g., instrument production files, fonts, support materials) provided by the TIMSS & PIRLS International Study Center?	10	48	1
After the translation verification, did you correct your translations/adaptations as suggested by the verifier in the majority of cases?			
TIMSS eighth-grade booklets	38	0	4 *(Not Answered)* 17 *(Not Applicable)*
TIMSS fourth-grade booklets	46	1	4 *(Not Answered)* 8 *(Not Applicable)*
TIMSS Numeracy booklets	8	0	4 *(Not Answered)* 47 *(Not Applicable)*
Eighth-grade context questionnaires	38	0	4 *(Not Answered)* 17 *(Not Applicable)*
Fourth-grade context questionnaires	49	0	4 *(Not Answered)* 6 *(Not Applicable)*
After the layout verification, did you correct your assessment instruments as noted by the verifier in the majority of cases?			
TIMSS eighth-grade booklets	39	0	3 *(Not Answered)* 17 *(Not Applicable)*
TIMSS fourth-grade booklets	47	1	3 *(Not Answered)* 8 *(Not Applicable)*
TIMSS Numeracy booklets	8	0	3 *(Not Answered)* 48 *(Not Applicable)*
Eighth-grade context questionnaires	39	0	3 *(Not Answered)* 17 *(Not Applicable)*
Fourth-grade context questionnaires	50	0	3 *(Not Answered)* 6 *(Not Applicable)*
Did you apply any quality control measures to check the achievement booklets and context questionnaires during the printing process (e.g., checking for missing pages, upside down pages, text too bright or too dark)?	54	2	3

Exhibit 6.4: Survey Activities Questionnaire, Section Two—Translating, Adapting, and Producing Assessment Instruments (Numbers of NRC Responses) (Continued)

Question	Yes	No	Not Answered
Did you take measures to protect the security of the assessment instruments during the translation, assembly, and printing process?	57	0	2
Did you detect any potential breaches in security of the assessment instruments?	1	56	2
Did you encounter any problems preparing the Online SurveySystem files for administering the school, teacher, and/or home (Early Learning Survey) questionnaires online?	5	14	3 *(Not Answered)* 37 *(Not Applicable)*

Nearly all of the countries conducted the recommended quality control checks during the process of printing the testing materials. The most common errors that countries detected and fixed during the printing process were pages that were missing or in the wrong order. One country expressed concerns about a breach of security, as the courier lost one package with the materials.

Five countries reported that they experienced problems with the Online SurveySystem. These problems were related to structural national adaptations, the national text being much longer than the original text in English, a very tight timeline for Southern Hemisphere countries, and some valid ranges (e.g., calendar dates) not being restricted.

Assessment Administration

The third section of the Survey Activities Questionnaire addressed the extent to which NRCs detected errors in the testing materials during packaging for shipment to schools. As shown in Exhibit 6.5, a small number of errors were found in the materials. About half of such errors were discovered before distributing materials to schools and fixed prior to their distribution. Errors found after distribution usually were very minor, and either were fixed by school coordinators or replacement materials were provided. The few cases where the errors could not be remedied were reported to the TIMSS & PIRLS International Study Center, where decisions were made about setting the problematic data to "Not Administered."

Exhibit 6.5: Survey Activities Questionnaire, Section Three—Assessment Administration (Numbers of NRC Responses)

Question	Yes	No	Not Answered
Was the information provided in the "TIMSS 2015 Survey Operations Procedures Unit 5 – Conducting the Data Collection" clear and sufficient?	57	0	2
Were any errors detected in any of the following assessment materials after they were sent to schools?			
Achievement booklets	18	38	3 *(Not Answered)* 0 *(Not Applicable)*
Achievement booklet ID labels	7	49	3 *(Not Answered)* 0 *(Not Applicable)*
Student Questionnaires	5	51	3 *(Not Answered)* 0 *(Not Applicable)*
Student Questionnaire ID labels	5	50	3 *(Not Answered)* 1 *(Not Applicable)*
Early Learning Surveys	1	48	3 *(Not Answered)* 7 *(Not Applicable)*
Early Learning Survey ID labels	4	45	3 *(Not Answered)* 7 *(Not Applicable)*
Student Tracking Forms	6	50	3 *(Not Answered)* 0 *(Not Applicable)*
Teacher Questionnaires	5	49	3 *(Not Answered)* 2 *(Not Applicable)*
Teacher Tracking Forms	2	51	3 *(Not Answered)* 3 *(Not Applicable)*
School Questionnaires	2	52	3 *(Not Answered)* 2 *(Not Applicable)*
School Coordinator Manuals	1	54	3 *(Not Answered)* 1 *(Not Applicable)*
Test Administrator Manuals	3	52	3 *(Not Answered)* 1 *(Not Applicable)*
If any errors were detected, did you correct the error(s) before the testing began?	15	24	2 *(Not Answered)* 18 *(Not Applicable)*
Does your country have a confidentiality policy that restricts putting student names on tracking forms and survey instrument covers?	16	41	2
Did you encounter any problems translating and/or adapting the School Coordinator Manual(s)?	2	55	2
Did you encounter any problems translating and/or adapting the Test Administrator Manual(s)?	1	55	3
Were School Coordinators appointed from within the participating schools?	50	7	2
Did you hold formal training session(s) for School Coordinators?	33	24	2

Exhibit 6.5: Survey Activities Questionnaire, Section Three—Assessment Administration (Numbers of NRC Responses) (Continued)

Question	Yes	No	Not Answered
Were Test Administrators trained by School Coordinators within the participating schools?	25	32	2
Did Test Administrators document any problems or special circumstances that occurred frequently during the assessment administration (please refer to the completed Test Administration Forms)?	20	36	3
If you administered school, teacher, and/or home (Early Learning Survey) questionnaires online, did any of the respondents in your country encounter any problems responding to the online questionnaires?	9	11	2 *(Not Answered)* 37 *(Not Applicable)*

Three NRCs reported difficulties translating the School Coordinator Manual and/or the Test Administrator Manual. Primarily, problems arose when the manual(s) had to be reorganized or adapted, and the standardized procedures were modified (e.g., no Class Listing Forms or Teacher Tracking Forms were used).

In 50 countries, School Coordinators were appointed within the participating schools, and in 25 of these countries, Test Administrators were trained by the School Coordinators. In the remaining countries, School Coordinators and/or Test Administrators either were from the national center or were contracted externally. In most countries, the National Research Coordinators organized training sessions for School Coordinators. In some, mostly larger countries, training was conducted either online or in a written form via extended manuals.

Among the problems documented by Test Administrators during assessment administration were the following: loud noises outside the classroom, many students asking questions, too much time, not enough time, and student complaints that the test was too difficult.

National Quality Control Program

The fourth section of the Survey Activities Questionnaire addressed the national quality control program that each country implemented during data collection. As part of the national quality assurance activities, NRCs were instructed to send National Quality Control Observers to 10 percent of the participating schools in order to observe test administration and document compliance with prescribed procedures. Due primarily to budgetary constraints, some countries sent national monitors to less than ten percent of participating schools, and three countries did not send monitors to any of the testing sessions.

As shown in Exhibit 6.6, when applicable, almost all of the national centers conducted their quality assurance program using the National Quality Control Monitor Manual provided by the TIMSS & PIRLS International Study Center. Among the few documented problems detected by the national monitors were students complaining about the length of the Student Questionnaire. In addition, one case was noted where the national monitor felt the Test Administrator was unprepared.

Exhibit 6.6: Survey Activities Questionnaire, Section Four—National Quality Control Program (Numbers of NRC Responses)

Question	Yes	No	Not Answered
Did you conduct a national quality control program that observed the data collection in the participating schools?	52	5	2
Did you use the National Quality Control Monitor (NQCM) Manual and the Classroom Observation Record provided by the TIMSS & PIRLS International Study Center to conduct your national quality control program?	49	4	3 *(Not Answered)* 3 *(Not Applicable)*
Did your national quality control monitors (NQCMs) document any major problems or special circumstances that occurred frequently during the assessment administration?	3	49	4 *(Not Answered)* 3 *(Not Applicable)*

Preparing for and Scoring the Constructed Response Items

Exhibit 6.7 provides data on responses to items asking NRCs about their experiences preparing for and scoring the constructed response items. Almost all NRCs found the scoring procedures as explained in the *Survey Operations Procedures Unit 6—Scoring the Constructed Response Items* to be clear and sufficient. Some countries reported that they would have liked to have scoring training practice materials for all items instead of select group of items. Countries reporting problems with the scoring training materials asked for more "borderline" examples including more detailed explanations within the scoring guides. All of the NRCs reported creating their own national examples and practice papers for training their scorers, as suggested by the TIMSS & PIRLS International Study Center.

Exhibit 6.7: Survey Activities Questionnaire, Section Five—Preparing for and Scoring the Constructed Response Items (Numbers of NRC Responses)

Question	Yes	No	Not Answered
Was the information provided in the "TIMSS 2015 Survey Operations Procedures Unit 6 – Scoring the Constructed Response Items" clear and sufficient?	55	2	2
Did you encounter any problems using the scoring training materials, provided by the TIMSS & PIRLS International Study Center?	11	46	2
Did you create national scoring training materials in addition to the international scoring training materials?	41	16	2
Did you scan the achievement booklets for electronic image scoring?			
TIMSS eighth-grade booklets	11	26	2 *(Not Answered)* 20 *(Not Applicable)*
TIMSS fourth-grade booklets	16	30	2 *(Not Answered)* 11 *(Not Applicable)*
TIMSS Numeracy booklets	0	9	2 *(Not Answered)* 48 *(Not Applicable)*

Exhibit 6.7: Survey Activities Questionnaire, Section Five—Preparing for and Scoring the Constructed Response Items (Numbers of NRC Responses) (Continued)

Question	Yes	No	Not Answered
Did you encounter any problems during the Trend Reliability Scoring?			
Procedural problems	1	51	2 *(Not Answered)* 5 *(Not Applicable)*
Technical, software related problems	10	42	2 *(Not Answered)* 5 *(Not Applicable)*
Did all your scorers participate in scoring student responses of the trend items?	30	21	3 *(Not Answered)* 5 *(Not Applicable)*
Did you encounter any problems during the Cross-country Reliability Scoring?			
Procedural problems	5	47	4 *(Not Answered)* 3 *(Not Applicable)*
Technical, software related problems	9	43	4 *(Not Answered)* 3 *(Not Applicable)*
Did all your scorers participate in the Cross-country Reliability Scoring?	17	36	3 *(Not Answered)* 3 *(Not Applicable)*

Eleven countries administering the eighth-grade assessment and 16 countries administering the fourth-grade assessment scanned their achievement booklets and scored student responses electronically. Some technical problems were encountered while using the Coding Expert Software and this feedback will be used by the IEA DPC to continue to improve the software. Because English was used for the cross-country reliability scoring task, three countries were unable to participate. For those countries that did not participate in the previous cycle of TIMSS, the question on the trend reliability scoring procedures did not apply.

Creating the Databases

The last section of the Survey Activities Questionnaire addressed data entry and quality control activities. As shown in Exhibit 6.8, all of the NRCs found the instructions in the *Survey Operations Procedures Unit 7* to be clear and sufficient. Some NRCs expressed a wish for a more automated data entry process in WinW3S (especially for entering the testing dates and time) and would like to have more detailed instructions on importing tables with information for multiple schools, teachers, and/or students. Most countries reported hiring temporary data entry staff to enter data manually, and a number of countries used optical scanning instead of manual data entry. A very positive finding of the TIMSS 2015 Survey Activities Questionnaire is that multiple countries reported exceeding the five percent requirement for double entry of each assessment instrument, with a couple of countries entering all of the instruments twice. All countries reported applying all required data quality checks.

Exhibit 6.8: Survey Activities Questionnaire, Section Six—Creating Databases (Numbers of NRC Responses)

Question	Yes	No	Not Answered
Was the information provided in the "TIMSS 2015 Survey Operations Procedures Unit 7 – Creating the Databases" clear and sufficient?	55	0	4
Did you encounter any problems entering test administration information and exporting your WinW3S database(s)?	19	36	4
Who primarily entered the data for your country?			
National center staff	13	-	0
Temporarily hired data entry staff	24	-	0
An external data entry firm	8	-	0
Combination of the above	8	-	0
Other	4	-	2
Did you use manual (key) data entry to create the data files for your country?			
TIMSS achievement booklets	43	12 *(Optical Scanning)*	3 *(Not Answered)* 1 *(Not Applicable)*
Context questionnaires	44	11 *(Optical Scanning)*	4 *(Not Answered)* 0 *(Not Applicable)*
Did you encounter any problems using the IEA's Data Manager Expert (DME) software?	10	45	4
If you entered data manually, did you enter 5% of each survey instrument twice as a quality control measure?	38	8	3 *(Not Answered)* 10 *(Not Applicable)*
Did you apply all the data quality checks described in the "TIMSS 2015 Survey Operations Procedures Unit 7 – Creating the Databases" before submitting your data to the IEA Data Processing and Research Center?	55	0	4
Have you stored all achievement booklets and context questionnaires in a secure storage area until the original documents can be discarded?	56	0	3

CHAPTER 7

Translation and Translation Verification for TIMSS 2015

David Ebbs
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Introduction

This chapter describes the activities and procedures related to countries' preparation of national versions of the TIMSS assessment instruments, focusing on two major activities:

- Translation and adaptation of the international version of the TIMSS assessment instruments into national languages
- International verification of the national translations/adaptations

The TIMSS & PIRLS International Study Center develops the international versions of the TIMSS assessment instruments in English. Then the Arabic international source version is produced in cooperation with the IEA Secretariat. After the release of the international source versions, all the participating countries are required to translate and/or adapt the international versions into their language(s) of instruction. To ensure that the translated national instruments are equivalent to the international versions, linguistic and assessment experts perform multiple rounds of review based on the international source version in English.

The translation and verification process aims to ensure high quality translations that are internationally comparable and adapted appropriately for each country's context and education system. As part of the TIMSS international quality assurance program, the translation verification process requires that each country's instruments undergo a formal external review of the translations and adaptations prior to the assessments.

All countries are required to follow standard, internationally agreed-upon procedures from the initial translation through final printing of their national instruments. At the national level, countries are responsible for translating and/or adapting the international assessment materials and questionnaires according to the international guidelines for TIMSS, conducting a review of their translations' quality and appropriateness, and documenting all national adaptations for reference at later stages. Even for countries whose survey language is English, national adaptations to the materials are required to accommodate the variations used in different English-speaking countries. Similarly, countries that use the Arabic international source version provided for the TIMSS assessment are expected to implement necessary adaptations to conform to each country's national usage and context.

At the international level, the IEA Secretariat arranges for each country's translated and adapted materials to undergo translation verification. The translation verifiers provide detailed feedback to improve the accuracy of the national instruments compared to the international instruments. When the verified materials are returned, the National Research Coordinators (NRCs) are tasked with reviewing the feedback of translation verification, revising their materials as needed, and updating their documentation for use during data processing and analysis.

The translation and translation verification processes of the assessment materials occur twice—first before the field test and then again before the assessment. The IEA Secretariat manages these processes, which consists of careful documentation of outcomes at the various stages of translation, adaptation, verification, and revision.

Prior to the field test and again before the assessment data collection, the same general verification procedures are followed, with the exception of items designed to measure trends from previous cycles. Trend items undergo a separate verification procedure to ensure consistency across assessment cycles.

The TIMSS assessment materials required to undergo translation verification are:

- Student achievement items (assembled in blocks of items)
- Background questionnaires for school principals, teachers, parents, and students
- Covers and directions (for achievement booklets and paper versions of context questionnaires)
- Online covers and directions (only for online data collection of home, teacher, and school questionnaires)

The TIMSS procedural manuals and scoring guides for the constructed-response items typically are translated but not subject to the international verification procedure.

Guidelines for Translation and Adaptation

The general purpose of translation and adaptation is to maintain the same meaning and level of difficulty as the international version while following the rules of the target language and the country's cultural context. This includes adapting the international versions in English to English usage in the context of each English speaking country; adapting the Arabic translations to each national education context; and adapting a translation developed by one country to another country's context.

In particular, translators and reviewers are asked to ensure that:

- The translation is at an appropriate level for the target population
- No information is omitted, added, or clarified in the translated text

- The translated text has the same meaning and uses equivalent terminology as the international version
- The translated text has the same register (language level and degree of formality) and level of difficulty as the international version
- Idiomatic expressions are translated appropriately, not necessarily word for word
- The translated text uses correct grammar, punctuation, qualifiers, and modifiers, as appropriate for the target language

After the field test, the TIMSS & PIRLS International Study Center provides NRCs with a list of changes to the international version that they can refer to while preparing their assessment instruments. This information minimizes the translation burden while highlighting the necessary changes to the translations before the assessment.

The Target Language

Identifying the language of the assessment (the "target" language) for most countries is relatively straightforward, because there is a dominant language used in both the public and private sectors of society. However, some countries use more than one language of instruction in their educational systems. In such cases, countries translate the student instruments into several target languages to ensure that the assessment can be administered in the language used for teaching in schools. Where the language of instruction may differ from the language commonly used at home, countries may translate the home questionnaire into one or more additional languages (the languages most commonly spoken in the home). This enables parents or caregivers to use the language that they feel most comfortable employing when filling out the questionnaire.

Scope of Translation and Verification in TIMSS 2015

For the TIMSS 2015 cycle at fourth and eighth grades, a total of 57 countries and seven benchmarking participants prepared 138 sets of achievement tests and 131 sets of background questionnaires in 43 languages.

The TIMSS 2015 assessment instruments were translated into 43 different languages, across 48 participating countries and seven benchmarking entities at the fourth grade, and 40 countries and seven benchmarking entities at the eighth grade. Of these participants, 22 countries and five benchmarking entities administered the instruments in more than one language (most commonly, the achievement test and student questionnaire).

Exhibits 7.1–7.3 list the TIMSS 2015 fourth grade, Numeracy, and eighth grade countries, the target languages identified for each country, and administered instruments. The most common languages used for the TIMSS 2015 assessment were English (21 countries) and Arabic (10 countries), with 22 countries administering all or parts of the assessment in two or more languages.

Exhibit 7.1 Languages Used for the TIMSS 2015 Fourth Grade Assessment Instruments

Country	Language	Instruments				
		Achievement Test	Student Questionnaire	Teacher Questionnaire	School Questionnaire	Home Questionnaire
Armenia	Armenian	●	●	●	●	●
Australia	English	●	●	●	●	●
Bahrain	Arabic	●	●	●	●	●
	English	●	●	●	●	●
Belgium (Flemish)	Dutch	●	●	●	●	●
Buenos Aires	Spanish	●	●	●	●	●
Bulgaria	Bulgarian	●	●	●	●	●
Canada	English	●	●	●	●	●
	French	●	●	●	●	●
Chile	Spanish	●	●	●	●	●
Chinese Taipei	Traditional Chinese	●	●	●	●	●
Croatia	Croatian	●	●	●	●	●
Cyprus	Greek	●	●	●	●	●
Czech Republic	Czech	●	●	●	●	●
Denmark	Danish	●	●	●	●	●
England	English	●	●	●	●	●
Finland	Finnish	●	●	●	●	●
	Swedish	●	●	●	●	●
France	French	●	●	●	●	●
Georgia	Georgian	●	●	●	●	●
Germany	German	●	●	●	●	●
Hong Kong (SAR)	English	●	●	●	●	●
	Traditional Chinese	●	●	●	●	●
Hungary	Hungarian	●	●	●	●	●
Indonesia	Bahasa Indonesian	●	●	●	●	●
Iran	Farsi	●	●	●	●	●
Ireland	English	●	●	●	●	●
	Irish	●	●	●	●	●
Italy	Italian	●	●	●	●	●
Japan	Japanese	●	●	●	●	●

Exhibit 7.1 Languages Used for the TIMSS 2015 Fourth Grade Assessment Instruments (Continued)

Country	Language	Instruments				
		Achievement Test	Student Questionnaire	Teacher Questionnaire	School Questionnaire	Home Questionnaire
Kazakhstan	Kazakh	●	●	●	●	●
	Russian	●	●	●	●	●
Korea	Korean	●	●	●	●	●
Kuwait	Arabic	●	●	●	●	●
	English	●	●	●	●	●
Lithuania[1]	Lithuanian	●	●	●	●	●
	Polish	●	●			
	Russian	●	●			
Morocco	Arabic	●	●	●	●	●
Netherlands	Dutch	●	●	●	●	●
New Zealand	English	●	●	●	●	●
Northern Ireland	English	●	●	●	●	●
	Irish	●	●	●	●	●
Norway	Bokmål	●	●	●	●	●
	Nynorsk	●	●	●	●	●
Oman	Arabic	●	●	●	●	●
	English	●	●	●	●	●
Poland	Polish	●	●	●	●	●
Portugal	Portuguese	●	●	●	●	●
Qatar	Arabic	●	●	●	●	●
	English	●	●	●	●	●
Russian Federation	Russian	●	●	●	●	●
Saudi Arabia	Arabic	●	●	●	●	●
	English	●	●	●	●	●
Serbia	Serbian	●	●	●	●	●
Singapore	English	●	●	●	●	●
	Traditional Chinese					●
	Tamil					●
	Malay					●
Slovak Republic	Slovak	●	●	●	●	●
	Hungarian	●	●			●

Exhibit 7.1 Languages Used for the TIMSS 2015 Fourth Grade Assessment Instruments (Continued)

Country	Language	Instruments				
		Achievement Test	Student Questionnaire	Teacher Questionnaire	School Questionnaire	Home Questionnaire
Slovenia	Slovene	●	●	●	●	●
Spain	Spanish	●	●	●	●	●
	Catalan	●	●	●	●	●
	Valencian	●	●	●	●	●
	Galician		●	●	●	●
	Basque	●	●	●	●	●
Sweden	Swedish	●	●	●	●	●
Turkey	Turkish	●	●	●	●	●
United Arab Emirates	Arabic	●	●	●	●	●
	English	●	●	●	●	●
	Arabic with some English text	●				
United States	English	●	●	●	●	●

1 In Lithuania, the fourth grade achievement test is administered in Polish (from Poland) and in Russian (from Russian Federation).

Exhibit 7.2 Languages Used for the TIMSS 2015 Numeracy Assessment Instruments

Country	Language	Instruments				
		Achievement Test	Student Questionnaire	Teacher Questionnaire	School Questionnaire	Home Questionnaire
Buenos Aires	Spanish	●				
Bahrain	Arabic	●				
	English	●				
Indonesia	Bahasa Indonesian	●				
Iran	Farsi	●				
Jordan	Arabic	●	●	●	●	●
Kuwait	Arabic	●				
	English	●				
Morocco	Arabic	●				
South Africa	Afrikaans	●	●	●	●	●
	English	●	●	●	●	●

Note: Countries that participate in both TIMSS fourth grade and TIMSS Numeracy administer the TIMSS fourth grade background questionnaires for both assessments.

Exhibit 7.3 Languages Used for the TIMSS 2015 Eighth Grade Assessment Instruments

Country	Language	Instruments			
		Achievement Test	Student Questionnaire	Teacher Questionnaires	School Questionnaire
Armenia	Armenian	●	●	●	●
Australia	English	●	●	●	●
Bahrain	English	●	●	●	●
	Arabic	●	●	●	●
Botswana	English	●	●	●	●
Buenos Aires	Spanish	●	●	●	●
Canada	English	●	●	●	●
	French	●	●	●	●
Chile	Spanish	●	●	●	●
Chinese Taipei (Taiwan)	Traditional Chinese	●	●	●	●
Egypt[1]	Arabic	●	●	●	●
	English	●			
England	English	●	●	●	●
Georgia	Georgian	●	●	●	●
Hong Kong (SAR)	English	●	●	●	●
	Traditional Chinese	●	●	●	●
Hungary	Hungarian	●	●	●	●
Iran	Farsi	●	●	●	●
Ireland	English	●	●	●	●
	Irish	●	●	●	●
Israel	Arabic	●	●	●	●
	Hebrew	●	●	●	●
Italy	Italian	●	●	●	●
Japan	Japanese	●	●	●	●
Jordan	Arabic	●	●	●	●
Kazakhstan	Kazakh	●	●	●	●
	Russian	●	●	●	●
Korea	Korean	●	●	●	●
Kuwait	Arabic	●	●	●	●
	English	●	●	●	●

Exhibit 7.3 Languages Used for the TIMSS 2015 Eighth Grade Assessment Instruments (Continued)

Country	Language	Instruments			
		Achievement Test	Student Questionnaire	Teacher Questionnaires	School Questionnaire
Lebanon	English	●	●	●	●
	French	●	●	●	●
Lithuania[2]	Lithuanian	●	●	●	●
	Polish	●	●		
	Russian	●	●		
Malaysia	English	●			
	Malay	●	●	●	●
Malta	English	●	●	●	●
Morocco	Arabic	●	●	●	●
New Zealand	English	●	●	●	●
Norway	Bokmål	●	●	●	●
	Nynorsk	●	●	●	●
Oman	Arabic	●	●	●	●
	English	●	●	●	●
Qatar	Arabic	●	●	●	●
	English	●	●	●	●
Russian Federation	Russian	●	●	●	●
Saudi Arabia	Arabic	●	●	●	●
	English	●	●	●	●
Singapore	English	●	●	●	●
Slovenia	Slovene	●	●	●	●
South Africa	Afrikaans	●	●	●	●
	English	●	●	●	●
Sweden	Swedish	●	●	●	●
Thailand	Thai	●	●	●	●
Turkey	Turkish	●	●	●	●
United Arab Emirates	Arabic	●	●	●	●
	English	●	●	●	●
	Arabic with some English text	●			
United States	English	●	●	●	●

1 In Egypt, the eighth grade achievement test in English did not undergo Adaptation/Translation Verification.

2 In Lithuania, the eighth grade achievement test is administered in Russian (from Russian Federation).

The Translation Process

The TIMSS & PIRLS International Study Center describes the procedures for translating the achievement items and questionnaires. Each country is responsible for having skilled and experienced translators translate the instruments. To ensure that national versions of the TIMSS instruments are consistent with the international version, the assessment translation guidelines allow for national adaptations where necessary. Following translation of the instruments, one or more qualified reviewers independently review the completed translations to ensure the nationally translated instruments are of the highest quality and student-level appropriate. Some countries employ multiple translators and reviewers, either working together to complete the tasks on schedule, or working independently to provide two or more views. When countries use more than one translator, the country must reconcile the translation differences to ensure that only a single consistently translated set of materials is produced. Similarly, when using more than one reviewer, countries are responsible for ensuring consistency of the reviews across the translated materials. When countries prepare translations in more than one language, professionals proficient in both languages should be involved to ensure equivalency across the translations.

Translators and Reviewers

Countries are strongly advised to hire highly qualified translators and reviewers who are well suited to the task of working with the TIMSS materials.

Essential qualifications for translators and reviewers include:

- Excellent knowledge of English
- Excellent knowledge of the target language
- Experience in the country's cultural context
- Experience translating texts in the subject areas related to the TIMSS assessment (mathematics and science)

The reviewers primarily are responsible for assessing the readability and accuracy of the translation for the target population. In addition to excellent language skills and knowledge of the country's cultural context, they are expected to have experience with students in the target grade (preferably as a school teacher).

Providing the Instruments for Translation and Adaptation

The TIMSS & PIRLS International Study Center provides NRCs with electronic files consisting of all materials to be translated, as well as special forms for documenting each step of the adaptation, translation, and verification processes. According to the TIMSS assessment design, most of the

achievement item blocks appear in more than one booklet, therefore the component parts of the booklets (blocks, covers, and directions) are prepared as separate files to facilitate translation. This approach allows countries to translate each component only once before assembling the booklets. The international instruments are accompanied by detailed manuals and instructional videos for NRCs that provide information on how to work with the electronic files, support materials for right-to-left languages, guidelines for translation and adaptation, and instructions for booklet assembly.

Translation and Adaptation of the Achievement Test

While translating the TIMSS achievement test, one of the main challenges is finding appropriate terms and expressions in the target language(s) of each country that convey the same meaning and style of text as the international version. When adapting and translating expressions with more contextually appropriate terms, translators must ensure that the meaning and difficulty of the item remains the same as the international version. For example, it is important that adaptation/translation of an item does not simplify or clarify the text in such a way as to provide a hint or definition of the meaning of a question. Also, translators must ensure the consistency of adaptations and translations from item to item. Similarly, for multiple-choice items, translators are instructed to pay particular attention to the literal and synonymous matches of text in both the question stem and answer options; matches in the international version should be maintained in the translated national version.

Although NRCs are strongly encouraged to keep adaptations to a minimum, some adaptations are necessary in order to prevent students from facing unfamiliar contexts or vocabulary that could hinder their ability to read and understand the item. In some cases, changes to the instruments may be necessary to follow national conventions of measurement, mathematical notation (e.g., decimal separator, multiplication sign), punctuation, and expressions of date and time. For example, a reference to the working week as Monday to Friday might be adapted according to national customs; similarly, a word such as "flashlight" in American English would be adapted to "torch" in British English. In addition, names of fictional characters and places may be modified to similar names in the target language. When the names of fictional cities or towns are adapted, translators are advised against using real place names to prevent students' responses from being influenced by their perception and knowledge of the names.

Some terms in the text are not to be changed or adapted beyond translation. Examples include proper names of actual people and places, as well as the fictional currency "zed" (which is used in the TIMSS items about money). To aid in the standardization of the most common adaptations across countries, the TIMSS & PIRLS International Study Center provides a list of specific examples of acceptable and unacceptable adaptations, including a list of measurement conversions.

Blocks of Achievement Items Designated to Measure Trends

According to a carefully specified design, a substantial number of blocks (about 60%) are carried over to the next cycle (see Chapter 1: Developing the TIMSS Advanced 2015 Achievement Items in *Methods and Procedures in TIMSS 2015*) for the purpose of measuring changes in student achievement over time. To ensure the quality of the trend measurement, these "trend blocks" must be administered in exactly the same way in every cycle. For countries that previously participated in TIMSS 2011 and/or TIMSS 2007, the translations of the trend blocks used in the previous assessment(s) were compared against the 2015 assessment translation.

If a country determines that changes to the trend blocks are absolutely necessary (e.g., in order to correct a mistranslation discovered in a previous translation), the changes are carefully documented and reviewed. Items with changes may not be included in the trend analyses for that participant.

The preparation of the trend blocks for countries not participating in the trend comparison follows the same general procedure for preparation as the newly developed assessment blocks for the current cycle.

Translation and Adaptation of the Questionnaires

The translation of the questionnaires differs from the assessment items in that participating countries are required to adapt some terms, and to ensure that questions are appropriate for the national context and education system. The terms requiring adaptation are listed in angle brackets in the international version with their country-specific information. For instance, <language of test> and <fourth grade> would be adapted to the name of the actual language and grade in which the assessment is being administered—for example, in Singapore, these terms would be replaced by equivalents "English" and "Primary 4". Some terms related to specific aspects of teaching and learning also are designated for adaptation—<in-service/professional development> should be adapted to the local term that denotes the supplemental training provided to teachers during their professional careers (e.g., in Lithuania this would be "qualification development"). Items assessing levels of education use the current version of the International Standard Classification of Education (ISCED) system, ISCED 2011 (UNESCO Institute for Statistics, 2012), and require adaptation to the nationally equivalent educational terms for each participating country.

The guidelines for translation and adaptation provide countries with detailed descriptions of the intent of each required adaptation to clarify the meaning of the terms used and to enable the translators to select the appropriate national term or expression to convey the intended meaning. For TIMSS 2015, the main difficulties encountered in adapting the questionnaires involved specific educational contexts, administration of the assessment at different grade levels than the internationally-defined target, and, for some countries, multiple languages of administration.

Countries are permitted to add a limited number of national interest questions to the questionnaires. To avoid influencing responses to the international questions, NRCs are advised to place any national interest questions at the end of the corresponding module or questionnaire, and to ensure these adopt the same format as the rest of the questionnaire. All national interest questions must be documented and approved by the TIMSS & PIRLS International Study Center before inclusion in the questionnaires.

The National Adaptation Forms

NRCs must prepare one National Adaptation Form (NAF) for each language and set of instruments. The NAF is an Excel document formatted to contain the complete translation, adaptation, and verification history of each set of national instruments. All national adaptations should be documented in the NAF. During various stages of the instrument preparation process, the form is completed and reviewed.

During the process of translation and adaptation for a set of national instruments, the first version of the NAF is filled out in collaboration with the translator(s), reviewer(s), and NRC. The translator and reviewer document the initial adaptations made to the instruments, which the NRC then reviews and consolidates. The NAF is updated and revised after each round of international verification, with comments from verifiers and the NRC.

Documenting an adaptation in the NAF requires recording the following information: identification of what is being adapted (location and/or question number), an English back translation of the adaptation, and recoding instructions (if applicable). For ease of use and documentation of the different stages of verification, the NAF includes designated areas for each item, respondent, and instrument.

The NAF is an important record of each country's final instruments, as it contains information used throughout the different stages of translation and verification. The International Quality Control Monitors also use the NAF after data collection to review the implementation of verification feedback (see Chapter 6: Survey Operations Procedures in TIMSS 2015 and Chapter 9: Quality Assurance for TIMSS 2015 in *Methods and Procedures in TIMSS 2015*). The NAF is referenced when adding national data to the international database and during data analysis.

International Translation Verification

The national translations of the instruments are required to undergo international translation verification. The IEA Secretariat manages the international translation verification process in coordination with an external translation verification company, cApStAn Linguistic Quality Control (based in Brussels, Belgium).

Translation Verifiers

For TIMSS, the international translation verifiers are responsible for reviewing and documenting the quality and comparability of the national instruments to the international instruments. The required qualifications for verifiers include:

- Fluency in English
- Mother tongue proficiency in the target language
- Formal credentials as translators working in English
- University-level education and (if possible) familiarity with the subject area
- Residency in the target country, or close contact with the country and its culture

The IEA Secretariat trains all international translation verifiers, and supplies verifiers with a comprehensive set of instructional materials to support their work. For TIMSS 2015, verifiers were trained through web-based seminars and were provided with information about TIMSS and the assessment instruments. Each verifier received a document containing the description of the adaptation and translation guidelines, the relevant manuals and instruments, and a document with the directions and instructions for reviewing the national instruments and registering deviations from the international version. During the verification of the final assessment instruments, verifiers were given a list of changes to the international instruments made after the field test and also were able to access the relevant national field test NAF.

The Translation Verification Process

The instructions and training given to the verifiers emphasize the importance of maintaining the same meaning and difficulty level in the translations and adaptations as in the international versions, and ensuring that translations and adaptations are adequate and consistent within and across national instruments. The translation verification process involves:

- Checking the accuracy, linguistic correctness, and comparability of the translation and adaptations of the achievement items and questionnaires
- Documenting any deviations between the national and international versions, including additions, deletions, and mistranslations
- Suggesting an alternative translation/adaptation to improve the accuracy and comparability of the national instruments

Verifiers provided feedback from translation verification in both the set of instruments and the associated NAF. Verifiers were asked to correct the text of the assessment items and questionnaires and/or to add notes specifying errors using either "Sticky Notes" in Adobe PDFs or "Track Changes" and "New Comment" functions in Microsoft Word. During translation

verification, some of the typical errors identified by the verifiers included mistranslations, omissions/additions of text, inconsistent translations (mathematical symbols, adaptation of ISCED levels, literal versus synonymous matches), adaptations of names (fictional versus real), gender agreement, and grammar. Some of the domain-specific concepts in mathematics and science (e.g., "line of symmetry") were a particular challenge to translate for some languages. With the documented comments and suggestions from the verifiers, NRCs were able revise and improve their national versions.

All comments viewed by the verifiers as deviations in the adaptation/translation were entered into the NAF. All verifier comments were accompanied by a code to help NRCs understand the severity and type of deviation of the translated text with the international version. Any adaptations reported in the NAF must also be reviewed by the verifier and commented on for their adequacy.

Codes Used in Verification Feedback

To help establish the quality and comparability of the translated/adapted instruments, the international translation verifiers aim to provide meaningful feedback to the NRCs, TIMSS & PIRLS International Study Center staff, and other members of the study consortium. To standardize the verification feedback across countries, verifiers are asked to assign a code to each intervention, indicating the nature and severity of the issue identified. These codes are accompanied by explanatory information, along with corrections or suggestions for improvement, if applicable. The criteria for coding are as follows:

CODE 1 indicates a major change or error. Examples include the omission or addition of a question or answer option; incorrect translation that changes the meaning or difficulty of the item or question; and incorrect order of questions or answer options in a multiple-choice question.

If in any doubt, verifiers are instructed to use **CODE 1?** so that the error can be referred to the TIMSS & PIRLS International Study Center for further consultation.

CODE 2 indicates a minor change or error, such as a spelling or grammar error that does not affect comprehension.

CODE 3 indicates that while the translation is adequate, the verifier has a suggestion for an alternative wording.

CODE 4 indicates that an adaptation is acceptable and appropriate. For example, a reference to winter for a country in the Southern Hemisphere is changed from January to July.

Verification of the Trend Assessment Blocks

For all countries assessing trends, the international verification procedure includes a 'trend check' for the achievement instruments to ensure that the trend items have not been changed. This involves:

- Checking that each of the trend items for the current cycle remain identical to the trend items as they were administered in the previous cycle
- Documenting any differences in content

The verifiers were instructed to record any discrepancies found in the trend items in the NAF. NRCs are instructed to carefully review all discrepancies and are instructed to discuss any proposed changes with the TIMSS & PIRLS International Study Center.

TIMSS 2015 Arabic International Source Version

As has been the practice since 2007, an Arabic version of the TIMSS 2015 instruments was made available to all Arabic-speaking countries to use as a starting point for their national assessment materials preparation. The international instruments that were translated into Arabic were the TIMSS Numeracy and the TIMSS 2015 fourth and eighth grade field test instruments (student achievement test and questionnaires for students, home, teachers, and school principals).

The initial translation of the TIMSS 2015 field test into Arabic was produced according to the guidelines for translation and the translation process design. The translation was produced by two teams of expert translators, from BranTra (an independent translation agency based in Brussels, Belgium). Each team consisted of a pair of translators and one reviewer. One team worked on the TIMSS Numeracy and the TIMSS 2015 fourth grade instruments, and the other team on the TIMSS 2015 eighth grade instruments. Every translator produced a separate translation that, upon completion, was compared and reviewed against the other translations, with only the best translations being selected by the reviewer for use in the field test instruments. The resulting draft source instruments underwent multiple review stages, with an emphasis on assessing the content and terminology used in specific school subjects at the target grades in a variety of Arabic-speaking countries.

Upon completion of the content review (also involving the most experienced NRCs from countries interested in using this source version), the materials were reviewed and reconciled based on the comments, suggestions and changes. The reconciled translation of the assessment materials was then sent to the TIMSS & PIRLS International Study Center for production.

The same groups of translators and reviewers reviewed and updated the Arabic translation of the TIMSS assessment after the field test and prior to the TIMSS 2015 assessment data collection. To aid the translators and reviewer in updating the Arabic translation, the TIMSS & PIRLS International Study Center provided a list of changes made to the international version after the field test.

The TIMSS & PIRLS International Study Center used the World Tools Plugin to convert the production InDesign files to a right-to-left format for the Arabic achievement booklets and background questionnaires. The TIMSS & PIRLS International Study Center imported the Arabic translation from rich-text format (RTF) documents into InDesign using the program CopyFlow Gold. After the translation was imported, the TIMSS & PIRLS International Study Center applied fonts, styles, and graphics to the instruments and thoroughly reviewed the documentation to ensure that the translations and layout resembled the international English version. Before the release of TIMSS 2015 assessment in Arabic to participating countries, an additional optical check was performed to verify the layout of the Arabic version and eradicate any remaining errors or issues that occurred during the import process. The multiple stages of translation and review of the Arabic version ensured that the translation was an adequate starting point for interested countries to begin the adaption process for their country contexts.

Outcomes and Summary for TIMSS 2015

To ensure high quality and international comparability of the national instruments prepared by participating countries, the 2015 cycle of TIMSS incorporated stringent procedures for translation and translation verification, similar to previous cycles. NRCs were provided with a comprehensive set of guidelines that contained information covering their responsibilities, from appointing highly skilled and experienced translators to ensuring the accuracy of the documentation of national adaptations recorded in the NAFs. After the initial completion of the national versions, countries were to perform an internal review that was followed by the international verification of the adaptations and translation performed by well-trained and experienced verifiers.

During the translation verification processes of the assessment, verifiers made comments and suggestions on errors, from typographical errors and inconsistent translations, to omissions/additions of text and mistranslations. This important feedback aided the NRCs in revising and improving the quality of their national versions in line with the translation guidelines for TIMSS 2015. Additionally, during the verification of the assessment materials, verifiers commented on the great care taken by the NRCs in implementing the field test verification feedback, improving the quality of the translations. Overall the documentation of national adaptations in the NAFs and feedback from the results of the assessment translation verification indicated that the TIMSS 2015 national instruments were of very high quality.

The verification outcomes confirm that countries rigorously implemented the guidelines, documentation, and policies and procedures (including submission of materials and review of post-verification materials).

References

UNESCO Institute for Statistics. (2012). *ISCED: International Standard Classification of Education*. Retrieved from http://www.uis.unesco.org/Education/Pages/international-standard-classification-of-education.aspx

CHAPTER 8

Layout Verification for TIMSS 2015

Erin Wry
Ieva Johansone

Layout verification is the final external review and ratification of each participating country's national assessment instruments and their corresponding National Adaptations Forms. To ensure that the instruments are of the highest quality and are comparable across all of the participating countries and benchmarking entities, countries follow standard internationally agreed-upon procedures in preparing national versions of the assessment instruments (see Chapter 6 on Survey Operations Procedures). Assessment translation guidelines allow for national adaptations to instruments as long as international comparability is maintained. Countries are required to document any national adaptations applied to the international assessment instruments within the TIMSS 2015 National Adaptations Forms. This documentation is verified nationally and internationally throughout all stages of preparing each country's national instruments.

Prior to both the field test and main data collection, all national instruments undergo independent translation verification coordinated by the IEA Secretariat, and after the contents of the achievement booklets and context questionnaires have completed translation verification, the national instruments are sent to the TIMSS & PIRLS International Study Center for layout verification. During the layout verification process, the TIMSS & PIRLS International Study Center checks to ensure that all national assessment instruments conform to the international format and that any national adaptations made to the TIMSS 2015 international instruments do not unduly influence their international comparability. In particular, layout verification focuses on the following:

- Reviewing the national assessment instruments for acceptable layout structure including pagination, page breaks, item sequence, response options, text formats, and graphics
- Reviewing the national adaptations applied to both the international achievement booklets and context questionnaires with respect to how they may influence the international comparability of the data

Scope of Layout Verification for TIMSS 2015

Participating countries and benchmarking entities prepare national versions of the instruments for the field test and then again for the main data collection. This includes translating and/or adapting the newly developed items and questionnaires in preparation for the field test. Then, changes resulting from the field test are applied to the achievement items selected for the main data collection and similar modifications are applied to the context questionnaires. Accordingly, in preparation for TIMSS 2015 assessment administration, layout verification was conducted twice for each participating country—once for the field test and again for the main data collection.

To complete layout verification, each country submits the following documentation for each language in which they are administering the assessment(s):

- A set of all achievement booklets assembled in complete, ready-to-print booklet form
- Context questionnaires for school principals, teachers, parents/guardians[1], and students in complete, ready-to-print booklet form
- National Adaptations Forms for both the achievement booklets and context questionnaires, including documentation of national adaptations and the feedback received from translation verification

For the TIMSS 2015 main data collection, layout verification was completed for 57 countries and seven benchmarking participants. This included 48 countries and 7 benchmarking participants for the fourth grade assessment, 7 countries and 1 benchmarking participant for the TIMSS Numeracy assessment, and 40 countries and 7 benchmarking participants for the eighth grade assessment. With 22 countries administering the assessment(s) in multiple languages, the TIMSS & PIRLS International Study Center reviewed a total of 140 sets of national TIMSS 2015 assessment instruments (each set including achievement booklets and context questionnaires). A list of assessment instruments and languages they were administered in each of the participating countries can be found in Exhibits 7.1-7.3 of the Translation and Translation Verification chapter of this volume.

Layout Verification of Achievement Booklets

The primary goal of layout verification is to ensure that students in different countries experience the assessment instruments in the same way. Thus, the national achievement booklets were checked against the international versions to identify any deviations from the international format.

Due to differences in languages, the national assessment instruments varied slightly in length and format. The international versions, however, were designed with this in mind, and extra space was provided in the margins of the pages to facilitate the use of longer text and different paper sizes (letter versus A4) without necessitating extensive changes to the layout of each page.

1 The Early Learning Survey, which is completed by parents/guardians, is administered only at the fourth grade.

National Research Coordinators (NRCs) were directed to document all national adaptations (apart from direct translations) made to the achievement booklets within the achievement booklet National Adaptations Forms. During layout verification, the verifiers also checked the achievement items for international comparability while taking into consideration the national adaptations documented by the NRCs. Any layout deviations or errors, as well as any concerns of international incomparability of assessment items, were documented by the verifiers in the National Adaptations Forms.

Per the TIMSS assessment design, the TIMSS 2015 achievement instruments include blocks of items from TIMSS 2011 and TIMSS 2007. These "trend blocks" provide the foundation for the measurement of change in student achievement over time and therefore must be administered in the same way across subsequent TIMSS cycles. As such, for countries that previously participated in TIMSS 2011 and/or TIMSS 2007, the TIMSS 2015 trend blocks were reviewed during the layout verification against those from the last cycle in which the country participated. Any deviations from the previous cycle were documented by the verifiers within the National Adaptations Forms.

Following layout verification, the National Adaptations Forms containing the verifiers' comments were sent back to the National Research Coordinators for consideration. The National Research Coordinators were asked to confirm that each of the suggested changes was implemented or provide an explanation for not implementing the suggested change.

Layout Verification of Context Questionnaires

As with the achievement booklets, the context questionnaires were also checked against the international versions to identify any potential layout issues as well as to ensure the international comparability of the questionnaire data.

In an effort to make the questionnaires general enough for international analyses but appropriate for each intended audience, participating countries were required to adapt certain phrases and designations in the text of the questionnaires. The text that requires country-specific adaptations is enclosed in brackets (e.g., <fourth grade>) in the international instruments. To assist the NRCs in finding comparable and appropriate substitutions for the bracketed text, the TIMSS & PIRLS International Study Center supplied documentation in one of the Survey Operations Units, providing explanations of the intended meaning of each bracketed text, and where applicable, offered examples to guide the National Research Coordinators in selecting appropriate replacements.

National Research Coordinators were directed to document all national adaptations made to the context questionnaires within the National Adaptations Forms. During the layout verification, the verifiers checked the instruments for international comparability, taking into consideration the national adaptations documented by the National Research Coordinators. Any internationally incomparable adaptations or errors were documented by the verifiers in the National Adaptations Forms along with recommendations for recoding or rewording.

Additionally, the verifiers ensured that all bracketed text, requiring country-specific adaptations, was properly documented with English back translations. The documentation for these universally adapted questionnaire items is intended for later use in the National Adaptations Database. The database is a compilation of each country's intended adaptations, to be used during data processing by the IEA Data Processing and Research Center, and the information included in the database is reported as a supplement to the user guide for the TIMSS 2015 International Database.

Similar to the layout verification process for the achievement items, layout verifiers provided the NRCs with feedback through the National Adaptations Forms, and the NRCs were asked to respond to the feedback by either confirming the implementation of the suggested modifications or providing an explanation as to why the changes were not applied.

CHAPTER 9

Quality Assurance Program for TIMSS 2015

Ieva Johansone
Erin Wry

Considerable effort has been made to develop standardized materials and survey operations procedures so that the TIMSS 2015 data meet the highest standards. To document data collection activities and verify that the standardized TIMSS procedures were followed, the TIMSS & PIRLS International Study Center, working in coalition with the IEA Secretariat, developed and implemented an ambitious International Quality Assurance Program. The purpose of this chapter is to provide an overview of the International Quality Assurance Program and report on the data collected through the program.

Overview

The International Quality Assurance Program was implemented by independent International Quality Control Monitors (IQCMs) appointed by the IEA Secretariat. The major task of the IQCMs was to conduct site visits during the data collection process. In each country, the IQCM visited a sample of 15 participating schools at each grade during the testing sessions. When there were one or more benchmarking participants from the same country, and only one centrally organized national center responsible for all aspects of data collection, five additional school visits were required for each benchmarking entity.

For each school visit, IQCMs observed the testing session and recorded their observations, noting any deviations from the standardized administration script, timing, and procedures. In addition, IQCMs interviewed the School Coordinators about their experiences coordinating the TIMSS 2015 assessment. IQCMs also checked whether the suggestions made by the international translation and layout verifiers had been integrated into the final assessment instruments, as documented in the National Adaptations Forms.

Prior to beginning their assignments, the IQCMs were mandated to attend a training session conducted by the TIMSS & PIRLS International Study Center. There were two training sessions, one for Southern Hemisphere countries and one for Northern Hemisphere countries. During the training, IQCMs were introduced to the TIMSS survey operations procedures and the design of

the TIMSS 2015 achievement booklets and context questionnaires. IQCMs were also supplied with a manual detailing their role and responsibilities as well as the necessary materials for completing the quality control tasks.

An important aspect of the International Quality Assurance Program is the independence of the IQCMs from the national centers. In most participating countries and benchmarking entities, the IEA Secretariat recruited IQCMs who had served in the same role in previous IEA assessments. For the remaining countries, National Research Coordinators assisted the IEA Secretariat in nominating an International Quality Control Monitor (ICQM). The nominated person could not be a member of the national center, or a family member or personal friend of the NRC. Often, this person was a school inspector, ministry official, or retired school teacher. The IQCM was required to be fluent in both English and the language(s) spoken in the country.

When necessary, the IQCMs were permitted to recruit assistants in order to effectively cover the territory and testing timetable. For TIMSS 2015, a total of 64 IQCMs were trained across the 57 participating countries and 7 benchmarking participants. In addition, the IQCMs trained more than 250 assistant monitors. Altogether, Quality Control Monitors observed 768 fourth grade testing sessions, 108 Numeracy sessions, and 614 eighth grade sessions. The results of the TIMSS 2015 IQCM observations are reported in the following sections of this chapter.

Quality Control Observations of the TIMSS 2015 Data Collection

International Quality Control Monitors (IQCMs) conducted site visits during TIMSS test administration to a sample of 15 schools per grade in each country. For each school visit, the IQCMs completed the TIMSS 2015 Classroom Observation Record. For purposes of reporting, the TIMSS Numeracy records were combined with the TIMSS fourth grade records.

The observation records were organized into four sections:

- Section A—Documentation of the TIMSS/TIMSS Numeracy Testing Session
- Section B—Summary Observations of the TIMSS/TIMSS Numeracy Testing Session
- Section C—Student Questionnaire Administration and Distribution of the Early Learning Survey
- Section D—Interview with the School Coordinator

Documentation and Summary Observations of the TIMSS 2015 Testing Sessions

Sections A and B of the Classroom Observation Record addressed activities that took place during the actual testing sessions. The achievement test was administered in two parts with a break of up to 30 minutes between each part. During test administration, IQCMs were asked to observe the activities of the Test Administrator, specifically the following:

- Distributing, collecting, and securing the test booklets
- Following the assessment administration script
- Making time announcements during the testing sessions

Exhibits 9.1 and 9.2 show that IQCMs reported that the assessments were conducted in accordance with the international procedures, particularly, in regard to booklet distribution and adherence to time limits. In a few sessions (4% for Part 1 and 6% for Part 2 at the fourth grade; 4% for Part 1 and 7% for Part 2 at the eighth grade), the total testing time for either Part 1 or Part 2 was not equal to the time allowed. Usually, this was because students had completed their work a few minutes before the allotted time had elapsed. If Test Administrators observed students working faster than expected, a remaining-time announcement was made prior to the planned 10 minute warning to inform students that they still had ample time to complete their work.

Exhibit 9.1: Observations of TIMSS 2015 Fourth Grade and TIMSS Numeracy Assessment Administration Sessions—876 Sessions (Percent of IQCM Responses)

Question	Yes (%)	No (%)	Not Answered (%)
Did the Test Administrator distribute the test booklets according to the booklet assignment on the *Student Tracking Form* and booklet labels?	99	1	0
Did the total testing time for Part 1 equal the time allowed?	96	4	0
Did the Test Administrator announce "you have 10 minutes left" prior to the end of Part 1?	93	7	0
Were there any other time remaining announcements made during Part 1?	24	76	0
Was the total time for the break equal to or less than 30 minutes?	95	5	0
Were the booklets left unattended or unsecured during the break?	4	96	0
Did the total testing time for Part 2 equal the time allowed?	94	6	0
Did the Test Administrator announce "you have 10 minutes left" prior to the end of Part 2?	92	8	0
Were there any other time remaining announcements made during Part 2?	19	81	0
Did any students finish either Part 1 or Part 2 of the assessment early (before the 36 minutes were up)?	85	15	0
Did the test administrator have a watch with a seconds hand (or stopwatch) for accurately timing the testing session(s)?	97	3	0
Were the booklets collected and secured after the testing session?	96	4	0

Exhibit 9.2: Observations of TIMSS 2015 Eighth Grade Assessment Administration Sessions —614 Sessions (Percent of IQCM Responses)

Question	Yes (%)	No (%)	Not Answered (%)
Did the Test Administrator distribute the test booklets according to the booklet assignment on the *Student Tracking Form* and booklet labels?	99	1	0
Did the total testing time for Part 1 equal the time allowed?	96	4	0
Did the Test Administrator announce "you have 10 minutes left" prior to the end of Part 1?	93	7	0
Were there any other time remaining announcements made during Part 1?	20	80	0
Was the total time for the break equal to or less than 30 minutes?	95	3	2
Were the booklets left unattended or unsecured during the break?	1	99	0
Did the total testing time for Part 2 equal the time allowed?	95	5	0
Did the Test Administrator announce "you have 10 minutes left" prior to the end of Part 2?	93	7	0
Were there any other time remaining announcements made during Part 2?	19	81	0
Did any students finish either Part 1 or Part 2 of the assessment early (before the 45 minutes were up)?	77	23	0
Did the test administrator have a watch with a seconds hand (or stopwatch) for accurately timing the testing session(s)?	96	4	0
Were the booklets collected and secured after the testing session?	96	4	0

For both grades, 95% of all IQCM records reported that the break between Part 1 and Part 2 of the testing session did not exceed 30 minutes, and nearly all IQCMs reported that the testing materials were almost always secured or supervised during the break (96% at the fourth grade and 99% at the eighth grade). In accordance with the TIMSS procedure, at the end of the testing session, Test Administrators were asked to collect and secure the test booklets. The IQCMs reported that in 96% of the testing sessions for both grades this occurred. However, in a few cases, the Student Questionnaire was attached to the test booklet, and in these cases students retained their test booklets until they completed their questionnaire.

Exhibits 9.3 and 9.4 report on the activities conducted during the assessment sessions. One of the most important methods of standardizing the assessment administration was to have all test administrators follow the script in the Test Administrator Manual. IQCMs reported that in more than three-quarters of the observations at both grades, the Test Administrators exactly followed the script. In the circumstances in which the Test Administrator deviated from the script, nearly all modifications were reported as "minor."

Exhibit 9.3: Test Administrators Following the Test Administration Script—876 Fourth Grade and TIMSS Numeracy Sessions (Percent of IQCM Responses)

Question	Yes (%)	No (%)	Not Answered (%)
Had the test administrator familiarized himself or herself with the test administration script prior to the testing?	94	4	2 *(I Cannot Answer)* 0 *(Not Answered)*
Did the test administrator follow the test administration script in the Test Administrator Manual?	77	21 *(Minor changes)* 2 *(Major changes)*	0
If the Test Administrator made changes to the script, how would you describe them?			
Additions	15	8	0 *(Not Answered)* 77 *(Not Applicable)*
Revisions	10	13	0 *(Not Answered)* 77 *(Not Applicable)*
Deletions	5	18	0 *(Not Answered)* 77 *(Not Applicable)*
Did the test administrator address student questions appropriately?	98	2	0

Exhibit 9.4: Test Administrators Following the Test Administration Script—614 Eighth Grade Sessions (Percent of IQCM Responses)

Question	Yes (%)	No (%)	Not Answered (%)
Had the test administrator familiarized himself or herself with the test administration script prior to the testing?	92	4	2 *(I Cannot Answer)* 0 *(Not Answered)*
Did the test administrator follow the test administration script in the Test Administrator Manual?	80	18 *(Minor changes)* 2 *(Major changes)*	0
If the Test Administrator made changes to the script, how would you describe them?			
Additions	11	9	0 *(Not Answered)* 80 *(Not Applicable)*
Revisions	11	9	0 *(Not Answered)* 80 *(Not Applicable)*
Deletions	7	13	0 *(Not Answered)* 80 *(Not Applicable)*
Did the test administrator address student questions appropriately?	98	1	1

Exhibits 9.5 and 9.6 present observations on student compliance with instructions and overall cooperation during the assessment administration. According to the IQCMs' observations, in almost all of the sessions, students complied well or very well with the instruction to stop work at the end of both Part 1 and Part 2. In addition, IQCMs described the students as extremely orderly and cooperative during most of the testing sessions.

Exhibit 9.5: Student Cooperation During Assessment Administration—876 Fourth Grade and TIMSS Numeracy Sessions (Percent of IQCM Responses)

Question	Very Well (%)	Fairly Well (%)	Not well at all (%)	Not Answered (%)
When the Test Administrator ended Part 1, how well did the students comply with the instruction to stop work?	88	12	0	0
When the Test Administrator ended Part 2, how well did the students comply with the instruction to stop work?	89	10	1	0

	Extremely (%)	Moderately (%)	Somewhat (%)	Hardly (%)	Not answered (%)
To what extent would you describe the students as orderly and cooperative?	78	20	2	0	0

Exhibit 9.6: Student Cooperation During Assessment Administration—614 Eighth Grade Sessions (Percent of IQCM Responses)

Question	Very Well (%)	Fairly Well (%)	Not well at all (%)	Not Answered (%)
When the Test Administrator ended Part 1, how well did the students comply with the instruction to stop work?	86	14	0	0
When the Test Administrator ended Part 2, how well did the students comply with the instruction to stop work?	86	13	1	0

	Extremely (%)	Moderately (%)	Somewhat (%)	Hardly (%)	Not answered (%)
To what extent would you describe the students as orderly and cooperative?	73	23	4	1	0

Summary Observations of the TIMSS 2015 Testing Sessions

Exhibits 9.7 and 9.8 report on the IQCMs' general observations of TIMSS assessment administration. Overall, IQCMs reported that the quality of testing sessions was very good or excellent (90% at the fourth grade and 87% at the eighth grade). In most of the testing sessions that the IQCMs attended, no problems were observed and in only 1% of cases for both grades did a student refuse to take the test. In addition, nearly all of the observed testing sessions took place under favorable room conditions that were suitable for students to work without distraction (96% at the fourth grade and 95% at the eighth grade). In 17% of the observed fourth grade testing sessions and in 10% of the eighth grade testing sessions, a student left the room for an "emergency" (usually a bathroom visit) during the testing session. In such cases, Test Administrators were instructed to collect the students' test booklets and return them when the students reentered the testing session. However, in a small number of cases, the students had already completed the test and, thus, it was not necessary to give back the test booklets when the students returned.

Exhibit 9.7: General Observations of the Testing Session—876 Fourth Grade and TIMSS Numeracy Sessions (Percent of IQCM Responses)

Question	Yes (%)	No (%)	Not Answered (%)
Did the student identification information on the booklets correspond with the *Student Tracking Form*?	98	2	0
Were any defective test booklets detected and replaced?	2 *(BEFORE the testing began)* 1 *(AFTER the testing began)*	98 *(BEFORE the testing began)* 97 *(AFTER the testing began)*	0 *(BEFORE the testing began)* 2 *(AFTER the testing began)*
If any defective test booklets were replaced, did the Test Administrator replace them appropriately?	2	1	0 *(Not Answered)* 97 *(Not Applicable)*
Did any students refuse to take the test?	0	100	0
If a student refused, did the Test Administrator accurately follow the instructions for excusing the student?	0	0	0 *(Not Answered)* 100 *(Not Applicable)*
Were any late students admitted to the testing room?	4 *(BEFORE the testing began)* 2 *(AFTER the testing began)*	92 *(There were no late students)* 1 *(Late students were not admitted)*	1
Did any students leave the room for an "emergency" during the testing?	17	83	0
If a student left the room for an emergency during the testing, did the Test Administrator address the situation appropriately (collect the test booklet, and if re-admitted, return the test booklet)?	15	2	2 *(Not Answered)* 83 *(Not Applicable)*
Were there any students requiring special accommodations (e.g., students with visual or hearing impairment, Dyslexia)?	14	86	0
Did students store away everything, including all electronic devices, having only a pen or a pencil and the test booklet for the duration of the test administration?	96	4	0
During the testing sessions did the test administrator walk around the room to be sure students were working on the correct section of the test and/or behaving properly?	94	6	0
Were the conditions in the testing room suitable (lighting, temperature, noise, etc.) for the students to work without distractions?	96	4	0
Did the seating arrangement provide adequate space for students to work and not be distracted by each other?	97	3	0
Did you see any evidence of students attempting to cheat on the tests (e.g., by copying from a neighbor)?	6	94	0

Question	Excellent (%)	Very Good (%)	Good (%)	Fair (%)	Poor (%)	Not Answered (%)
In general, how would you describe the overall quality of the testing session?	58	32	8	2	0	0

Exhibit 9.8: General Observations of the Testing Session—614 Eighth Grade Sessions (Percent of IQCM Responses)

Question	Yes (%)	No (%)	Not Answered (%)
Did the student identification information on the booklets correspond with the *Student Tracking Form*?	98	2	0
Were any defective test books detected and replaced?	1 *(BEFORE the testing began)* 1 *(AFTER the testing began)*	99 *(BEFORE the testing began)* 97 *(AFTER the testing began)*	0 *(BEFORE the testing began)* 2 *(AFTER the testing began)*
If any defective test books were replaced, did the Test Administrator replace them appropriately?	2	0	0 *(Not Answered)* 98 *(Not Applicable)*
Did any students refuse to take the test?	1	98	1
If a student refused, did the Test Administrator accurately follow the instructions for excusing the student?	1	0	1 *(Not Answered)* 98 *(Not Applicable)*
Were any late students admitted to the testing room	5 *(BEFORE the testing began)* 5 *(AFTER the testing began)*	88 *(There were no late students)* 2 *(Late students were not admitted)*	0
Did any students leave the room for an "emergency" during the testing?	10	89	1
If a student left the room for an emergency during the testing, did the Test Administrator address the situation appropriately (collect the test booklet, and if re-admitted, return the test booklet)?	9	1	1 *(Not Answered)* 89 *(Not Applicable)*
Were there any students requiring special accommodations (e.g., students with visual or hearing impairment, Dyslexia)?	6	94	0
Did students store away everything, including all electronic devices, having only a pen or a pencil and the test booklet for the duration of the test administration?	96	4	0
During the testing sessions did the test administrator walk around the room to be sure students were working on the correct section of the test and/or behaving properly?	96	4	0
Were the conditions in the testing room suitable (lighting, temperature, noise, etc.) for the students to work without distractions?	95	5	0
Did the seating arrangement provide adequate space for students to work and not be distracted by each other?	96	4	0
Did you see any evidence of students attempting to cheat on the tests (e.g., by copying from a neighbor)?	6	94	0

Question	Excellent (%)	Very Good (%)	Good (%)	Fair (%)	Poor (%)	Not Answered (%)
In general, how would you describe the overall quality of the testing session?	51	36	10	2	1	0

Student Questionnaire Administration

Exhibits 9.9 and 9.10 summarize the IQCMs' observations of the Student Questionnaire administration. IQCMs reported that the Student Questionnaires were distributed according to the Student Tracking Forms and questionnaire labels. In most cases (75% at the fourth grade and 80% at the eighth grade), Test Administrators followed the Student Questionnaire administration script exactly. If the Test Administrator deviated from the script, most frequently the modifications were "minor." In 37% of all the fourth grade sessions, Test Administrators read Student Questionnaire questions aloud (this was not an option for the eighth grade sessions), while in 54% of the sessions, students answered these questions independently. It should be noted that some schools chose to administer the questionnaire on a different date than the TIMSS achievement booklets, and in these cases, IQCMs were not required to observe student questionnaire administration.

Exhibit 9.9: Student Questionnaire Administration—876 Fourth Grade and TIMSS Numeracy Sessions (Percent of IQCM Responses)

Question	Yes (%)	No (%)	Not Answered (%)
When the test administrator read the script to end the assessment session followed by the Student Questionnaire administration, did the test administrator announce a break?	86	7	7
Did the Test Administrator distribute the Student Questionnaires according to the *Student Tracking Form* and questionnaire labels?	90	1	9 *(Not Applicable)*
Did the test administrator follow the questionnaire administration script in the Test Administrator Manual?	75	13 *(Minor changes)* 2 *(Major changes)*	1 *(Not Answered)* 9 *(Not Applicable)*
If the Test Administrator made changes to the script, how would you describe them?			
Additions	10	6	0 *(Not Answered)* 84 *(Not Applicable)*
Revisions	7	9	0 *(Not Answered)* 84 *(Not Applicable)*
Deletions	5	11	0 *(Not Answered)* 84 *(Not Applicable)*
Did the test administrator read the questions aloud to the students?	37	54 *(students answer the questions independently)*	0 *(Not Answered)* 9 *(Not Applicable)*
After the Student Questionnaire administration, did the Test Administrator distribute the Early Learning Surveys?	26	63	2 *(Not Answered)* 9 *(Not Applicable)*
If the Early Learning Surveys were distributed at this time, did the Test Administrator distribute them according to the Student Tracking Form and survey labels?	26	0	2 *(Not Answered)* 72 *(Not Applicable)*

Exhibit 9.10: Student Questionnaire Administration—614 Eighth Grade Sessions (Percent of IQCM Responses)

Question	Yes (%)	No (%)	Not Answered (%)
When the test administrator read the script to end the assessment session followed by the Student Questionnaire administration, did the test administrator announce a break?	87	9	4
Did the Test Administrator distribute the Student Questionnaires according to the *Student Tracking Form* and questionnaire labels?	93	3	4 *(Not Applicable)*
Did the test administrator follow the questionnaire administration script in the Test Administrator Manual?	80	13 *(Minor changes)* 3 *(Major changes)*	4 *(Not Applicable)*
If the Test Administrator made changes to the script, how would you describe them?			
Additions	9	7	0 *(Not Answered)* 84 *(Not Applicable)*
Revisions	8	8	0 *(Not Answered)* 84 *(Not Applicable)*
Deletions	6	10	0 *(Not Answered)* 84 *(Not Applicable)*

Interview with the School Coordinator

Section D was the final component of the Classroom Observation Record and involved the IQCM conducting an interview with the School Coordinator. The interview addressed issues such as the following:

- Shipment of assessment materials
- Arrangements for test administration
- Responsiveness of the national center to queries
- Necessity for make-up sessions
- Organization of classes in the school (to validate within-school sampling procedure)

As shown in Exhibits 9.11 and 9.12, a large majority of School Coordinators considered that the TIMSS 2015 administration in their school went very well overall (92% at the fourth grade and 89% at the eighth grade), that the School Coordinator Manual provided worked well (92% at the fourth grade and 93% at the eighth grade), and that other school staff members had mostly positive attitudes toward TIMSS testing (80% at the fourth grade and 81% eighth grade).

Exhibit 9.11: Interview with the School Coordinator, Overview—Fourth Grade and TIMSS Numeracy (Percent of School Coordinator Responses)

Question	Very well, no problems (%)	Satisfactorily, few problems (%)	Unsatisfactorily, many problems (%)	Not Answered (%)
Overall, how would you say the session went?	92	7	1	0
	Positive (%)	**Neutral (%)**	**Negative (%)**	**Not Answered (%)**
Overall, how would you rate the attitude of the other school staff members towards the TIMSS testing?	80	17	2	1
	Worked well (%)	**Needs improvement (%)**	**Not Answered (%)**	
Overall, do you feel the School Coordinator Manual worked well for you or does it need improvement?	92	3	5	

Exhibit 9.12: Interview with the School Coordinator, Overview—Eighth Grade (Percent of School Coordinator Responses)

Question	Very well, no problems (%)	Satisfactorily, few problems (%)	Unsatisfactorily, many problems (%)	Not Answered (%)
Overall, how would you say the session went?	89	11	0	0
	Positive (%)	**Neutral (%)**	**Negative (%)**	**Not Answered (%)**
Overall, how would you rate the attitude of the other school staff members towards the TIMSS testing?	81	16	3	0
	Worked well (%)	**Needs improvement (%)**	**Not Answered (%)**	
Overall, do you feel the School Coordinator Manual worked well for you or does it need improvement?	93	4	3	

Exhibits 9.13 and 9.14 show that there were only a small number of cases where components were missing from the shipments of test materials. In some cases where the School Coordinator reported not receiving all of the TIMSS materials, test materials were brought to the school on the testing day by external Test Administrators.

Exhibit 9.13: Interview with the School Coordinator, Details—Fourth Grade and TIMSS Numeracy (Percent of School Coordinator Responses)

Question	Yes (%)	No (%)	Not Answered (%)
Prior to the testing day, did you have time to check your shipment of materials from the national center?	78	18	4
Did you receive the correct shipment of the materials as listed in your School Coordinator Manual and according to the tracking forms?	88	8	4
If no, did the national center provide the missing materials in time for the testing?	4	5	0 *(Not Answered)* 91 *(Not Applicable)*
Was the national center responsive to your questions or concerns?	93	4	3
Was the Teacher Questionnaire administered online?	25	71	4
If the Teacher Questionnaire was administered online, did the teacher(s) encounter any problems?	3	22	0 *(Not Answered)* 75 *(Not Applicable)*
Was the School Questionnaire administered online?	25	71	4
If the School Questionnaire was administered online, did the person completing it encounter any problems?	2	23	0 *(Not Answered)* 75 *(Not Applicable)*
Was the Early Learning Survey administered online?	9	80	11
If the Early Learning Survey was administered online, did the parents/guardians encounter any problems?	0	9	1 *(Not Answered)* 90 *(Not Applicable)*
Do you anticipate that a makeup session will be required at your school?	8	92	0
If yes, do you intend to conduct one?	8	0	2 *(Not Answered)* 90 *(Not Applicable)*
Did the students receive any special instructions, motivational talk, or incentives to prepare them for the assessment?	61	39	0
Is this a complete list of the classes in this grade in this school?	90	8	2
To the best of your knowledge, are there any students in this grade level who are not in any of these classes?	3	95	2
To the best of your knowledge, are there any students in this grade level in more than one of these classes?	1	97	2
If there was another international assessment, would you be willing to serve as a School Coordinator?	91	9	0

Exhibit 9.14: Interview with the School Coordinator, Details—Eighth Grade (Percent of School Coordinator Responses)

Question	Yes (%)	No (%)	Not Answered (%)
Prior to the testing day, did you have time to check your shipment of materials from the national center?	76	23	1
Did you receive the correct shipment of the materials as listed in your School Coordinator Manual and according to the tracking forms?	84	13	3
If no, did the national center provide the missing materials in time for the testing?	4	8	4 *(Not Answered)* 84 *(Not Applicable)*
Was the national center responsive to your questions or concerns?	95	4	1
Was the Teacher Questionnaire administered online?	31	64	5
If the Teacher Questionnaire was administered online, did the teacher(s) encounter any problems?	5	26	5 *(Not Answered)* 64 *(Not Applicable)*
Was the School Questionnaire administered online?	30	65	5
If the School Questionnaire was administered online, did the person completing it encounter any problems?	1	28	6 *(Not Answered)* 65 *(Not Applicable)*
Do you anticipate that a makeup session will be required at your school?	15	85	0
If yes, do you intend to conduct one?	14	1	0 *(Not Answered)* 85 *(Not Applicable)*
Did the students receive any special instructions, motivational talk, or incentives to prepare them for the assessment?	65	35	0
Is this a complete list of the classes in this grade in this school?	89	9	2
To the best of your knowledge, are there any students in this grade level who are not in any of these classes?	6	93	1
To the best of your knowledge, are there any students in this grade level in more than one of these classes?	2	96	2
If there was another international assessment, would you be willing to serve as a School Coordinator?	91	9	0

In more than half of the cases (61% at the fourth grade and 65% at the eighth grade), School Coordinators indicated that students were given special instructions, motivational talks, or incentives by a school official or the classroom teacher prior to testing. Eight percent of School Coordinators at the fourth grade and 15% of School Coordinators at the eighth grade anticipated needing a makeup session, and almost all of these coordinators intended to conduct one.

Because the sampling of classes requires a complete list of all classes in the school at the target grade, IQCMs were also asked to verify that the class list did indeed include all classes. Most School Coordinators confirmed that the complete list of classes had been documented and that all students appeared in one and only one of these classes.

As a reflection of the successful planning and implementation of TIMSS 2015, 91% of respondents for both grades said that they would be willing to serve as a School Coordinator in future international assessments. Finally, it is notable that the response rate for the Classroom Observation Records was considerably high on all questions, with only a handful of questions going unanswered.

CHAPTER 10

Creating the TIMSS 2015 International Database

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This chapter describes the procedures implemented by the IEA Data Processing and Research Center (IEA DPC) for checking the TIMSS 2015 data and creating the TIMSS 2015 International Database (IDB).

Preparing the TIMSS 2015 International Database (IDB) and ensuring its integrity was a complex endeavor requiring extensive collaboration between the IEA Data Processing and Research Center, the TIMSS & PIRLS International Study Center, Statistics Canada, and the national centers of participating countries. Once the countries had created their data files and submitted them to the IEA DPC, an exhaustive process of checking and editing known as "data cleaning" began.

Data cleaning is the process of checking data for inconsistencies and formatting the data to create a standardized output. The overriding concerns of the data cleaning process were to ensure:

- All information in the database conformed to the internationally defined data structure
- The content of all codebooks and documentation appropriately reflected national adaptations to questionnaires
- All variables used for international comparisons were in fact comparable across countries (after harmonization, where necessary)
- All institutions involved in this process applied quality control measures throughout in order to assure the quality and accuracy of the TIMSS 2015 data

The IEA DPC was responsible for checking the data files from each country, applying standardized data cleaning rules to verify the accuracy and consistency of the data and documenting any deviations from the international file structure. Data files were created at each country's national center and reviewed prior to submission to the IEA DPC. The National Research Coordinators (NRCs) collaborated with the IEA DPC to resolve any queries which emerged during the data cleaning process, and the NRCs checked interim versions of the national/benchmarking participant database(s) produced by the IEA DPC. The TIMSS & PIRLS International Study Center

provided the NRCs with univariate data almanacs containing summary statistics on each variable so that the national centers could evaluate their data from an international perspective.

The TIMSS & PIRLS International Study Center also scaled the achievement and background data, as documented in Chapter 13: Scaling the TIMSS 2015 Achievement Data, and produced achievement scores (plausible values) and scores on the background scales. Using the Within-School Sampling Software (WinW3S)[1] database and response data provided by the IEA DPC, Statistics Canada in collaboration with the IEA DPC calculated the sampling weights, population coverage, and school and student participation rates—as documented in Chapter 3 and Chapter 5.

Data Sources

Data Entry and Verification of Paper Questionnaires

Each national center was responsible for inputting the information collected in test booklets and paper-based questionnaires into computer data files using the IEA Data Management Expert (DME) software. The DME is a software system developed by the IEA DPC that facilitates data entry and includes validation checks to identify inconsistencies. As a general rule of thumb, national centers were instructed to enter data for any questionnaire that contained at least one valid response, discarding unused or empty questionnaires.

National centers entered responses from the paper instruments into data files using a predefined international codebook. The codebook contained information about the names, lengths, labels, valid ranges for continuous measures or counts or valid values for nominal or ordinal questions, and missing codes for each variable.

As documented in Chapter 7: Translation and Translation Verification, countries participating in TIMSS are expected to make national adaptations to certain questions in the international questionnaires (e.g., the questions about parents' education must be adapted to the national context). Countries making such adaptations were required to adapt the codebook structure to reflect the adaptations made to the national questionnaire versions before beginning the data entry process.

To ensure consistency across participating countries, the basic rule for data entry in the DME required national staff to enter data "as is" without any interpretation, correction, truncation, imputation, or cleaning.

The rules for data entry included the following:

- Responses to closed response items coded as "1" if the first option was used, "2" if the second option is marked, and so on
- Responses to open response questions, for example number of students in the TIMSS class, entered "as is" even if the value is outside the originally expected range

1 WinW3S is a software developed by the IEA DPC that stores participation information at school, teacher, class, and student levels in a relational database while maintaining a hierarchical ID system. The software allows users to perform all necessary within-school sampling according to the TIMSS standards, and also provides some data validation in and across these levels.

- Responses to filter questions and filter-dependent questions entered exactly as filled in by the respondent, even if the information provided is logically inconsistent
- Non-response, ambiguous responses, responses given outside of the expected format, or conflicting responses (e.g., selection of two options in a multiple-choice question), coded as "omitted or invalid"

As each respondent ID number was entered it was checked by the DME software for alignment with a five-digit checksum generated by WinW3S. A mistype in either the ID or the checksum resulted in an error message prompting the data-entry person to check the entered values. The data-verification module of DME also checked for a range of other issues such as inconsistencies in identification codes and out-of-range or otherwise invalid codes. When such issues were flagged by the software, the individuals entering the data were prompted to resolve the inconsistency or confirm that an issue existed before resuming data entry.

Double-Data Entry

To check data entry reliability in participating countries, national centers were required to enter a 5% sample of each survey instrument (achievement booklet or questionnaire) twice by two different data entry persons (punchers). The IEA DPC recommended that countries begin the double-data entry process as early as possible during the data capture period in order to identify possible systematic misunderstandings or mishandlings of data-entry rules and to initiate appropriate remedial actions—for example, retraining national center staff. Those entering the data were required to resolve discrepancies between the first and second data entries by consulting the original questionnaire and applying the international rules in a uniform way.

While it was desirable that each and every discrepancy be resolved before submission of the complete dataset, the acceptable level of disagreement between the originally entered and double-entered data was established at 1 percent or less for questionnaire data and at the 0.1 percent or less level for achievement data. Values above this level required a complete re-entry of data.

The level of disagreement between the originally entered and double-entered data was evaluated by the IEA DPC, and it was found that in general the margin of error observed for processed data was well below the required threshold.

Data Verification at the National Centers

Before sending the data to the IEA DPC for further processing, national centers carried out mandatory validation and verification steps on all entered data and undertook corrections as necessary.

While the questionnaire data were being entered, the data manager or other staff at each national center used the information from the Teacher Tracking Forms to verify the completeness of the materials. Student participation information (e.g., whether a student participated in the assessment or was absent) was entered via WinW3S.

The validation process was supported by an option in WinW3S to generate an inconsistency report. This report listed all of the types of discrepancies between variables recorded during the within-school sampling and test administration process and made it possible to cross-check these data against data entered in the DME, the database for online respondents, and the uploaded student data on the central international server.

Data managers were requested to resolve such issues before final data submission to the IEA DPC. If inconsistencies remained or the national center could not solve them, the DPC asked the center to provide documentation on these problems.

As well as submitting the validated data to the IEA DPC, NRCs also provided extensive documentation. In addition to documentation on inconsistencies, national centers submitted hard copies or electronic scans of all original student and Teacher Tracking Forms, Student-Teacher Linkage Forms, and when applicable a report on data-capture activities collected as part of the online Survey Activities Questionnaire.

Data from Online Questionnaire Administration

As documented in Chapter 6: Survey Operations Procedures, national centers had the option of administering the principal, teacher, and home questionnaires online instead of, or in addition to, using paper-based questionnaires.

To ensure confidentiality, national centers provided every respondent with a letter that contained individual login information along with information on how to access the online questionnaire. This login information corresponded to the ID and checksum provided from WinW3S, meaning that the identity validation step occurring at the national centers for paper-based questionnaires occurred when the respondents' logged-in to the survey. Also, since responses were collected in digital format and stored directly on the IEA DPC server, there was no need for data entry, reducing the workload for national centers.

As a further advantage of online administration, the data tended to have less inconsistencies when compared with the data collected through the paper-based questionnaires, mitigating the number of issues needed to be resolved by the IEA DPC and the national centers. This is partly because, to some extent, the online system does not allow inconsistent response patterns. For example, if the directions ask the respondent to "Check one circle for each line," the system does not allow the respondent to check more than one response category on each line.

The TIMSS 2015 online questionnaires also include skip logic, which minimized response burden and improved data consistency. The TIMSS questionnaires have a number of questions that filter out respondents—meaning the subsequent questions are not applicable given the response to the filter question. For example, question 12 of the eighth grade school questionnaire reads "Does your school have a school library? If yes, go to 12a, and if no, go to 13." If a respondent chooses "No," the online survey skips directly to Question 13, omitting Questions 12a and 12b. Not only does the skip logic save the respondents' time, it also results in fewer inconsistencies in the data received by the IEA DPC.

Cleaning the International and National Databases

Overview

In order to ensure the integrity of the international database, a uniform data cleaning process was followed, involving regular consultation between the IEA Data Processing and Research Center and the NRCs. After each country had submitted its data, codebooks, and documentation, the DPC, in collaboration with the NRCs, conducted a four-step cleaning procedure upon the submitted data and documentation:

1. A structural check
2. A check of the identification (ID) variables
3. Linkage cleaning
4. Background cleaning

The cleaning process was an iterative process. Numerous iterations of the four-step cleaning procedure were completed on each national data set. This repetition ensured that all data were properly cleaned and that any new errors that could have been introduced during the data cleaning were rectified. The cleaning process was repeated as many times as necessary until all data were made consistent and comparable. Any inconsistencies detected during the cleaning process were resolved in collaboration with national centers, and all corrections made during the cleaning process were documented in a cleaning report, produced for each country.

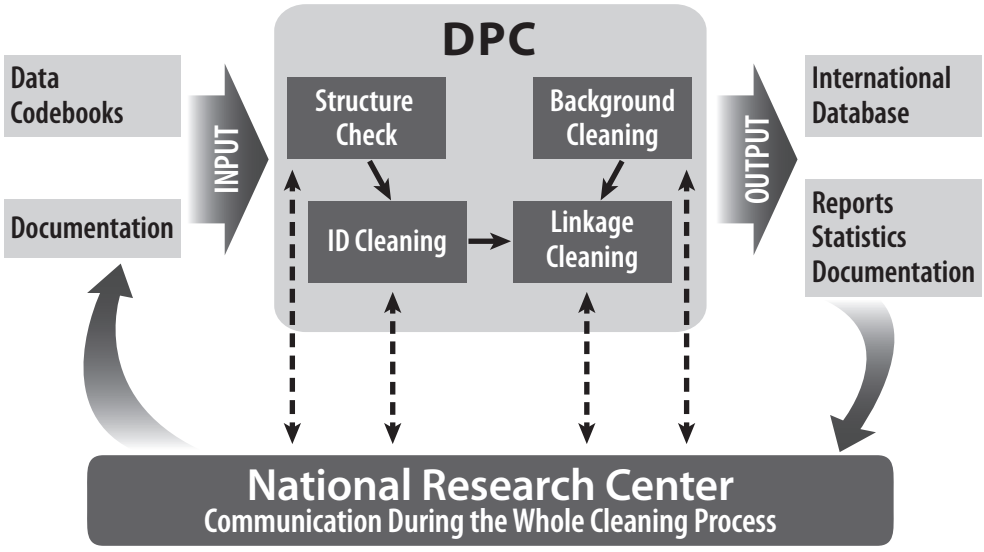
After the final cleaning iteration, each country's data were sent to Statistics Canada for the calculation of sampling weights, and then the data, including sampling weights, were sent to the TIMSS & PIRLS International Study Center so that scaling could be performed. The NRCs were provided with interim data products to review at two different points in the process.

Preparing National Data Files for Analysis

The main objectives of the data cleaning process were to ensure that the data adhered to international formats, that school, teacher, and student information could be linked across different survey files, and that the data reflected the information collected within each country in an accurate and consistent manner.

As illustrated in Exhibit 10.1, the program-based data cleaning consisted of a set of activities explained in the following subsections. The IEA DPC carried out all of these activities in close communication with the national centers.

Exhibit 10.1: Overview of Data Processing at the IEA Data Processing and Research Center



Checking Documentation, Import, and Structure

For each country, data cleaning began with an exploratory review of its data-file structures and its data documentation, including a review of National Adaptation Forms, Student Tracking Forms, Teacher Tracking Forms, Student-Teacher Linkage Forms, and the Survey Activities Questionnaire.

The IEA DPC first merged the tracking information and sampling information captured in the WinW3S database with the student-level database containing the corresponding student survey instrument data. During this step, IEA DPC staff also merged the data from the school and teacher questionnaires for both the online and paper modes of administration. At this stage, data from the different sources was transformed and imported into one structured query language (SQL) database so that this information would be available during all further data-processing stages.

The first checks identified differences between the international and the national file structures. Some countries made adaptations (such as adding national variables or omitting or modifying international variables) to their questionnaires. The extent and nature of such changes differed across countries: some countries administered the questionnaires without any modifications (apart from translations and necessary adaptations relating to cultural or language-specific terms), whereas other countries inserted response categories within existing international variables or added national variables.

To keep track of adaptations, staff at the TIMSS & PIRLS International Study Center asked the national centers to complete National Adaptation Forms while they were translating the international version of the survey instruments. Where necessary, the IEA DPC modified the structure and values of the national data files to ensure that the resulting data remained comparable

across countries. Details about country-specific adaptations to the international instruments can be found in Supplement 2 of the *TIMSS 2015 User Guide for the International Database*.

The IEA DPC then discarded variables created purely for verification purposes during data entry, and made provision for adding new variables necessary for analysis and reporting, including reporting variables, derived variables, sampling weights, and scale scores.

Once IEA DPC staff had ensured that each data file matched the international format, they applied a series of standard data cleaning rules for further processing. Processing during this step employed software developed by the IEA DPC that could identify and correct inconsistencies in the data. Each potential problem flagged at this stage was identified by a unique problem number, and then described and recorded in a database. The action taken by the cleaning program or IEA DPC staff with respect to each problem was also recorded.

The IEA DPC referred problems that could not be rectified automatically through the program to the responsible NRC so that national center staff could check the original data-collection instruments and tracking forms to trace the source of these errors. Wherever possible, staff at the IEA DPC suggested a remedy and asked the national centers to either accept it or propose an alternative. If a national center could not solve issue through verification of the instruments or forms, the IEA DPC applied a general cleaning rule to the files to rectify the error. When all automatic updates had been applied, IEA DPC staff used SQL recoding scripts to directly apply any remaining corrections to the data files.

Cleaning Identification Variables

Each record in a data file needs to have a unique identification number. The existence of records with duplicate ID numbers in a file implies an error of some kind. Some countries administered the school, teacher, and home questionnaire (fourth grade only) online in addition to the paper mode. This could yield the theoretical possibility that a respondent completed both the paper and the online versions of the questionnaire. If two records in a TIMSS 2015 database shared the same ID number and contained exactly the same data, the IEA DPC deleted one of the records and kept the other one in the database. In the rare case that both records contained different data and IEA DPC staff found it impossible to identify which record contained the "true data," national centers were asked which record to keep.

Although the ID cleaning covered all data from all instruments, it focused mainly on the student file. In addition to checking the unique student ID number, it was crucial to check variables pertaining to student participation and exclusion status, as well as students' dates of birth and dates of testing in order to calculate student age at the time of testing. The Student Tracking Forms provided an important tool for resolving anomalies in the database.

As mentioned previously, the IEA DPC conducted all cleaning procedures in close cooperation with the national centers. After national center staff had cleaned the identification variables, they passed the clean databases with information about student participation and exclusion on to

Statistics Canada, which used this information to calculate students' participation rates, exclusion rates, and student sampling weights.

Checking Linkages

As data on students, parents, teachers, and schools appeared in a number of different data files, a process of linkage cleaning was implemented to ensure that the data files would correctly link together. The linking of the data files followed a hierarchical system of identification codes that included school, class, and student components. These codes linked the students with their class and/or school membership. Further information on linkage codes can be found in Chapter 6: Survey Operations Procedures.

Linkage cleaning consisted of a number of checks to verify that student entries matched between achievement files, student background files, scoring reliability files, and home background files. In addition, at this stage, checks were conducted to ensure that teacher and student records linked correctly with their corresponding schools. The Student Tracking Forms, Teacher Tracking Forms, and Student-Teacher Linkage Forms were crucial in resolving any anomalies. The IEA DPC also liaised with NRCs about any problematic cases, and the national centers were provided with standardized reports listing all inconsistencies identified within the data.

Resolving Inconsistencies in Questionnaire Data

The amount of inconsistent and implausible responses in questionnaire data files varied considerably across countries. The IEA DPC determined the treatment of inconsistent responses on a question-by-question basis, using all available documentation to make an informed decision. IEA DPC staff also checked all questionnaire data for consistency across the responses given. For example, Question 1 in the school questionnaire asked for the total school enrollment in all grades, while Question 2 asked for the enrollment in the target grade only. Logically, the number given as a response to Question 2 could not exceed the number provided by school principals in Question 1. Similarly, it is not possible that the amount of years a teacher has been teaching altogether (Question 1 in the teacher questionnaires) exceeds his/her age (Question 3 in the teacher questionnaires). The IEA DPC flagged inconsistencies of this kind and then asked the national centers to review these issues. IEA DPC staff recoded as "invalid" those cases that could not be corrected.

Filter questions, which appeared in some questionnaires, directed respondents to a particular subquestion. The IEA DPC applied the following cleaning rule to these filter questions and the dependent questions that followed: If a respondent answered "No" to Question 13 in the school questionnaire "Does your school have a school library?" IEA DPC recoded any responses to the dependent questions as "logically not applicable." Also, following the same example, if the filter question was omitted but at least one valid response was found in the dependent questions then the IEA DPC recoded the filter question to "Yes." This of course is only possible for dichotomous filter questions (e.g., with response options such "Yes/No").

The IEA DPC also applied what are known as split variable checks to questions where the answer was coded into several variables. For example, Question 6 in the student questionnaire asked students: "Do you have any of these things at your home?" Student responses were captured in a set of eleven variables, each one coded as "Yes" if the corresponding "Yes" option was filled in and "No" if the "No" option was filled in. Occasionally, students checked the "Yes" boxes but left the "No" boxes unchecked. Because, in these cases, it was clear that the unchecked boxes actually meant "No," these responses were recoded accordingly.

Resolving Inconsistencies Between Tracking Information and Questionnaire Data

Two different sets of TIMSS 2015 data indicated age and gender for students. The first set was the tracking information provided by the school coordinator or test administrator throughout the within-school sampling and test/questionnaire administration process. The second set comprised the actual responses given by students in the student questionnaires. In some cases, data across these two sets did not match and resolution was needed.

If the information on gender or birth year and month was missing in the student questionnaire but the student participated, this information, when available, was copied over from the tracking data to the questionnaire. If discrepancies were found between existing tracking and questionnaire gender and age data, the IEA DPC queried the case with the national center, and the national center investigated which source of information was correct.

Handling of Missing Data

Two types of entries were possible during the TIMSS 2015 data capture: valid data values and missing data values. Missing data can be assigned a value of omitted/invalid, or not administered during data capture. The IEA DPC applied additional missing codes to the data to facilitate further analyses. This process led to four distinct types of missing data in the international database:

- **Omitted or invalid:** The respondent had a chance to answer the question but did not do so, leaving the corresponding item or question blank. This code was also used if the response was uninterpretable or out-of-range.
- **Not administered:** This signified that the item or question was not administered to the respondent, which meant that the respondent could not read and answer the question. The not administered missing code was used for those student test items that were not in the set of assessment blocks administered to a student either deliberately (due to the rotation of assessment blocks) or, in a very few cases, due to technical failure or incorrect translations. This missing code was also used for those records that were included in the international database but did not contain a single response to one of the assigned questionnaires. This situation applied to students who participated in the student test but the parent/guardian did not answer the home questionnaire.

In addition, the not administered code was used for individual questionnaire items that a national center decided not to include in the country-specific version of the questionnaire.

- **Logically not applicable:** The respondent answered a preceding filter question in a way that made the following dependent questions not relevant to him or her.
- **Not reached:** This applied only to the individual items of the student achievement test and indicated those items that students did not attempt due to a lack of time. "Not reached" codes were derived as follows: First, the last answer given by a student in a session is identified. This could be either a valid or invalid response to an item. The first omitted response after this last answer is coded as "omitted," but all following responses to these items in the session are then coded as "not reached." For example, the response pattern "1 9 4 2 9 9 9 9 9" (where "9" represents "omitted") is recoded to "1 9 4 2 9 R R R R R" (where "R" represents "not reached").

Data Cleaning Quality Control

Because TIMSS 2015 was a large and highly complex study with very high standards for data quality, maintaining these standards required an extensive set of interrelated data checking and data cleaning procedures. To ensure that all procedures were conducted in the correct sequence, that no special requirements were overlooked, and that the cleaning process was implemented independently of the persons in charge, the data quality control process included the following steps:

- **Thorough testing of all data cleaning programs:** Before applying the programs to real datasets, the IEA DPC applied them to simulation datasets containing all possible problems and inconsistencies
- **Registering all incoming data and documents in a specific database:** The IEA DPC recorded the date of arrival as well as specific issues requiring attention
- **Carrying out data cleaning according to strict rules:** Deviations from the cleaning sequence were not possible, and the scope for involuntary changes to the cleaning procedures was minimal
- **Documenting all systematic data recodings that applied to all countries:** The IEA DPC recorded all changes to data in the comprehensive cleaning documentation provided to national centers
- **Logging every "manual" correction to a country's data files in a recoding script:** Logging these changes, which occurred only occasionally, allowed IEA DPC staff to undo changes or to redo the whole manual-cleaning process at any later stage of the data cleaning process

- **Repeating, on completion of data cleaning for a country, all cleaning steps from the beginning:** This step allowed the IEA DPC to detect any problems that might have been inadvertently introduced during the data cleaning process
- **Working closely with national centers at various steps of the cleaning process:** The IEA DPC provided national centers with the processed data files and accompanying documentation so that center staff could thoroughly review and correct any identified inconsistencies

The IEA DPC compared national adaptations recorded in the documentation for the national datasets with the structure of the submitted national data files. IEA DPC staff then recorded any identified deviations from the international data structure in the national adaptation database and for the supplementary materials provided with the *TIMSS 2015 User Guide for the International Database*. Whenever possible, the IEA DPC recoded national deviations to ensure consistency with the international data structure.

Interim Data Products

Before the TIMSS International Databases were finalized, two major interim versions of the data files were sent to each country—each country receiving only its own data. The first version was sent as soon as the data could be considered "clean" as regards identification codes and linkage issues. Documentation, with a list of the cleaning checks and corrections made in the data, was included to enable the NRC to review the cleaning process before the 7th NRC meeting in Lisbon in December 2015. A second version of the data files was sent to countries when the weights and international achievement scores were available and had been merged with the data files. This version, containing only records that satisfied the sampling standards, allowed the NRCs to replicate the results presented in the international reports.

Interim data products were accompanied by detailed data processing and national adaptation documentation, codebooks, and summary statistics. The summary statistics, preliminary versions of the TIMSS 2015 Almanacs, were created by the TIMSS & PIRLS International Study Center and included weighted univariate statistics for all questionnaire variables for each country. For categorical variables, representing the majority of variables, the percentages of respondents choosing each of the response options were displayed. For continuous numeric variables, various descriptive statistics were reported, including the minimum, maximum, mean, standard deviation, median, mode, and percentiles. For both types of variables, the percentages of missing data were reported. Additionally, for the achievement items, the TIMSS & PIRLS International Study Center provided item analysis and reliability statistics listing information regarding the number of valid cases, percentages, percentage correct, Rasch item difficulty, scoring reliability, and so forth. These statistics were used for a more in-depth review of the data at the international and national levels in terms of plausibility, unexpected response patterns, etc.

Final Product—the TIMSS 2015 International Databases

The data cleaning effort implemented at the IEA DPC ensured that the TIMSS 2015 international databases contained high-quality data. More specifically, the process ensured that:

- Information coded in each variable was internationally comparable
- National adaptations were reflected appropriately in all variables
- All entries in the database could be successfully linked within and across levels
- Sampling weights and student achievement scores were available for international comparisons

Supplements to the *TIMSS 2015 International Database and User Guide* document all national adaptations made to questionnaires by individual countries and how they were handled in the data. The meaning of country-specific items also can be found in this supplement, as well as recoding requirements by the TIMSS & PIRLS International Study Center.

CHAPTER 11

Reviewing the TIMSS 2015 Achievement Item Statistics

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The TIMSS & PIRLS International Study Center conducted a review of a range of diagnostic statistics to examine and evaluate the psychometric characteristics of each achievement item across the countries that participated in the TIMSS 2015 assessments. This review of item statistics is essential to the successful application of item response theory (IRT) scaling to derive student achievement scores for analysis and reporting. This review played a crucial role in the quality assurance of the TIMSS 2015 achievement data prior to scaling, making it possible to detect unusual item properties that could signal a problem or error for a particular country. For example, an item that was uncharacteristically easy or difficult, or had an unusually low discriminating power, could indicate a potential problem with either translation or printing. Similarly, a constructed response item with unusually low scoring reliability could indicate a problem with a scoring guide in a particular country. In the rare instances where such items were found, the country's translation verification documents and printed booklets were examined for flaws or inaccuracies and, if necessary, the item was removed from the international database for that country.

Statistics for Item Review

The TIMSS & PIRLS International Study Center computed item statistics for all achievement items in the 2015 assessments, including TIMSS fourth grade (169 mathematics items and 176 science items), TIMSS eighth grade (212 mathematics items and 220 science items), and TIMSS Numeracy (124 items). The item statistics for each of the participating countries were then carefully reviewed. Exhibits 11.1 and 11.2 show actual samples of the statistics calculated for a multiple-choice and a constructed response item, respectively.

Exhibit 11.1: Example International Item Statistics for a TIMSS 2015 Multiple-Choice Item

Trends in International Mathematics and Science Study - TIMSS 2015 Assessment Results - 4th Grade
International Item Review Statistics (Unweighted)

Mathematics: Number / Applying (M08_04 - M061040) Type: MC Key: A
Label: Shaded fraction of a square

Country	Cases	DIFF	DISC	Percentages P_A	P_B	P_C	P_D	P_OM	P_NR	Point Biserials PB_A	PB_B	PB_C	PB_D	PB_OM	PB_NR	RDIFF	Flags
*Australia	856	47.8	0.52	47.8	24.0	10.4	15.6	2.2	0.7	0.52	-0.24	-0.16	-0.27	-0.06	-0.09	0.04	
Bahrain	600	21.0	0.34	21.0	26.4	11.5	38.6	2.4	1.7	0.34	-0.03	-0.00	-0.25	-0.04	-0.01	0.81	_C____
Belgium (Flemish)	768	50.3	0.53	50.3	25.5	11.0	12.0	1.3	0.3	0.53	-0.30	-0.18	-0.23	-0.03	-0.03	0.41	
Bulgaria	616	31.4	0.47	31.4	27.7	13.2	13.7	14.0	0.3	0.47	-0.20	-0.12	-0.16	-0.09	-0.04	1.06	
*Canada	1777	39.1	0.50	39.1	23.6	10.8	23.8	2.7	1.0	0.50	-0.17	-0.11	-0.30	-0.06	-0.04	0.48	
Chile	676	31.9	0.43	31.9	26.0	8.4	30.2	3.5	1.6	0.43	-0.10	-0.10	-0.26	-0.07	-0.02	0.55	____F_
Chinese Taipei	611	66.3	0.56	66.3	11.0	8.5	13.9	0.3	0.0	0.56	-0.32	-0.24	-0.28	-0.01	.	0.44	____F_
Croatia	570	25.2	0.28	25.2	25.9	18.8	17.1	13.0	1.2	0.28	-0.16	0.00	-0.13	-0.02	-0.10	1.13	
*Cyprus	594	54.1	0.56	54.1	15.3	11.9	16.1	2.7	0.7	0.56	-0.24	-0.24	-0.30	-0.03	-0.11	-0.12	
*Czech Republic	741	37.7	0.47	37.7	26.7	10.6	19.1	6.0	0.4	0.47	-0.20	-0.08	-0.22	-0.11	-0.03	0.93	
Denmark	534	52.6	0.55	52.6	15.3	12.0	15.3	4.8	2.1	0.55	-0.27	-0.13	-0.29	-0.14	0.03	0.36	
*England	569	44.0	0.56	44.0	22.2	17.4	14.1	2.3	0.2	0.56	-0.26	-0.12	-0.31	-0.11	0.00	0.57	
Finland	708	53.5	0.45	53.5	17.2	12.5	13.0	3.8	0.4	0.45	-0.18	-0.19	-0.21	-0.12	0.02	0.05	
France	688	30.4	0.49	30.4	23.8	14.8	24.9	6.1	2.5	0.49	-0.19	-0.07	-0.25	-0.05	-0.07	0.54	
Georgia	564	23.9	0.35	23.9	22.8	14.5	26.7	12.1	3.5	0.35	-0.16	0.05	-0.16	-0.09	-0.08	0.72	_C____
Germany	561	32.6	0.31	32.6	23.4	20.8	14.5	8.8	0.4	0.31	-0.19	-0.04	-0.10	-0.05	-0.04	1.23	
*Hong Kong SAR	516	79.5	0.48	79.5	9.1	6.6	4.5	0.4	0.0	0.48	-0.30	-0.27	-0.21	-0.02	.	-0.07	____F_
*Hungary	719	51.8	0.56	51.8	18.0	11.2	16.8	2.2	0.4	0.56	-0.31	-0.15	-0.27	-0.06	-0.04	0.29	
Indonesia	577	27.8	0.25	27.8	28.9	17.4	24.5	1.4	0.3	0.25	-0.10	0.00	-0.16	-0.00	-0.05	-0.21	
*Iran, Islamic Rep. of	546	40.7	0.48	40.7	25.9	10.6	18.7	4.1	1.1	0.48	-0.22	-0.12	-0.24	-0.06	-0.01	-0.44	
*Ireland	625	52.7	0.49	52.7	26.4	10.7	9.0	1.1	0.2	0.49	-0.27	-0.20	-0.19	-0.08	-0.05	0.26	____F_
*Italy	627	33.1	0.42	33.1	28.1	8.9	25.0	5.0	1.1	0.42	-0.16	-0.07	-0.22	-0.05	-0.02	0.75	____F_
*Japan	631	75.1	0.51	75.1	7.9	9.4	7.0	0.6	0.0	0.51	-0.19	-0.29	-0.31	-0.05	.	0.10	____F_
Kazakhstan	673	57.0	0.51	57.0	17.0	7.7	17.3	1.0	0.1	0.51	-0.28	-0.13	-0.28	-0.09	-0.10	0.01	____F_
*Korea, Rep. of	662	76.1	0.47	76.1	6.9	7.1	9.7	0.2	0.0	0.47	-0.19	-0.21	-0.34	0.02	.	0.14	____F_
Kuwait	503	17.1	0.27	17.1	32.3	13.4	29.2	8.0	3.4	0.27	-0.20	-0.04	0.03	-0.03	0.13	0.12	_C_A__
Lithuania	662	34.5	0.53	34.5	21.3	18.7	22.3	3.2	0.6	0.53	-0.13	-0.16	-0.31	-0.06	-0.09	1.17	
Morocco	719	22.8	0.30	22.8	31.8	18.5	22.9	4.0	2.4	0.30	-0.12	-0.13	-0.03	-0.06	-0.04	-0.17	_C____
*Netherlands	641	51.9	0.43	51.9	17.4	13.5	15.0	2.2	0.5	0.43	-0.17	-0.15	-0.24	-0.07	-0.03	0.24	
*New Zealand	915	44.8	0.55	44.8	25.4	13.9	14.4	1.5	0.4	0.55	-0.27	-0.16	-0.29	-0.03	-0.06	-0.15	
Northern Ireland	433	56.8	0.51	56.8	17.6	14.5	10.9	0.2	0.0	0.51	-0.26	-0.20	-0.26	-0.05	.	0.35	
*Norway (5)	612	51.4	0.56	51.4	19.3	9.7	18.0	1.6	0.8	0.56	-0.25	-0.13	-0.33	-0.11	-0.02	0.58	____F_
Oman	1300	30.7	0.43	30.7	24.0	16.4	26.8	2.1	0.5	0.43	-0.18	-0.12	-0.16	-0.08	0.02	-0.09	
Poland	686	54.5	0.57	54.5	20.1	10.1	13.6	1.6	0.6	0.57	-0.28	-0.25	-0.26	-0.06	0.04	-0.01	
*Portugal	668	40.3	0.58	40.3	31.4	10.3	16.2	1.8	1.2	0.58	-0.22	-0.10	-0.39	-0.05	-0.02	0.64	_C____
Qatar	750	24.8	0.49	24.8	24.3	15.0	32.6	3.0	1.6	0.49	-0.13	-0.06	-0.27	-0.04	-0.07	0.50	_C____
Russian Federation	698	53.5	0.52	53.5	18.6	12.1	14.0	1.9	0.4	0.52	-0.27	-0.16	-0.25	-0.13	-0.10	0.78	
Saudi Arabia	618	24.5	0.31	24.5	26.2	19.3	25.9	4.1	1.1	0.31	-0.18	-0.03	-0.06	-0.08	-0.03	-0.10	_C____
Serbia	573	40.9	0.56	40.9	25.7	10.4	16.8	6.2	1.4	0.56	-0.27	-0.16	-0.23	-0.09	-0.08	0.73	
*Singapore	936	70.5	0.46	70.5	10.3	9.8	9.1	0.3	0.0	0.46	-0.15	-0.26	-0.30	-0.01	.	0.25	____F_
Slovak Republic	815	27.8	0.50	27.8	30.1	13.4	22.4	6.3	0.9	0.50	-0.25	-0.05	-0.18	-0.06	-0.08	1.02	
*Slovenia	650	46.7	0.59	46.7	21.8	11.0	15.6	4.9	0.5	0.59	-0.27	-0.15	-0.30	-0.12	-0.01	0.48	
Spain	1104	33.2	0.43	33.2	29.8	9.4	23.6	4.0	0.8	0.43	-0.14	-0.08	-0.24	-0.03	-0.03	0.75	____F_
Sweden	501	44.5	0.51	44.5	21.1	13.9	14.4	6.1	0.7	0.51	-0.24	-0.10	-0.22	-0.19	-0.01	0.37	
Turkey	931	53.3	0.49	53.3	15.2	12.5	17.8	1.3	0.2	0.49	-0.25	-0.10	-0.32	-0.01	-0.05	-0.42	
United Arab Emirates	3025	29.7	0.49	29.7	23.0	12.2	32.4	2.7	0.4	0.49	-0.18	-0.08	-0.25	-0.04	-0.01	0.46	
*United States	1439	48.8	0.56	48.8	21.4	9.7	16.4	3.7	1.0	0.56	-0.19	-0.19	-0.35	-0.08	-0.06	0.38	____F_
*Reference Avg (n=19)	14724	51.9	0.51	51.9	20.1	10.7	14.9	2.4	0.5	0.51	-0.23	-0.17	-0.28	-0.06	-0.04	0.28	
International Avg (n=47)	36268	43.4	0.47	43.4	22.0	12.4	18.5	3.7	0.8	0.47	-0.21	-0.13	-0.24	-0.06	-0.04	0.38	
Buenos Aires, Argentina	443	20.9	0.41	20.9	28.2	8.0	20.7	22.3	3.8	0.41	-0.10	-0.01	-0.12	-0.17	-0.13	0.45	_C_F__
Ontario, Canada	659	39.0	0.47	39.0	23.9	12.3	21.9	2.9	1.5	0.47	-0.19	-0.08	-0.29	-0.03	-0.06	0.56	____F_
Quebec, Canada	401	46.0	0.50	46.0	20.9	9.3	22.1	1.8	0.7	0.50	-0.10	-0.23	-0.32	-0.06	-0.05	0.65	
Norway (4)	586	36.4	0.43	36.4	25.9	12.6	21.2	4.0	1.0	0.43	-0.21	-0.11	-0.15	-0.08	0.05	0.48	____F_
Abu Dhabi, UAE	713	24.7	0.43	24.7	25.8	15.3	30.9	3.2	0.1	0.43	-0.19	-0.10	-0.15	0.01	-0.02	0.34	
Dubai, UAE	1074	40.5	0.56	40.5	18.4	11.7	27.0	2.3	0.5	0.56	-0.17	-0.13	-0.36	-0.05	0.01	0.44	_C____
Florida, US	282	54.8	0.45	54.8	19.4	13.3	9.3	3.2	1.1	0.45	-0.26	-0.17	-0.19	-0.06	0.02	0.15	____F_

Keys: DIFF= Percent correct score; DISC= Item discrimination; P_A...P_D= Percentage choosing each option; P_OM, P_NR= Percentage Omitted, Not Reached;
PB_A...PB_D= Point Biserial for each option; PB_OM, PB_NR= Point Biserial for Omitted, Not Reached; RDIFF= Rasch difficulty.
Flags: A= Attractive distractor; C= Difficulty less than chance; D= Negative/low discrimination; E= Easier than average;
F= Distractor chosen by less than 10%; H= Harder than average; V= Difficulty greater than 95%.

Exhibit 11.2: Example International Item Statistics for a TIMSS 2015 Constructed Response Item

Trends in International Mathematics and Science Study - TIMSS 2015 Assessment Results - 8th Grade
International Item Review Statistics (Unweighted)

Science: Biology / Knowing (S14_04 - S062101) Type: CR 2 Points
Label: Stomach tissue and function

Country	Cases	DIFF	DISC	Percentages P_0	P_1	P_2	P_OM	P_NR	Point Biserials PB_0	PB_1	PB_2	PB_OM	PB_NR	RDIFF	Reliability N	Score	Code	Flags
*Australia	1455	59.0	0.59	16.5	41.6	38.2	3.7	0.2	-0.40	-0.08	0.49	-0.26	-0.05	-0.57	317	99.1	98.7	
Bahrain	698	35.8	0.53	42.5	34.0	18.8	4.7	0.1	-0.41	0.22	0.38	-0.24	-0.07	0.13	196	88.8	88.3	
Botswana (9)	850	29.2	0.55	48.7	35.5	11.4	4.4	0.0	-0.42	0.22	0.43	-0.16	.	0.17	210	95.2	95.2	
*Canada	1245	52.5	0.48	22.1	43.6	30.7	3.6	0.2	-0.34	0.01	0.39	-0.24	-0.06	-0.10	220	95.9	95.5	
*Chile	690	45.3	0.53	27.8	32.7	28.9	10.6	0.3	-0.31	0.03	0.46	-0.27	0.02	-0.35	181	96.1	96.1	
*Chinese Taipei	821	73.3	0.47	9.9	32.2	57.2	0.7	0.0	-0.46	-0.04	0.34	-0.17	.	-0.59	220	98.2	98.2	F
Egypt	1114	17.0	0.44	60.6	21.1	6.5	11.8	0.4	-0.26	0.33	0.26	-0.23	-0.02	0.35	209	99.0	98.6	AF
*England	675	58.0	0.52	19.9	41.1	37.5	1.5	0.4	-0.41	-0.05	0.43	-0.16	-0.08	-0.26	237	97.0	97.0	
Georgia	576	52.1	0.60	23.9	27.4	38.4	10.3	0.5	-0.39	-0.01	0.53	-0.28	-0.07	-0.92	206	97.6	97.6	
*Hong Kong SAR	592	68.6	0.48	13.7	34.0	51.6	0.7	0.2	-0.41	-0.06	0.38	-0.20	-0.09	-0.70	194	100.0	100.0	
*Hungary	682	64.7	0.59	16.6	34.3	47.5	1.6	0.0	-0.47	-0.11	0.50	-0.15	.	-0.61	190	98.4	98.4	
*Iran, Islamic Rep. of	879	38.7	0.54	35.7	37.1	20.2	7.1	0.2	-0.38	0.15	0.42	-0.23	-0.08	-0.10	214	99.5	99.5	
*Ireland	680	59.7	0.51	16.4	40.7	39.4	3.5	0.3	-0.31	-0.11	0.44	-0.24	-0.04	-0.47	247	98.4	98.4	
*Israel	790	47.2	0.58	30.8	32.5	31.0	5.7	0.6	-0.43	0.09	0.47	-0.26	-0.11	0.11	195	98.5	98.5	
*Italy	648	50.8	0.53	23.5	41.8	29.9	4.8	0.0	-0.32	-0.05	0.47	-0.25	.	-0.31	199	96.0	96.0	
*Japan	671	73.4	0.53	11.0	29.0	59.0	1.0	0.1	-0.40	-0.18	0.46	-0.20	-0.12	-0.63	213	100.0	100.0	
*Jordan	1133	23.0	0.46	56.7	28.9	8.6	5.9	0.0	-0.33	0.30	0.29	-0.23	.	0.43	209	99.5	97.1	AF
Kazakhstan	704	48.9	0.55	30.2	25.8	36.0	8.0	0.3	-0.34	0.05	0.48	-0.35	-0.05	0.02	221	86.0	86.0	
*Korea, Rep. of	762	67.7	0.55	18.4	26.0	54.7	0.9	0.0	-0.45	-0.11	0.48	-0.20	.	-0.51	267	96.3	95.9	
Kuwait	661	21.1	0.56	50.3	22.2	10.0	17.5	1.4	-0.23	0.26	0.44	-0.32	-0.02	0.30	188	97.9	97.3	F
Lebanon	542	25.4	0.47	44.4	28.2	11.3	16.2	1.8	-0.28	0.34	0.27	-0.27	-0.11	0.15	192	93.8	92.7	A
*Lithuania	621	58.5	0.59	18.2	34.1	41.4	6.3	0.0	-0.36	-0.11	0.53	-0.29	.	-0.44	197	100.0	100.0	
*Malaysia	1383	39.8	0.58	37.5	38.4	20.6	3.5	0.0	-0.47	0.19	0.43	-0.22	.	0.47	231	99.1	98.7	
Malta	540	39.8	0.60	37.8	36.3	21.7	4.3	0.0	-0.50	0.23	0.43	-0.23	.	0.07	210	91.0	91.0	
*Morocco	1899	19.5	0.40	57.2	24.9	7.1	10.8	0.3	-0.25	0.23	0.29	-0.16	0.01	0.12	206	95.1	91.7	F
*New Zealand	1149	54.3	0.56	22.4	39.0	34.8	3.8	0.2	-0.41	-0.01	0.46	-0.23	-0.06	-0.27	204	99.0	99.0	
Norway (9)	666	57.0	0.58	25.5	24.8	44.6	5.1	0.3	-0.40	-0.06	0.52	-0.28	-0.02	-0.49	229	97.4	97.4	
Oman	1282	30.6	0.54	46.6	29.7	15.7	8.0	0.3	-0.33	0.19	0.43	-0.29	-0.06	0.22	229	97.4	96.5	
Qatar	765	36.3	0.60	38.8	36.8	17.9	6.4	0.7	-0.45	0.22	0.45	-0.24	-0.07	0.24	237	98.7	97.9	
*Russian Federation	685	75.0	0.49	9.2	25.4	62.3	3.1	0.0	-0.33	-0.16	0.42	-0.24	.	-0.86	249	98.8	98.4	F
Saudi Arabia	544	26.1	0.58	55.0	28.3	11.9	4.8	0.0	-0.44	0.25	0.45	-0.18	.	-0.14	190	100.0	99.5	
*Singapore	875	68.5	0.57	13.9	33.4	51.8	0.9	0.0	-0.48	-0.09	0.46	-0.17	.	-0.13	218	96.8	96.8	
*Slovenia	605	67.2	0.59	17.2	26.3	54.0	2.5	0.0	-0.38	-0.23	0.57	-0.24	.	-0.41	211	100.0	100.0	
South Africa (9)	1787	18.7	0.55	57.2	24.8	6.3	11.7	0.2	-0.34	0.27	0.44	-0.16	0.01	0.12	194	95.9	92.8	F
*Sweden	582	47.4	0.51	31.0	35.6	29.6	3.8	0.2	-0.35	-0.05	0.47	-0.16	-0.10	0.09	199	95.5	95.5	
*Thailand	929	47.1	0.53	21.4	42.6	25.9	10.1	0.1	-0.30	0.08	0.41	-0.31	0.02	-0.58	207	100.0	100.0	
*Turkey	865	29.8	0.48	46.1	39.8	9.9	4.2	0.0	-0.38	0.26	0.32	-0.18	.	0.81	173	98.3	98.3	F
United Arab Emirates	2574	34.1	0.59	43.1	29.4	19.4	8.0	0.2	-0.42	0.23	0.45	-0.27	0.01	0.28	722	96.4	96.4	
*United States	1457	59.8	0.53	18.0	40.0	39.8	2.2	0.2	-0.38	-0.11	0.46	-0.16	-0.04	-0.35	215	99.1	99.1	
*Reference Avg (n=25)	22773	54.0	0.53	24.4	35.0	36.5	4.1	0.1	-0.38	-0.01	0.43	-0.22	-0.06	-0.25	5413	98.2	97.9	
International Avg (n=39)	36076	46.7	0.54	31.2	32.8	30.3	5.7	0.3	-0.38	0.06	0.43	-0.23	-0.05	-0.15	8846	97.2	96.8	
Buenos Aires, Argentina	440	25.1	0.52	32.1	25.1	12.6	30.2	2.3	-0.09	0.24	0.40	-0.43	-0.08	-0.12	151	98.0	97.4	
Ontario, Canada	640	55.7	0.50	20.2	41.0	35.2	3.6	0.2	-0.32	-0.03	0.42	-0.28	-0.06	-0.30	126	94.4	94.4	
Quebec, Canada	565	49.0	0.47	24.2	46.9	25.6	3.4	0.4	-0.35	0.06	0.36	-0.19	-0.07	0.22	90	97.8	96.7	
Norway (8)	689	55.1	0.61	24.7	27.3	41.5	6.6	0.6	-0.43	-0.06	0.55	-0.22	-0.11	-0.61	231	95.2	94.8	
Abu Dhabi, UAE	690	24.6	0.60	47.5	25.7	11.8	15.1	0.1	-0.29	0.30	0.44	-0.36	0.04	0.43	227	96.0	96.0	
Dubai, UAE	871	47.9	0.57	31.5	34.3	30.8	3.4	0.1	-0.48	0.13	0.43	-0.19	-0.00	0.13	279	97.8	97.8	
Florida, US	291	56.7	0.61	22.1	35.3	39.1	3.5	0.7	-0.44	-0.13	0.56	-0.14	-0.02	-0.35	52	96.2	96.2	

Keys: DIFF= Percent correct score; DISC= Item discrimination; P_0...P_2= Percentage obtaining score level; P_OM, P_NR= Percentage Omitted, Not Reached;
PB_0...PB_2= Point Biserials for score level; PB_OM, PB_NR= Point Biserials for Omitted, Not Reached; RDIFF= Rasch difficulty;
Reliability: N= Responses double scored; Score= Percentage agreement on score; Code= Percentage agreement on code.
Flags: A= Point Biserials not ordered; C= Difficulty less than chance; D= Negative/low discrimination; E= Easier than average;
F= Score obtained by less than 10%; H= Harder than average; R= Scoring reliability less than 85%; V= Difficulty greater than 95%.

For all items, regardless of format (i.e., multiple-choice or constructed response), statistics included the number of students that responded in each country, the difficulty level (the percentage of students that answered the item correctly), and the discrimination index (the point-biserial correlation between success on the item and total score).[1] Also provided was an estimate of the difficulty of the item using a Rasch one-parameter IRT model. Statistics for each item were displayed alphabetically by country, together with an international average—i.e., based on all participating countries listed above the international average—and a reference average—based on a pool of countries that have participated regularly in the TIMSS assessments—for each statistic. The reference countries are shown with an asterisk next to their names. The international and reference averages of the item difficulties and item discriminations served as guides to the overall statistical properties of the items. The item review outputs also listed the benchmarking participants.

Statistics displayed for multiple-choice items included the percentage of students that chose each response option—as well as the percentage of students that omitted or did not reach the item—and the point-biserial correlations for each response option. Statistics displayed for constructed response items (which could have 1 or 2 score points) included the percent correct and point-biserial of each score level. Constructed response item tables also provided information about the reliability with which each item was scored in each country, showing the total number of double-scored responses, the percentage of score agreement between the scorers, and—because TIMSS has a 2-digit scoring scheme—the percentage of code agreement between scorers.

During item review, "not reached" responses (i.e., items toward the end of the booklet that the student did not attempt)[2] were treated as "not administered" and thus did not contribute to the calculation of the item statistics. However, the percentage of students not reaching each item was reported. Omitted responses, although treated as incorrect, were tabulated separately from incorrect responses for the sake of distinguishing students who provided no form of response from students who attempted a response.

The definitions and detailed descriptions of the statistics that were calculated are given below. The statistics were calculated separately by grade and subject, and within each table are listed in order of their appearance in the item review outputs:

CASES: This is the number of students to whom the item was administered. Not-reached responses were not included in this count.

DIFF: The item difficulty is the average percent correct on an item. For a 1-point item, including all multiple-choice items, it is the percentage of students providing a fully correct response to the item. For 2-point items, it is the average percentage of points. For example, if 25 percent of students scored 2 points, 50 percent scored 1 point on a 2-point item, and the

1 For computing point-biserial correlations, the total score is the percentage of points a student has scored on the items (s)he was administered. In the context of TIMSS, a separate total score is computed for mathematics and for science. Not-reached responses are not included in the total score.

2 An item was considered "not reached" if the item itself and the item immediately preceding it were not answered and no subsequent items had been attempted. The decision as to whether an item was not reached was made separately for part 1 and part 2 of each assessment booklet.

other 25 percent score 0 points, then the average percent correct for such an item would be 50 percent. For this statistic, not-reached responses were not included.

DISC: The item discrimination is computed as the correlation between the response to an item and the total score on all items administered to a student. Items exhibiting good measurement properties should have a moderately positive correlation, indicating that the more able students get the item right, the less able get it wrong. For this statistic, not-reached items were not included.

PCT_A, PCT_B, PCT_C, and PCT_D: Available for multiple-choice items. Each column indicates the percentage of students choosing the particular response option for the item (A, B, C, or D). Not-reached responses were excluded from the denominator.

PCT_0, PCT_1, and PCT_2: Available for constructed response items. Each column indicates the percentage of students responding at that particular score level, up to and including the maximum score level for the item. Not-reached items were excluded from the denominator.

PCT_OM: Percentage of students who, having reached the item, did not provide a response. Not reached responses were excluded from the denominator.

PCT_NR: Percentage of students who did not reach the item. This statistic is the number of students who did not reach an item as a percentage of all students who were administered that item, including those who omitted or did not reach that item.

PB_A, PB_B, PB_C, and PB_D: Available for multiple-choice items. These columns show the point-biserial correlations between choosing each of the response options (A, B, C, or D) and the total score on all of the items administered to a student. Items with good psychometric properties have moderately positive correlations for the correct option and negative correlations for the distracters (the incorrect options). Not-reached responses were not included in these calculations.

PB_0, PB_1, and PB_2: Available for constructed response items. These columns present the point-biserial correlations between the score levels on the item (0, 1, or 2) and the overall score on all of the items the student was administered. For items with good measurement properties, the correlation coefficients should monotonically increase from negative to positive as the score on the item increases. Not-reached responses were not included in these calculations.

PB_OM: The point-biserial correlation between a binary variable indicating an omitted response to the item, and the total score on all items administered to a student. This correlation should be negative or near zero. Not-reached responses were not included in this statistic.

PB_NR: The point-biserial correlation between a binary variable indicating a not-reached response to the item, and the total score on all items administered to a student. This correlation should be negative or near zero.

RDIFF: An estimate of the difficulty of an item based on a Rasch one-parameter IRT model applied to the achievement data of a given country. The difficulty estimate is expressed in the logit metric (with a positive logit indicating a difficult item) and was scaled so that the average Rasch item difficulty across all items within each country was zero.

Reliability (N): To provide a measure of the reliability of the scoring of the constructed response items, items in approximately 25 percent of the test booklets in each country were independently scored by two scorers. This column indicates the number of responses that were double-scored for a given item in a country.

Reliability (Score): This column contains the percentage of agreement on the score value of the two-digit diagnostic codes assigned by the two independent TIMSS scorers.

Reliability (Code): This column contains the percentage of agreement on the two-digit diagnostic codes assigned by the two independent TIMSS scorers.

As an aid to the reviewers, the item-review displays included a series of flags signaling the presence of one or more conditions that might indicate a problem with an item. The following conditions were flagged:

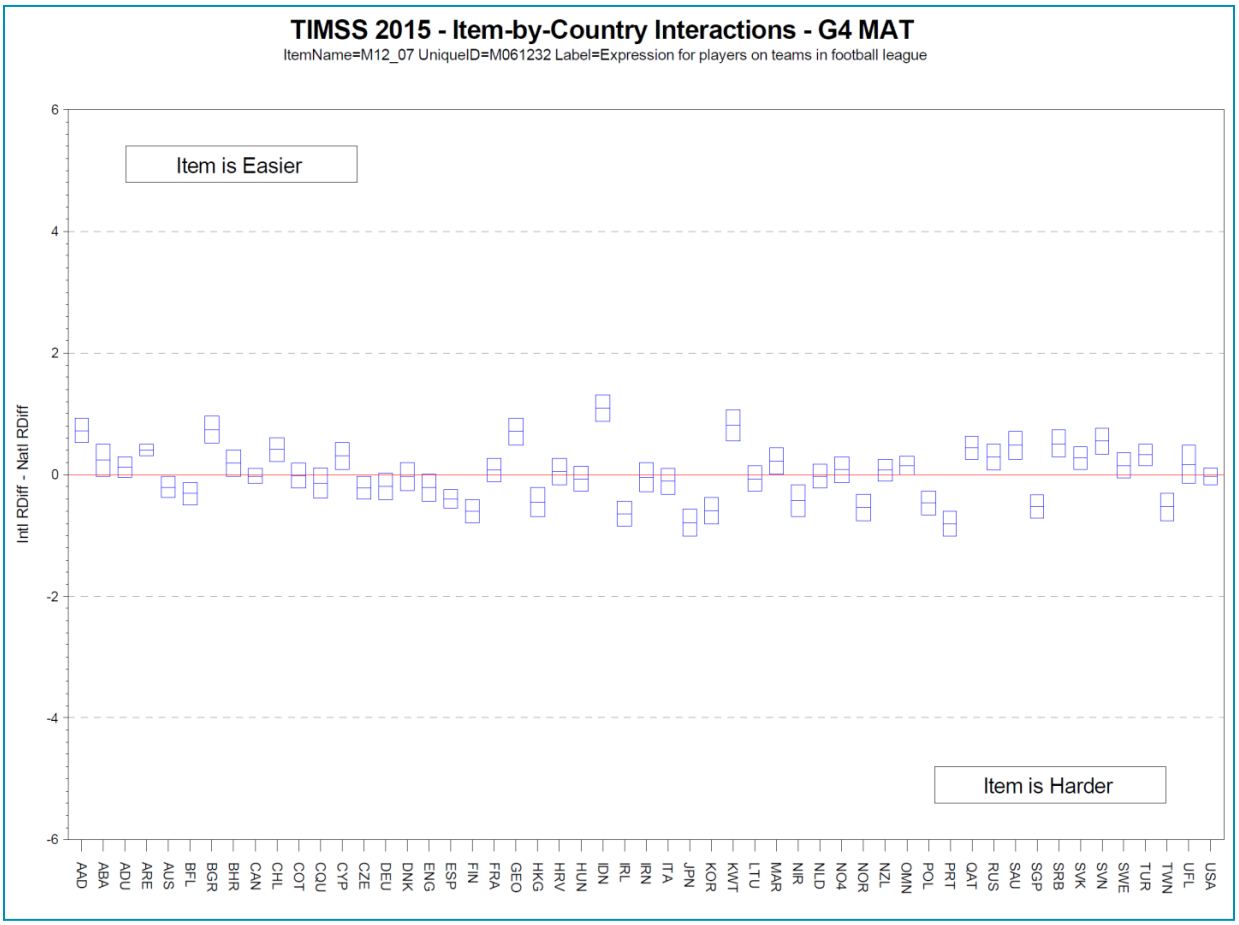
- The item discrimination (DISC) was less than 0.10 (flag D)
- The item difficulty (DIFF) was less than .25 for multiple-choice items (flag C)
- The item difficulty (DIFF) exceeded .95 (flag V)
- The Rasch difficulty estimate (RDIFF) for a given country made the item either easier (flag E) or more difficult (flag H) relative to the international average for that item
- The point-biserial correlation for at least one distracter in a multiple-choice item was positive, or the point-biserial correlations across the score levels of a constructed response item were not ordered (flag A)
- The percentage of students selecting one of the response options for a multiple-choice item, or one of the score values for a constructed response item, was less than 10 percent (flag F)
- Scoring reliability for agreement on the score value of a constructed response item was less than 85 percent (flag R)

Although not all of these conditions necessarily indicated a problem, the flags were a useful tool to draw attention to potential sources of concern.

Item–by–Country Interaction

Although countries are expected to exhibit some variation in performance across items, in general countries with high average performance on the assessment should perform relatively well on each of the items, and low-scoring countries should do less well on each of the items. When this does not occur (e.g., when a high-performing country has low performance on an item on which other countries are doing well), there is said to be an item-by-country interaction. When large, such item-by-country interactions may be a sign that an item is flawed in some way and that steps should be taken to address the problem. To assist in detecting sizeable item-by-country interactions, the TIMSS & PIRLS International Study Center produced a graphical display for each item showing the difference between each country's Rasch item difficulty and the international average Rasch item difficulty across all countries. An example of the graphical displays is provided in Exhibit 11.3.

Exhibit 11.3: Example Plot of Item-by-Country Interaction for a TIMSS 2015 Item



In each of these item-by-country interaction displays, the difference in Rasch item difficulty for each country is presented as a 95 percent confidence interval, which includes a built-in Bonferroni correction for multiple comparisons across the participating countries. The limits for this confidence interval were computed as follows:

$$\text{Upper Limit} = RDIFF_{i.} - RDIFF_{ik} + SE(RDIFF_{ik}) \cdot Z_b$$
$$\text{Lower Limit} = RDIFF_{i.} - RDIFF_{ik} - SE(RDIFF_{ik}) \cdot Z_b$$

where $RDIFF_{ik}$ is the Rasch difficulty of item i in country k, $RDIFF_{i.}$ is the international average Rasch difficulty of item i, $SE(RDIFF_{ik})$ is the standard error of the Rasch difficulty of item i in country k, and Z_b is the 95% critical value from the Z distribution corrected for multiple comparisons using the Bonferroni procedure.

Trend Item Review

In order to measure trends, TIMSS 2015 included achievement items from previous assessments as well as items developed for use for the first time in 2015. Accordingly, the TIMSS 2015 assessments included items from 2007, 2011, and 2015. An important review step, therefore, was to check that these "trend items" had statistical properties in 2015 similar to those they had in the previous assessments (e.g., a TIMSS item that was relatively easy in 2011 should still be relatively easy in 2015).

As can be seen in the example in Exhibit 11.4, the trend item review focused on statistics for trend items from the current and previous assessments (2015 and 2011) for countries that participated in both. For each country, trend item statistics included the percentage of students in each score category (or response option for multiple-choice items) for each assessment, as well as the difficulty of the item and the percent correct by gender. In reviewing these item statistics, the aim was to detect any unusual changes in item difficulties between administrations, which might indicate a problem in using the item to measure trends.

Exhibit 11.4: Example Item Statistics for a TIMSS 2015 Trend Item

Trends in International Mathematics and Science Study - TIMSS 2015 Assessment Results - 8th Grade
Trend Achievement Data Almanac for Science Items (Weighted)

S06_08 (S052049): Chemistry / Applying Type: CR 2 Points
Label: Separating iron and copper

COUNTRY	Year	N	20 %	10 %	79 %	OMITTED %	NOT REACHED %	V1 %	V2 %	GIRL PCT RIGHT	BOY PCT RIGHT
Australia	2011	1078	13.8	34.7	48.8	2.6	0.0	48.5	13.8	12.1	15.5
	2015	1468	12.1	32.2	52.1	3.3	0.4	44.3	12.1	13.5	10.5
Bahrain	2011	654	21.7	27.8	46.3	3.2	1.0	49.5	21.7	27.8	15.3
	2015	702	11.4	34.2	50.5	3.3	0.7	45.5	11.4	15.4	7.5
Botswana	2011	764	7.3	18.3	70.0	3.7	0.7	25.6	7.3	7.8	6.8
	2015	847	6.6	20.7	68.4	3.5	0.8	27.3	6.6	5.9	7.3
Chile	2011	828	4.2	26.7	57.1	10.8	1.3	30.9	4.2	4.3	4.2
	2015	676	11.1	18.5	53.2	16.7	0.5	29.6	11.1	12.1	10.1
Chinese Taipei	2011	718	28.3	42.3	27.1	2.2	0.1	70.6	28.3	30.9	25.9
	2015	821	24.7	47.2	25.3	2.7	0.2	71.9	24.7	27.1	22.1
England	2011	542	24.3	34.2	36.3	4.3	0.8	58.5	24.3	24.6	24.1
	2015	692	22.1	32.4	41.1	4.0	0.4	54.5	22.1	24.4	19.2
Georgia	2011	653	14.8	28.5	38.3	17.4	0.9	43.4	14.8	11.7	17.7
	2015	572	19.7	35.4	36.5	8.1	0.4	55.0	19.7	19.1	20.2
Hong Kong SAR	2011	576	12.5	34.6	49.8	3.0	0.2	47.0	12.5	15.5	9.3
	2015	597	11.6	35.7	50.9	1.8	0.0	47.3	11.6	11.8	11.3
Hungary	2011	730	17.1	46.0	33.8	3.0	0.0	63.2	17.1	15.1	18.9
	2015	704	17.7	48.6	30.8	2.9	0.0	66.3	17.7	21.4	13.8
Iran, Islamic Rep. of	2011	874	5.7	41.9	47.9	4.5	0.1	47.5	5.7	6.4	5.0
	2015	886	3.9	40.8	50.2	4.7	0.3	44.8	3.9	5.2	2.7
Israel	2011	664	18.1	35.0	43.5	2.6	0.8	53.1	18.1	21.9	14.6
	2015	787	18.5	37.9	38.6	4.5	0.5	56.3	18.5	22.6	14.0
Italy	2011	563	15.5	40.0	33.2	11.1	0.2	55.6	15.5	18.7	12.5
	2015	627	9.4	46.4	36.3	7.9	0.0	55.8	9.4	8.9	9.9
Japan	2011	628	32.4	25.6	38.2	3.8	0.0	57.9	32.4	29.6	35.3
	2015	681	19.7	43.5	33.2	3.1	0.5	63.2	19.7	19.1	20.3
Jordan	2011	1092	12.7	36.1	45.2	5.3	0.8	48.8	12.7	17.3	8.4
	2015	1134	9.0	31.3	52.2	7.4	0.2	40.3	9.0	9.4	8.6
Kazakhstan	2011	617	30.6	32.8	24.5	11.7	0.4	63.4	30.6	31.1	30.1
	2015	697	32.6	38.7	24.8	3.3	0.6	71.3	32.6	31.0	34.4
Korea, Rep. of	2011	741	21.5	47.2	29.7	1.5	0.1	68.7	21.5	24.6	18.2
	2015	757	13.9	43.0	41.5	1.6	0.0	56.9	13.9	16.4	12.0
Lebanon	2011	557	11.7	19.1	56.5	11.5	1.2	30.8	11.7	10.9	12.6
	2015	548	10.3	25.5	45.8	13.9	4.3	35.9	10.3	11.5	9.1
Lithuania	2011	673	5.9	45.7	44.2	4.0	0.3	51.5	5.9	7.1	4.8
	2015	621	6.6	41.7	48.6	3.1	0.1	48.3	6.6	9.2	3.7

V1 = Percent scoring 1 pt or better; V2 = Percent scoring 2 pts; Percent right for boys and girls corresponds to percent obtaining full credit.
Because of missing gender information, some totals may appear inconsistent.

Exhibit 11.4: Example Item Statistics for a TIMSS 2015 Trend Item (Continued)

Trends in International Mathematics and Science Study - TIMSS 2015 Assessment Results - 8th Grade
Trend Achievement Data Almanac for Science Items (Weighted)

S06_08 (S052049): Chemistry / Applying Type: CR 2 Points
Label: Separating iron and copper

COUNTRY	Year	N	20 %	10 %	79 %	OMITTED %	NOT REACHED %	V1 %	V2 %	GIRL PCT RIGHT	BOY PCT RIGHT
Malaysia	2011	833	12.0	26.4	53.4	6.7	1.6	38.4	12.0	12.6	11.4
	2015	1377	14.8	34.3	43.9	6.6	0.5	49.0	14.8	15.3	14.3
Morocco	2011	1335	3.0	22.8	66.3	6.8	1.1	25.7	3.0	3.4	2.6
	2015	1879	0.3	17.4	74.8	7.0	0.6	17.6	0.3	0.5	0.1
New Zealand	2011	755	21.1	29.9	43.6	5.1	0.4	51.0	21.1	20.9	21.2
	2015	1122	23.1	26.5	46.8	3.2	0.4	49.5	23.1	25.4	20.6
Oman	2011	1363	14.9	23.4	55.0	6.1	0.6	38.3	14.9	21.7	7.7
	2015	1255	12.2	25.2	55.6	6.6	0.4	37.4	12.2	14.6	10.0
Qatar	2011	624	15.0	25.4	55.1	4.3	0.2	40.3	15.0	19.0	11.3
	2015	768	11.7	31.1	50.9	5.6	0.7	42.8	11.7	12.3	11.2
Russian Federation	2011	709	15.8	49.3	28.4	5.2	1.3	65.0	15.8	13.3	18.2
	2015	677	35.8	32.5	28.0	3.6	0.1	68.3	35.8	33.6	37.8
Saudi Arabia	2011	628	4.1	19.8	72.4	3.4	0.3	23.9	4.1	3.3	4.9
	2015	531	3.7	24.0	69.4	2.5	0.5	27.6	3.7	4.0	3.3
Singapore	2011	850	33.1	31.8	33.6	1.3	0.1	65.0	33.1	36.7	29.7
	2015	872	43.4	30.6	25.4	0.6	0.0	74.0	43.4	43.5	43.3
Slovenia	2011	633	20.8	47.3	29.8	2.1	0.0	68.0	20.8	21.3	20.4
	2015	604	33.9	35.5	28.5	2.1	0.0	69.4	33.9	35.7	32.1
South Africa	2011	1704	6.0	7.0	77.8	7.7	1.5	13.0	6.0	6.0	5.9
	2015	1791	1.3	14.4	78.3	4.4	1.6	15.7	1.3	1.6	0.9
Sweden	2011	797	11.2	38.0	46.2	4.3	0.2	49.3	11.2	11.2	11.3
	2015	585	15.9	35.0	42.4	6.0	0.8	50.9	15.9	18.6	13.9
Thailand	2011	859	9.6	33.8	39.6	16.4	0.6	43.4	9.6	10.9	8.0
	2015	918	6.9	32.1	48.9	11.8	0.2	39.0	6.9	10.7	2.3
Turkey	2011	990	10.8	41.0	37.8	9.7	0.7	51.9	10.8	12.7	8.8
	2015	869	22.0	26.8	45.1	6.1	0.0	48.8	22.0	25.9	18.4
United Arab Emirates	2011	1999	12.0	33.8	50.0	3.3	0.8	45.8	12.0	12.6	11.5
	2015	2581	10.2	33.9	50.7	4.9	0.3	44.1	10.2	11.3	9.2
United States	2011	1490	13.9	37.0	45.7	3.2	0.3	50.8	13.9	13.7	14.0
	2015	1475	10.3	37.5	48.5	2.7	0.9	47.8	10.3	10.8	9.8
International Avg (n=33)	2011	28521	15.2	32.8	45.6	5.8	0.6	48.0	15.2	16.3	14.1
	2015	31121	15.3	33.0	46.0	5.1	0.5	48.4	15.3	16.6	14.1
Ontario, Canada	2011	682	19.8	28.5	44.9	6.2	0.7	48.3	19.8	18.9	20.4
	2015	644	10.0	26.9	56.3	6.1	0.8	36.8	10.0	9.7	10.2

V1 = Percent scoring 1 pt or better; V2 = Percent scoring 2 pts; Percent right for boys and girls corresponds to percent obtaining full credit.
Because of missing gender information, some totals may appear inconsistent.

Exhibit 11.4: Example Item Statistics for a TIMSS 2015 Trend Item (Continued)

Trends in International Mathematics and Science Study - TIMSS 2015 Assessment Results - 8th Grade
Trend Achievement Data Almanac for Science Items (Weighted)

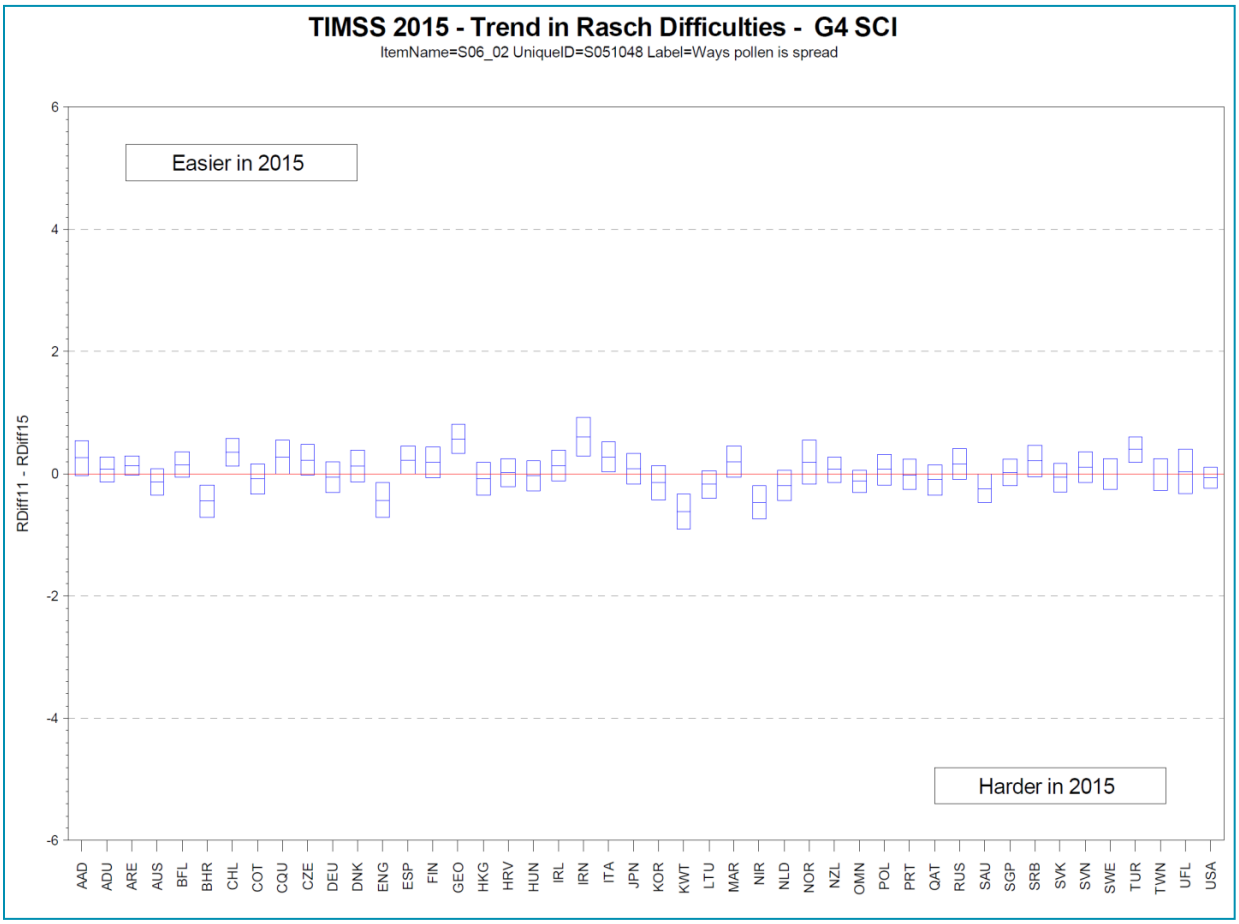
S06_08 (S052049): Chemistry / Applying Type: CR 2 Points
Label: Separating iron and copper

COUNTRY	Year	N	20 %	10 %	79 %	OMITTED %	NOT REACHED %	V1 %	V2 %	GIRL PCT RIGHT	BOY PCT RIGHT
Quebec, Canada	2011	880	20.2	33.2	41.5	4.5	0.6	53.4	20.2	20.9	19.5
	2015	555	13.9	33.1	46.8	5.0	1.2	47.0	13.9	15.0	12.7
Norway (8)	2011	540	8.6	37.2	48.9	5.0	0.3	45.8	8.6	11.1	5.9
	2015	685	10.3	35.4	46.7	7.2	0.4	45.8	10.3	10.1	10.5
Abu Dhabi, UAE	2011	624	12.2	31.7	52.5	2.7	0.9	43.9	12.2	9.8	14.3
	2015	692	7.1	30.0	56.4	6.0	0.5	37.1	7.1	7.8	6.5
Dubai, UAE	2011	789	14.0	32.8	48.1	4.0	1.2	46.8	14.0	15.3	12.7
	2015	879	16.8	37.4	42.1	3.3	0.4	54.3	16.8	17.7	15.8
Florida, US	2011	246	10.9	34.9	52.1	2.2	0.0	45.8	10.9	11.4	10.4
	2015	298	8.4	33.1	57.0	1.5	0.0	41.5	8.4	9.3	7.6

V1 = Percent scoring 1 pt or better; V2 = Percent scoring 2 pts; Percent right for boys and girls corresponds to percent obtaining full credit.
Because of missing gender information, some totals may appear inconsistent.

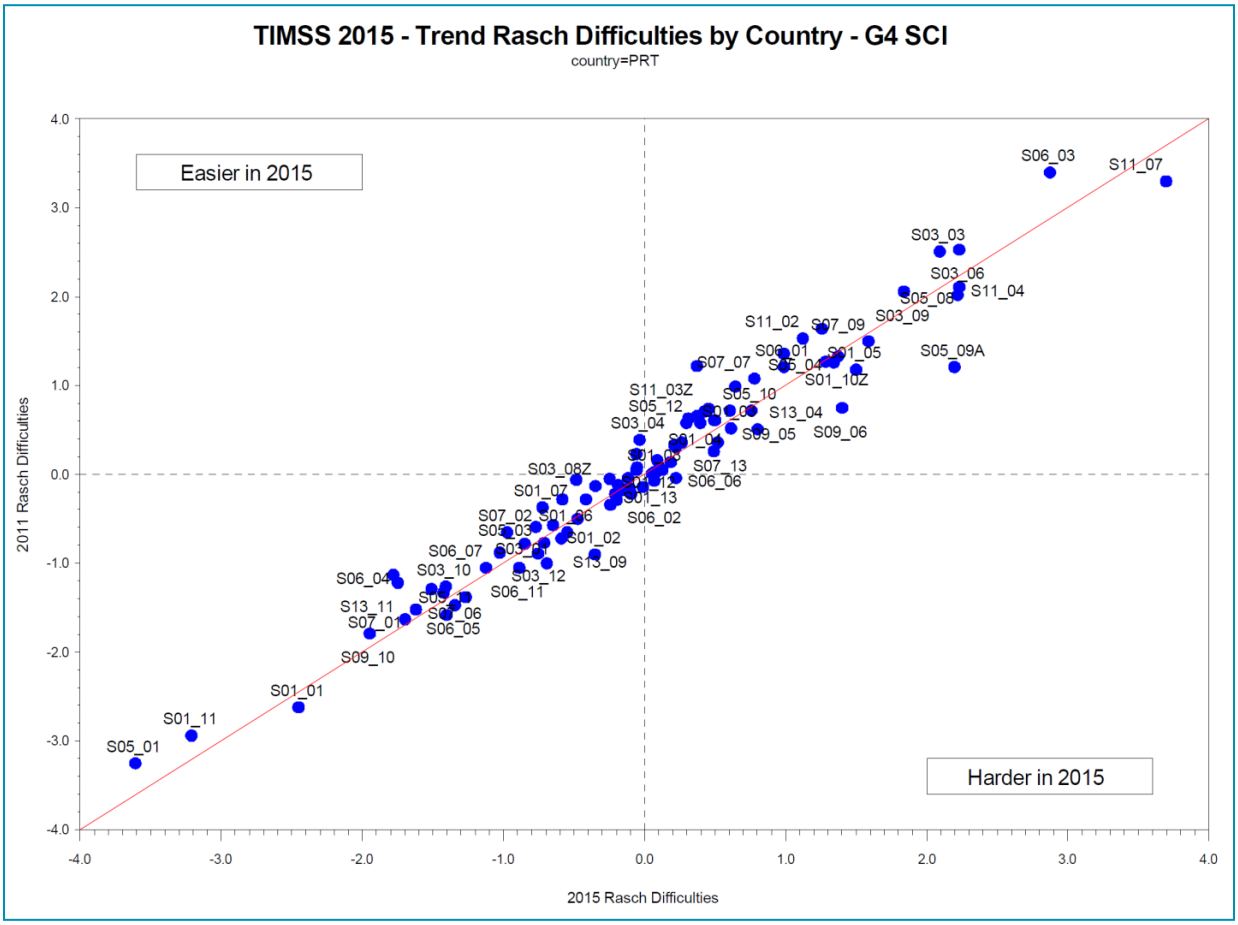
While some changes in item difficulties were anticipated as countries' overall achievement may have improved or declined, items were noted if the difference between the Rasch difficulties across the two assessments for a particular country was greater than 2 logits. The TIMSS & PIRLS International Study Center used two different graphical displays to examine the differences in item difficulties. The first of these, shown for an example item in Exhibit 11.5, displays the difference in Rasch item difficulty of the item between 2015 and 2011 for each country. A positive difference for a country indicates that the item was relatively easier in 2015, and a negative difference indicates that the item was relatively more difficult.

Exhibit 11.5: Example Plot of Differences in Rasch Item Difficulties Between 2015 and 2011 for a TIMSS 2015 Trend Item



The second graphical display, presented in Exhibit 11.6, shows the performance of a given country on all trend items simultaneously. For each country, the graph plots the 2015 Rasch difficulty of every trend item against its Rasch difficulty in 2011. Where there were no differences between the difficulties in the two successive administrations, the data points aligned on or near the diagonal.

Exhibit 11.6: Example Plot of Rasch Item Difficulties Across TIMSS Trend Items by Country



Reliability

Documenting the reliability of the TIMSS 2015 assessments was a critical quality control step in reviewing the items. As one indicator of reliability, the review considered Cronbach's Alpha coefficient of reliability calculated at the assessment booklet level. Secondly, the scoring of the constructed response items had to meet specific reliability criteria in terms of consistent within-country scoring, cross-country scoring, and across assessment or trend–scoring.

Test Reliability

Exhibits 11.7 and 11.8 display the TIMSS 2015 fourth and eighth grade mathematics and science test reliability coefficients for every country, respectively. Exhibit 11.7 also displays the test reliability coefficients for TIMSS Numeracy. These coefficients are the median Cronbach's alpha reliability across all TIMSS 2015 assessment booklets. In general, reliabilities were relatively high. For TIMSS at the fourth grade, the international median reliability (the median of the reliability coefficients for all countries) was 0.83 for mathematics and 0.78 for science, and at the eighth

grade, 0.88 for mathematics and 0.83 for science. The international median reliability for TIMSS Numeracy was 0.92.

Exhibit 11.7: Cronbach's Alpha Reliability Coefficient – TIMSS 2015 Fourth Grade

Country	Reliability Coefficient		
	Mathematics	Numeracy	Science
Australia	0.86	—	0.79
Bahrain	0.81	0.93	0.82
Belgium (Flemish)	0.80	—	0.73
Bulgaria	0.86	—	0.85
Canada	0.82	—	0.79
Chile	0.80	—	0.76
Chinese Taipei	0.83	—	0.77
Croatia	0.81	—	0.73
Cyprus	0.85	—	0.77
Czech Republic	0.83	—	0.78
Denmark	0.84	—	0.76
England	0.86	—	0.77
Finland	0.81	—	0.74
France	0.82	—	0.78
Georgia	0.82	—	0.76
Germany	0.82	—	0.77
Hong Kong SAR	0.81	—	0.77
Hungary	0.88	—	0.82
Indonesia	0.76	0.91	0.76
Iran, Islamic Rep. of	0.83	0.94	0.80
Ireland	0.84	—	0.77
Italy	0.82	—	0.75
Japan	0.83	—	0.77
Jordan	—	0.92	—
Kazakhstan	0.86	—	0.81
Korea, Rep. of	0.82	—	0.75
Kuwait	0.76	0.92	0.78
Lithuania	0.83	—	0.77
Morocco	0.76	0.92	0.78
Netherlands	0.77	—	0.71
New Zealand	0.85	—	0.82

Exhibit 11.7: Cronbach's Alpha Reliability Coefficient – TIMSS 2015 Fourth Grade (Continued)

Country	Reliability Coefficient		
	Mathematics	Numeracy	Science
Northern Ireland	0.87	—	0.77
Norway (5)	0.83	—	0.72
Oman	0.83	—	0.84
Poland	0.83	—	0.78
Portugal	0.84	—	0.72
Qatar	0.84	—	0.82
Russian Federation	0.84	—	0.77
Saudi Arabia	0.76	—	0.80
Serbia	0.87	—	0.80
Singapore	0.88	—	0.83
Slovak Republic	0.84	—	0.82
Slovenia	0.82	—	0.78
South Africa (5)	—	0.93	—
Spain	0.80	—	0.77
Sweden	0.81	—	0.79
Turkey	0.87	—	0.81
United Arab Emirates	0.87	—	0.85
United States	0.87	—	0.82
International Median	**0.83**	**0.92**	**0.78**
Benchmarking Participants			
Buenos Aires, Argentina	0.78	0.91	0.78
Ontario, Canada	0.83	—	0.79
Quebec, Canada	0.80	—	0.73
Norway (4)	0.81	—	0.74
Abu Dhabi, UAE	0.86	—	0.85
Dubai, UAE	0.87	—	0.85
Florida, US	0.85	—	0.81

Exhibit 11.8: Cronbach's Alpha Reliability Coefficient – TIMSS 2015 Eighth Grade

Country	Reliability Coefficient	
	Mathematics	Science
Australia	0.89	0.84
Bahrain	0.83	0.86
Botswana (9)	0.75	0.79
Canada	0.87	0.80
Chile	0.82	0.79
Chinese Taipei	0.92	0.87
Egypt	0.81	0.79
England	0.90	0.85
Georgia	0.87	0.78
Hong Kong SAR	0.89	0.81
Hungary	0.91	0.86
Iran, Islamic Rep. of	0.87	0.82
Ireland	0.88	0.83
Israel	0.92	0.88
Italy	0.86	0.81
Japan	0.91	0.83
Jordan	0.77	0.80
Kazakhstan	0.91	0.85
Korea, Rep. of	0.91	0.84
Kuwait	0.82	0.83
Lebanon	0.80	0.80
Lithuania	0.88	0.83
Malaysia	0.88	0.85
Malta	0.88	0.87
Morocco	0.72	0.74
New Zealand	0.90	0.85
Norway (9)	0.87	0.83
Oman	0.82	0.84
Qatar	0.88	0.87
Russian Federation	0.89	0.83
Saudi Arabia	0.76	0.79
Singapore	0.91	0.87
Slovenia	0.87	0.84
South Africa (9)	0.80	0.82

Exhibit 11.8: Cronbach's Alpha Reliability Coefficient – TIMSS 2015 Eighth Grade (Continued)

Country	Reliability Coefficient	
	Mathematics	Science
Sweden	0.86	0.84
Thailand	0.86	0.80
Turkey	0.91	0.87
United Arab Emirates	0.89	0.87
United States	0.89	0.85
International Median	**0.88**	**0.83**
Benchmarking Participants		
Buenos Aires, Argentina	0.82	0.79
Ontario, Canada	0.87	0.81
Quebec, Canada	0.84	0.78
Norway (8)	0.83	0.80
Abu Dhabi, UAE	0.88	0.86
Dubai, UAE	0.90	0.86
Florida, US	0.89	0.86

Scoring Reliability for Constructed Response Items

A sizeable proportion of the items in the TIMSS 2015 assessments were constructed response items, comprising about half of the assessment score points. An essential requirement for use of such items is that they be reliably scored by all participants. That is, a particular student response should receive the same score, regardless of the scorer. In conducting TIMSS 2015, measures taken to ensure that the constructed response items were scored reliably in all countries included developing scoring guides for each constructed response question (that provided descriptions of acceptable responses for each score point value) and providing extensive training in the application of the scoring guides. See Chapter 1: Developing the TIMSS 2015 Achievement Items for more information on the scoring guides and see Chapter 6: Survey Operations Procedures for information on the scoring process.

Within-Country Scoring Reliability

To gather and document information about the within-country agreement among scorers for TIMSS 2015, a random sample of approximately 25 percent of the assessment booklets was selected to be scored independently by two scorers. The inter-scorer agreement for each item in each country was examined as part of the item review process. Exact percent agreement across items was high on average across countries—96 percent or above, on average internationally. In TIMSS 2015 there also was high agreement at the diagnostic score level, where percent agreement

ranged from 94 percent in science at the eighth grade to 98 percent in mathematics at the fourth grade, on average. See Appendix 11A for the average and range of the within-country percentage of correctness score agreement across all items. The TIMSS Within-Country Scoring Reliability documents also provide the average and range of the within-country percentage of diagnostic score agreement.

Trend Item Scoring Reliability

The TIMSS & PIRLS International Study Center also took steps to show that the 2015 constructed response items used in TIMSS 2011 were scored in the same way in both assessments. In anticipation of this, countries that participated in TIMSS 2011 sent samples of scored student booklets from the 2011 data collections to the IEA Data Processing and Research Center (IEA DPC), where they were digitally scanned and stored for later use. As a check on scoring consistency from one administration to the next, staff members working in each country on scoring the 2015 data were asked also to score these 2011 responses using the Trend Reliability Scoring Software developed by the IEA DPC. Each country scored 200 responses for each of 21 mathematics and 23 science items at the fourth grade, and 27 mathematics and 33 science items at the eighth grade.

There was a very high degree of scoring consistency in TIMSS 2015. The exact agreement between the scores awarded in 2011 and those given by the 2015 scorers ranged from 92 percent in science to 98 percent in mathematics at the fourth grade, on average internationally. There also was high agreement in TIMSS at the diagnostic score level, although somewhat less in science than in mathematics, on average. The average and range of scoring consistency over time can be found in Appendix 11B.

Cross-Country Scoring Reliability Study

It also was important to document the consistency of scoring across countries. Because of the many different languages in use in TIMSS 2015, establishing the reliability of constructed response scoring across all countries was not feasible. However, the TIMSS & PIRLS International Study Center did conduct a cross-country study of scoring reliability among Northern Hemisphere countries that had scorers who were proficient in English. A sample of student responses was provided by the English-speaking Southern Hemisphere countries. Cross-country scoring included 200 student responses for each of 11 mathematics and 10 science items at the fourth grade, and 13 mathematics and 13 science items at the eighth grade. This set of student responses in English was then scored independently in each country that had two scorers proficient in English, using the Cross-country Scoring Reliability Software provided by the IEA DPC. In all, scorers from 46 countries at fourth grade and 37 countries at eighth grade participated in the study. Scoring for this study took place shortly after the other scoring reliability activities were completed. Making all possible comparisons among scorers gave 1,035 comparisons at fourth grade and 666 comparisons at eighth grade for each student response to each item. This resulted in more than 130,000 total

comparisons at each grade and subject when aggregated across all 200 student responses to that item. Agreement across countries was defined in terms of the percentage of these comparisons that were in exact agreement.

On average internationally, scorer reliability across countries in TIMSS 2015 was high. The exact agreement between the scores awarded across countries ranged from 86 percent in science to 97 percent in mathematics at the fourth grade and from 83 percent in science to 93 percent in mathematics at the eighth grade, on average internationally. There also was high agreement at the diagnostic score level, where percent agreement ranged from 79 percent in science at the eighth grade to 97 percent in mathematics at the fourth grade, on average. See Appendix 11C for the results of the cross-country scoring reliability study.

Item Review Procedures

Using the information from the comprehensive collection of item analyses and reliability data that were computed and summarized for TIMSS 2015, the TIMSS & PIRLS International Study Center thoroughly reviewed all item statistics for every participating country and benchmarking participant to ensure that the items were performing comparably across countries. In particular, items with the following problems were considered for possible deletion from the international database:

- An error was detected during translation verification but was not corrected before test administration
- Data checking revealed a multiple-choice item with more or fewer options than in the international version
- The item analysis showed the item to have a negative biserial, or, for an item with more than 1 score point, point biserials that did not increase with each score level
- The item-by-country interaction results showed a very large negative interaction for a particular country
- For constructed response items, the within-country scoring reliability data showed an agreement of less than 70 percent
- For trend items, an item performed substantially differently in 2015 compared to the TIMSS 2011 administration, or an item was not included in the previous assessment for a particular country

When the item statistics indicated a problem with an item, the documentation from the translation verification was used as an aid in checking the test booklets. If a question remained about potential translation or cultural issues, however, then the National Research Coordinator was consulted before deciding how the item should be treated.

The checking of the TIMSS 2015 achievement data involved review of more than 750 items and resulted in the detection of very few items that were inappropriate for international comparisons. Among the few items singled out in the review process were mostly items with differences attributable to either translation or printing problems. See Appendix 11D: Country Adaptations to Items and Item Scoring for a list of deleted items, as well as a list of recodes made to constructed response item codes. There also were a number of items in each study that were combined, or derived, for scoring purposes. See Appendix 11E for details about how score points were awarded for each derived item.

Appendix 11A: TIMSS 2015 Within–Country Scoring Reliability for the Constructed Response Items

TIMSS 2015 Within-Country Scoring Reliability for the Fourth Grade Constructed Response Mathematics Items

Country	Correctness Score Agreement			Diagnostic Score Agreement		
	Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement		Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement	
		Minimum	Maximum		Minimum	Maximum
Australia	98	87	100	97	86	100
Bahrain	99	90	100	99	89	100
Belgium (Flemish)	98	90	100	97	80	100
Bulgaria	99	96	100	98	94	100
Canada	97	80	100	95	77	100
Chile	99	91	100	98	87	100
Chinese Taipei	99	89	100	99	88	100
Croatia	99	89	100	98	81	100
Cyprus	100	99	100	100	98	100
Czech Republic	98	89	100	97	86	100
Denmark	97	89	100	95	84	100
England	99	95	100	99	92	100
Finland	99	90	100	99	89	100
France	98	84	100	97	68	100
Georgia	99	96	100	98	85	100
Germany	98	78	100	98	78	100
Hong Kong SAR	100	98	100	100	98	100
Hungary	99	96	100	99	95	100
Indonesia	99	92	100	96	68	100
Iran, Islamic Rep. of	99	89	100	97	85	100
Ireland	99	94	100	99	94	100
Italy	98	92	100	97	86	100
Japan	99	96	100	99	96	100
Kazakhstan	93	84	99	93	82	98
Korea, Rep. of	100	95	100	99	95	100
Kuwait	99	96	100	98	93	100
Lithuania	100	98	100	100	97	100
Morocco	95	43	100	91	42	99

TIMSS 2015 Within-Country Scoring Reliability for the Fourth Grade Constructed Response Mathematics Items (Continued)

Country	Correctness Score Agreement			Diagnostic Score Agreement		
	Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement		Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement	
		Minimum	Maximum		Minimum	Maximum
Netherlands	98	83	100	96	76	100
New Zealand	99	88	100	98	81	100
Northern Ireland	99	90	100	98	88	100
Norway (5)	98	86	100	97	77	100
Oman	98	90	100	96	72	100
Poland	99	90	100	98	82	100
Portugal	100	99	100	100	97	100
Qatar	99	97	100	98	93	100
Russian Federation	99	97	100	99	97	100
Saudi Arabia	98	81	100	96	77	100
Serbia	97	79	100	94	66	100
Singapore	99	94	100	99	93	100
Slovak Republic	100	100	100	100	99	100
Slovenia	99	97	100	99	96	100
Spain	99	95	100	98	92	100
Sweden	98	86	100	97	81	100
Turkey	100	98	100	100	98	100
United Arab Emirates	98	85	100	96	80	100
United States	98	81	100	97	78	100
International Avg.	**99**	**90**	**100**	**98**	**85**	**100**
Benchmarking Participants						
Buenos Aires, Argentina	97	87	100	94	80	100
Ontario, Canada	96	69	100	94	69	100
Quebec, Canada	98	84	100	97	83	100
Norway (4)	98	86	100	97	74	100
Abu Dhabi, UAE	98	86	100	96	78	100
Dubai, UAE	97	85	100	96	79	100
Florida, US	98	83	100	97	80	100

TIMSS Numeracy 2015 Within-Country Scoring Reliability for the Constructed Response Items

Country	Correctness Score Agreement			Diagnostic Score Agreement		
	Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement		Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement	
		Minimum	Maximum		Minimum	Maximum
Bahrain	100	97	100	99	97	100
Indonesia	98	87	100	96	78	100
Iran, Islamic Rep. of	99	94	100	98	94	100
Jordan	99	98	100	98	93	100
Kuwait	99	95	100	98	95	100
Morocco	94	53	100	92	53	100
South Africa (5)	100	97	100	99	97	100
Benchmarking Participants						
Buenos Aires, Argentina	96	83	100	94	83	100

TIMSS 2015 Within-Country Scoring Reliability for the Fourth Grade Constructed Response Science Items

Country	Correctness Score Agreement			Diagnostic Score Agreement		
	Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement		Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement	
		Minimum	Maximum		Minimum	Maximum
Australia	95	85	100	94	85	100
Bahrain	92	80	99	90	71	98
Belgium (Flemish)	95	79	100	94	79	99
Bulgaria	97	80	100	97	78	100
Canada	95	82	100	94	82	99
Chile	95	86	100	94	79	100
Chinese Taipei	94	85	100	94	76	100
Croatia	97	91	100	96	82	100
Cyprus	99	97	100	99	97	100
Czech Republic	94	83	100	93	70	100
Denmark	93	81	99	91	73	98
England	97	78	100	97	78	100
Finland	96	87	100	95	87	100
France	94	59	100	93	56	100
Georgia	97	90	100	96	81	100
Germany	95	83	100	95	81	100
Hong Kong SAR	100	98	100	99	97	100
Hungary	98	91	100	97	88	100
Indonesia	95	66	100	93	64	100
Iran, Islamic Rep. of	98	92	100	96	86	100
Ireland	98	89	100	98	88	100
Italy	95	86	100	95	86	100
Japan	99	93	100	99	93	100
Kazakhstan	94	89	98	94	89	98
Korea, Rep. of	97	93	100	97	93	100
Kuwait	99	96	100	98	92	100
Lithuania	100	98	100	99	98	100
Morocco	91	65	100	88	61	99
Netherlands	92	78	99	91	69	99
New Zealand	96	82	100	95	81	100
Northern Ireland	95	86	100	94	86	99
Norway (5)	89	64	100	88	64	100

TIMSS 2015 Within-Country Scoring Reliability for the Fourth Grade Constructed Response Science Items (Continued)

Country	Correctness Score Agreement			Diagnostic Score Agreement		
	Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement		Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement	
		Minimum	Maximum		Minimum	Maximum
Oman	93	76	100	91	76	99
Poland	93	75	100	93	75	99
Portugal	99	97	100	99	96	100
Qatar	99	96	100	97	93	100
Russian Federation	98	94	100	98	94	100
Saudi Arabia	97	88	100	95	86	100
Serbia	90	72	99	88	70	98
Singapore	97	90	100	96	88	100
Slovak Republic	100	98	100	100	98	100
Slovenia	98	91	100	97	90	100
Spain	98	90	100	98	86	100
Sweden	93	81	100	93	81	100
Turkey	99	92	100	99	91	100
United Arab Emirates	92	80	99	90	78	98
United States	95	85	100	95	80	100
International Avg.	**96**	**85**	**100**	**95**	**82**	**100**
Benchmarking Participants						
Buenos Aires, Argentina	93	76	100	90	75	98
Ontario, Canada	94	82	100	93	79	100
Quebec, Canada	96	81	100	95	81	100
Norway (4)	91	71	100	90	71	100
Abu Dhabi, UAE	93	80	99	91	77	98
Dubai, UAE	90	75	100	89	73	98
Florida, US	95	85	100	95	77	100

TIMSS 2015 Within-Country Scoring Reliability for the Eighth Grade Constructed Response Mathematics Items

Country	Correctness Score Agreement			Diagnostic Score Agreement		
	Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement		Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement	
		Minimum	Maximum		Minimum	Maximum
Australia	98	87	100	97	86	100
Bahrain	99	97	100	99	96	100
Botswana (9)	98	74	100	96	60	100
Canada	97	87	100	95	81	100
Chile	98	85	100	96	77	100
Chinese Taipei	98	87	100	97	63	100
Egypt	99	95	100	97	88	100
England	99	95	100	99	95	100
Georgia	99	93	100	98	88	100
Hong Kong SAR	100	98	100	100	98	100
Hungary	99	93	100	98	89	100
Iran, Islamic Rep. of	99	93	100	97	89	100
Ireland	98	87	100	98	84	100
Israel	98	92	100	96	87	100
Italy	98	86	100	97	85	100
Japan	100	93	100	100	93	100
Jordan	99	97	100	98	90	100
Kazakhstan	89	71	98	88	70	96
Korea, Rep. of	99	89	100	98	88	100
Kuwait	99	95	100	98	93	100
Lebanon	96	75	100	93	74	99
Lithuania	100	99	100	100	98	100
Malaysia	99	95	100	98	93	100
Malta	98	90	100	97	79	100
Morocco	97	45	100	93	44	100
New Zealand	98	91	100	97	86	100
Norway (9)	97	79	100	95	70	100
Oman	98	85	100	96	77	100
Qatar	99	96	100	98	92	100
Russian Federation	99	95	100	99	91	100
Saudi Arabia	100	97	100	99	90	100
Singapore	98	86	100	97	84	100

TIMSS 2015 Within-Country Scoring Reliability for the Eighth Grade Constructed Response Mathematics Items (Continued)

Country	Correctness Score Agreement			Diagnostic Score Agreement		
	Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement		Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement	
		Minimum	Maximum		Minimum	Maximum
Slovenia	99	97	100	99	96	100
South Africa (9)	100	94	100	99	89	100
Sweden	98	81	100	96	79	100
Thailand	100	99	100	99	85	100
Turkey	99	98	100	99	96	100
United Arab Emirates	98	87	100	96	75	100
United States	98	81	100	97	75	100
International Avg.	**98**	**89**	**100**	**97**	**84**	**100**
Benchmarking Participants						
Buenos Aires, Argentina	99	96	100	98	93	100
Ontario, Canada	97	85	100	95	77	100
Quebec, Canada	97	79	100	96	76	100
Norway (8)	97	83	100	96	77	100
Abu Dhabi, UAE	98	86	100	96	81	100
Dubai, UAE	97	81	100	95	65	100
Florida, US	99	87	100	97	83	100

TIMSS 2015 Within-Country Scoring Reliability for the Eighth Grade Constructed Response Science Items

Country	Correctness Score Agreement			Diagnostic Score Agreement		
	Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement		Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement	
		Minimum	Maximum		Minimum	Maximum
Australia	95	82	100	94	80	100
Bahrain	92	72	100	88	60	100
Botswana (9)	91	72	100	88	62	100
Canada	94	73	100	92	69	99
Chile	94	85	100	92	78	99
Chinese Taipei	95	85	100	94	77	100
Egypt	99	93	100	97	87	100
England	98	93	100	98	93	100
Georgia	98	86	100	97	86	100
Hong Kong SAR	100	98	100	100	98	100
Hungary	97	93	100	97	91	100
Iran, Islamic Rep. of	98	91	100	97	86	100
Ireland	96	77	100	95	77	100
Israel	98	92	100	96	85	100
Italy	95	87	100	94	86	100
Japan	99	84	100	99	84	100
Jordan	98	94	100	96	81	100
Kazakhstan	89	73	97	89	73	97
Korea, Rep. of	96	87	100	95	87	100
Kuwait	99	94	100	97	91	100
Lebanon	93	78	100	88	57	99
Lithuania	100	98	100	99	96	100
Malaysia	98	94	100	97	91	100
Malta	92	71	100	89	71	100
Morocco	91	73	100	84	52	100
New Zealand	96	84	100	95	84	100
Norway (9)	92	63	100	91	63	100
Oman	93	78	100	91	72	100
Qatar	99	97	100	98	89	100
Russian Federation	98	92	100	97	79	100
Saudi Arabia	98	84	100	96	81	100
Singapore	96	82	100	95	81	100

TIMSS 2015 Within-Country Scoring Reliability for the Eighth Grade Constructed Response Science Items (Continued)

Country	Correctness Score Agreement			Diagnostic Score Agreement		
	Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement		Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement	
		Minimum	Maximum		Minimum	Maximum
Slovenia	99	97	100	99	93	100
South Africa (9)	98	87	100	97	79	100
Sweden	94	74	100	92	74	100
Thailand	100	99	100	99	92	100
Turkey	97	89	100	96	80	100
United Arab Emirates	92	74	99	90	71	99
United States	94	75	100	93	75	100
International Avg.	**96**	**85**	**100**	**94**	**80**	**100**
Benchmarking Participants						
Buenos Aires, Argentina	99	96	100	98	92	100
Ontario, Canada	94	82	100	93	71	100
Quebec, Canada	94	71	100	92	69	100
Norway (8)	93	73	100	91	72	100
Abu Dhabi, UAE	93	77	100	91	70	99
Dubai, UAE	91	70	100	88	66	100
Florida, US	95	79	100	94	71	100

Appendix 11B: Trend Scoring Reliability for the Constructed Response Items

TIMSS 2015 Trend Scoring Reliability for the Fourth Grade Constructed Response Mathematics Items

Country	Correctness Score Agreement			Diagnostic Score Agreement		
	Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement		Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement	
		Minimum	Maximum		Minimum	Maximum
Australia	99	95	100	97	88	100
Bahrain	98	82	100	94	68	100
Belgium (Flemish)	97	89	100	95	62	100
Canada	98	85	100	95	78	100
Chile	97	71	100	94	69	99
Chinese Taipei	97	77	100	96	69	100
Croatia	98	89	100	97	85	100
Czech Republic	98	82	100	95	78	99
Denmark	97	80	100	95	77	100
England	98	85	100	96	52	100
Finland	98	84	100	97	83	100
Georgia	98	87	100	96	82	100
Germany	99	93	100	98	92	100
Hungary	98	76	100	97	76	100
Iran, Islamic Rep. of	98	90	100	96	85	99
Ireland	98	80	100	96	76	100
Italy	97	82	100	95	82	100
Japan	98	87	100	97	75	100
Kazakhstan	94	72	99	91	66	99
Korea, Rep. of	99	89	100	99	85	100
Kuwait	95	72	100	89	60	99
Lithuania	98	88	100	97	81	100
Netherlands	97	79	99	95	79	99
New Zealand	97	78	100	95	77	100
Northern Ireland	98	80	100	97	79	100
Norway	97	70	100	95	69	100
Oman	97	82	100	93	74	99
Poland	98	89	100	96	86	99

TIMSS 2015 Trend Scoring Reliability for the Fourth Grade Constructed Response Mathematics Items (Continued)

Country	Correctness Score Agreement			Diagnostic Score Agreement		
	Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement		Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement	
		Minimum	Maximum		Minimum	Maximum
Portugal	98	91	100	98	90	100
Qatar	98	86	100	95	74	100
Russian Federation	97	81	100	95	48	100
Serbia	98	87	100	96	70	100
Singapore	98	87	100	98	82	100
Slovak Republic	98	96	100	97	91	100
Slovenia	96	84	99	93	73	99
Spain	96	72	100	93	67	100
Sweden	98	80	100	96	79	100
Turkey	97	78	100	95	75	100
United Arab Emirates	97	86	100	94	59	99
United States	97	84	100	96	83	100
International Avg.	**98**	**83**	**100**	**95**	**76**	**100**
Benchmarking Participant						
Dubai, UAE	98	83	100	94	63	100

TIMSS 2015 Trend Scoring Reliability for the Fourth Grade Constructed Response Science Items

Country	Correctness Score Agreement			Diagnostic Score Agreement		
	Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement		Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement	
		Minimum	Maximum		Minimum	Maximum
Australia	94	88	100	93	85	99
Bahrain	88	73	96	85	70	96
Belgium (Flemish)	89	61	98	87	61	98
Canada	91	81	99	89	77	99
Chile	91	75	99	89	72	99
Chinese Taipei	87	62	99	84	55	99
Croatia	92	74	100	91	74	99
Czech Republic	92	71	100	90	69	100
Denmark	87	69	98	85	67	97
England	92	74	100	91	74	100
Finland	94	84	100	93	81	100
Georgia	92	78	99	89	71	99
Germany	95	89	99	94	88	99
Hungary	94	84	100	93	83	99
Iran, Islamic Rep. of	92	75	99	90	72	99
Ireland	91	67	99	89	66	99
Italy	95	85	100	93	85	99
Japan	89	55	100	88	53	100
Kazakhstan	83	60	95	76	50	95
Korea, Rep. of	94	80	100	94	78	100
Kuwait	93	85	99	88	76	96
Lithuania	93	56	100	91	56	99
Netherlands	89	65	99	88	65	99
New Zealand	94	82	100	93	80	99
Northern Ireland	94	78	100	93	78	100
Norway	91	69	99	90	69	99
Oman	94	84	99	89	77	99
Poland	90	65	99	87	65	98
Portugal	95	83	99	93	83	99
Qatar	92	83	99	90	80	98

TIMSS 2015 Trend Scoring Reliability for the Fourth Grade Constructed Response Science Items (Continued)

Country	Correctness Score Agreement			Diagnostic Score Agreement		
	Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement		Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement	
		Minimum	Maximum		Minimum	Maximum
Russian Federation	95	82	100	94	81	100
Serbia	89	68	98	86	67	98
Singapore	93	85	100	93	83	100
Slovak Republic	97	90	99	96	89	99
Slovenia	89	62	99	86	62	97
Spain	88	70	99	85	68	99
Sweden	92	75	99	91	75	99
Turkey	92	68	98	90	68	98
United Arab Emirates	92	76	98	88	72	97
United States	92	77	100	92	76	100
International Avg.	**92**	**75**	**99**	**90**	**73**	**99**
Benchmarking Participant						
Dubai, UAE	91	78	100	89	77	100

TIMSS 2015 Trend Scoring Reliability for the Eighth Grade Constructed Response Mathematics Items

Country	Correctness Score Agreement			Diagnostic Score Agreement		
	Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement		Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement	
		Minimum	Maximum		Minimum	Maximum
Australia	98	91	100	96	86	100
Bahrain	97	75	100	93	60	100
Botswana	96	77	100	92	63	100
Canada	95	83	100	92	77	98
Chinese Taipei	95	67	100	94	67	100
England	97	80	100	94	76	100
Georgia	97	86	100	93	66	100
Hong Kong SAR	97	82	100	95	76	100
Hungary	97	79	100	96	78	100
Iran, Islamic Rep. of	97	76	100	94	67	100
Israel	97	83	100	95	81	100
Italy	98	86	100	96	83	100
Japan	97	84	100	95	77	100
Jordan	97	84	100	93	61	100
Kazakhstan	91	74	100	87	60	100
Korea, Rep. of	98	91	100	97	88	100
Lithuania	98	85	100	97	81	100
Malaysia	97	86	100	92	70	99
New Zealand	96	75	100	94	68	100
Norway	97	76	100	94	68	100
Oman	97	84	100	91	60	98
Qatar	97	88	100	95	83	99
Russian Federation	97	81	100	94	76	100
Singapore	97	79	100	96	73	100
Slovenia	96	71	100	93	71	100
South Africa	96	87	99	91	71	99
Sweden	97	79	100	95	74	100
Thailand	98	91	100	96	82	100
Turkey	96	83	100	92	72	100
United Arab Emirates	97	85	100	94	81	100
United States	96	69	100	94	62	100
International Avg.	**97**	**81**	**100**	**94**	**73**	**100**
Benchmarking Participant						
Dubai, UAE	97	85	100	95	78	100

TIMSS 2015 Trend Scoring Reliability for the Eighth Grade Constructed Response Science Items

Country	Correctness Score Agreement			Diagnostic Score Agreement		
	Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement		Average of Exact Percent Agreement Across Items	Range of Exact Percent Agreement	
		Minimum	Maximum		Minimum	Maximum
Australia	94	85	100	92	85	100
Bahrain	90	71	99	86	60	98
Botswana	90	67	98	84	61	96
Canada	90	66	100	85	64	100
Chinese Taipei	93	75	100	90	75	100
England	92	57	100	89	57	100
Georgia	94	76	99	89	58	99
Hong Kong SAR	93	67	100	91	66	100
Hungary	95	70	100	93	70	100
Iran, Islamic Rep. of	92	68	99	88	67	98
Israel	93	73	100	90	72	100
Italy	94	86	99	91	77	99
Japan	93	73	100	89	54	99
Jordan	94	76	99	88	70	99
Kazakhstan	85	52	100	77	52	99
Korea, Rep. of	95	79	100	93	76	100
Lithuania	96	81	100	95	77	100
Malaysia	92	66	99	82	59	97
New Zealand	94	73	100	91	73	100
Norway	93	64	100	91	64	100
Oman	93	65	99	87	61	98
Qatar	92	79	99	87	76	98
Russian Federation	94	68	100	92	68	100
Singapore	93	66	100	91	66	100
Slovenia	90	57	99	88	56	98
South Africa	95	82	100	88	47	100
Sweden	94	72	100	91	69	100
Thailand	96	81	100	93	77	100
Turkey	94	77	100	91	77	99
United Arab Emirates	93	66	100	90	64	99
United States	94	61	100	90	60	99
International Avg.	**93**	**71**	**100**	**89**	**66**	**99**
Benchmarking Participant						
Dubai, UAE	93	72	100	90	72	100

Appendix 11C: TIMSS 2015 Cross–Country Scoring Reliability for the Constructed Response Items

TIMSS 2015 Cross-Country Scoring Reliability for the Fourth Grade Constructed Response Mathematics Items

Item Label	Total Valid Comparisons	Exact Percent Agreement	
		Correctness Score Agreement	Diagnostic Score Agreement
M09_01 - M051206	207000	97	97
M09_04 - M051045	207000	99	98
M09_06 - M051030	206820	98	98
M09_11 - M051533	206910	99	99
M09_12 - M051080	206865	91	88
M11_01 - M051401	206865	99	99
M11_03 - M051402	207000	99	99
M11_05 - M051131	206955	98	98
M11_07 - M051217	206955	97	96
M11_08 - M051079	207000	97	97
M11_11 - M051009	207000	98	98
Average Percent Agreement		**97**	**97**

TIMSS 2015 Cross-Country Scoring Reliability for the Fourth Grade Constructed Response Science Items

Item Label	Total Valid Comparisons	Exact Percent Agreement	
		Correctness Score Agreement	Diagnostic Score Agreement
S09_01 - S051044	198000	88	88
S09_04 - S051168	198000	81	77
S09_05 - S051010	198000	86	83
S09_07 - S051059	198000	71	71
S09_10 - S051151	198000	98	98
S11_04 - S051194	198000	89	89
S11_06 - S051077	198000	95	95
S11_07 - S051200	198000	86	86
S11_08 - S051075	198000	84	84
S11_12 - S051175	198000	77	77
Average Percent Agreement		**86**	**85**

TIMSS 2015 Cross-Country Scoring Reliability for the Eighth Grade Constructed Response Mathematics Items

Item Label	Total Valid Comparisons	Exact Percent Agreement	
		Correctness Score Agreement	Diagnostic Score Agreement
M09_05A - M052174A	133128	97	97
M09_05B - M052174B	132675	96	94
M09_08 - M052110	132948	98	98
M09_09 - M052105	133164	88	88
M09_11 - M052036	133200	87	87
M09_12 - M052502	133056	95	95
M09_13 - M052117	133092	86	71
M11_03 - M052364	133200	98	98
M11_04 - M052215	133020	98	98
M11_08 - M052087	131767	94	94
M11_09 - M052048	133056	95	83
M11_10 - M052039	133164	98	98
M11_14 - M052421	132984	80	80
Average Percent Agreement		**93**	**91**

TIMSS 2015 Cross-Country Scoring Reliability for the Eighth Grade Constructed Response Science Items

Item Label	Total Valid Comparisons	Exact Percent Agreement	
		Correctness Score Agreement	Diagnostic Score Agreement
S09_02 - S052272	133200	90	82
S09_03A - S052085A	133128	78	68
S09_03B - S052085B	133200	78	78
S09_04 - S052094	133200	95	95
S09_06 - S052146	133200	91	88
S09_10 - S052214	133200	98	98
S09_12 - S052101	132948	82	82
S11_01B - S052090B	133200	80	66
S11_04 - S052273	133056	52	52
S11_06 - S052051	133092	83	83
S11_10 - S052189	133128	79	74
S11_13 - S052099	133164	80	80
S11_14 - S052118	133164	90	84
Average Percent Agreement		**83**	**79**

Appendix 11D: Country Adaptations to Items and Item Scoring

TIMSS Fourth Grade Mathematics

Deleted Items

BELGIUM (FLEMISH)

M041200, M05_13 (printing error)

BULGARIA

M051125B, M06_11B (translation error)

FRANCE

M061239, M02_10 (printing error)

IRAN, ISLAMIC REP. OF

M061041, M14_04 (transcription error)

LITHUANIA

M041034, M01_03 (Russian only; translation error)

M051236, M06_10 (Polish only; translation error)

TURKEY

M051502, M09_07 (printing error)

Constructed Response Items with Category Recodes

ALL COUNTRIES

M061239, M02_10 (recode 20 to 10, 10 to 70, 11 to 71)

M061084, M08_11 (recode 20 to 10, 10 to 70)

M051080, M09_12 (recode 20 to 10, 10 to 71, 11 to 72)

M061254, M14_02 (recode 20 to 10, 10 to 70)

M061224, M14_08 (recode 70 to 12)

TIMSS Fourth Grade Mathematics – Numeracy

Constructed Response Items with Category Recodes

ALL COUNTRIES

M061239, N04_10 (recode 20 to 10, 10 to 70, 11 to 71)

M061084, N08_11 (recode 20 to 10, 10 to 70)

TIMSS Fourth Grade Science

Deleted Items

ALL COUNTRIES

S041193, S01_09 (poor discrimination)

S041002, S05_07 (faulty distracters)

S051079, S06_09 (attractive distracter)

TIMSS Fourth Grade Science

Deleted Items (Continued)
S041080, S07_08 (attractive distracter)
S041171, S07_10 (faulty distracters)
S051020, S09_02 (poor discrimination)
S061166, S10_05 (poor discrimination)
S051138C, S11_03C (poor discrimination)
S061125, S14_01 (poor discrimination)
FRANCE
S051106, S13_10 (printing error)
INDONESIA
S051191, S11_10 (negative discrimination)
LITHUANIA
S041052, S07_06 (Polish only; translation error)
NORWAY
S061081, S02_06 (translation error)

TIMSS Eighth Grade Mathematics

Deleted Items
ALL COUNTRIES
M062345B, M04_12B (poor discrimination)
M062345BA, M04_12BA (poor discrimination)
M062345BB, M04_12BB (poor discrimination)
M062345BC, M04_12BC (poor discrimination)
M062345BD, M04_12BD (poor discrimination)
M062342, M10_07 (poor discrimination)
M062048, M14_12 (poor discrimination)
M062048A, M14_12A (poor discrimination)
M062048B, M14_12B (poor discrimination)
M062048C, M14_12C (poor discrimination)
KAZAKHSTAN
M062106, M02_12 (negative discrimination)
KUWAIT
M062271, M12_01 (translation error)
LITHUANIA
M052125, M13_03 (Russian only; translation error)
MOROCCO
M052090, M06_07 (negative discrimination)

TIMSS Eighth Grade Mathematics

Deleted Items (Continued)

SWEDEN

M062237, M02_04 (transcription error)

M052090, M06_07 (transcription error)

Constructed Response Items with Category Recodes

ALL COUNTRIES

M042302C, M01_06C (recode 11 to 71)

M042229B, M05_10B (recode 11 to 71)

M052095, M06_04 (recode 20 to 10 and 10 to 70)

M062254, M08_13 (recode 20 to 10)

M052087, M11_08 (recode 20 to 10 and 10 to 70)

TIMSS Eighth Grade Science

Deleted Items

ALL COUNTRIES

S042401, S01_13 (faulty distracters)

S062189C, S02_01C (poor discrimination)

S062272, S08_12 (poor discrimination)

S052221, S09_11 (poor discrimination)

S062036, S12_12 (attractive distracter)

S062242C, S12_15C (poor discrimination)

S062266, S14_05 (attractive distracter)

BOTSWANA

S062032, S10_05 (negative discrimination)

S052134, S13_06 (negative discrimination)

JORDAN

S052134, S13_06 (negative discrimination)

KAZAKHSTAN

S062090, S10_01 (negative discrimination)

KUWAIT

S052134, S13_06 (negative discrimination)

LITHUANIA

S062190, S04_13 (Polish only; translation error)

MOROCCO

S052134, S13_06 (negative discrimination)

SAUDI ARABIA

S062225, S08_04 (not administered)

TIMSS Eighth Grade Science
Deleted Items (Continued)
SOUTH AFRICA
S062032, S10_05 (negative discrimination)
THAILAND
S052141, S06_12 (translation error)

Appendix 11E: Derived Items in TIMSS 2015

TIMSS Fourth Grade Mathematics

M051061Z, M06_08 – Item parts A, B, and C are combined to create a 1-point item, where 1 score point is awarded if all parts are correct

M061018, M10_01 – Item parts A, B, C, and D are combined to create a 1-point item, where 1 score point is awarded if all parts are correct

M061240, M14_01 – Item parts A, B, and C are combined to create a 1-point item, where 1 score point is awarded if all parts are correct

TIMSS Numeracy

MN11042, N01_10 – Item parts B, C, D, and E are combined to create a 1-point item, where 1 score point is awarded if all parts are correct (part A is an example)

TIMSS Fourth Grade Science

S041149Z, S01_10 – Item parts A and B are combined to create a 2-point item, where 2 score points are awarded if both parts A and B are correct, 1 score point is awarded if either part A or part B is correct, and 0 score points are awarded if both parts A and B are incorrect

S051026Z, S03_05 – Item parts A, B, C, and D are combined to create a 1-point item, where 1 score point is awarded if all parts are correct

S051121Z, S03_08 – Item parts A, B, C, D, and E are combined to create a 1-point item, where 1 score point is awarded if all parts are correct

S051188Z, S06_08 – Item parts A, B, C, D, and E are combined to create a 1-point item, where 1 score point is awarded if all parts are correct

S061083, S10_06 – Item parts B, C, and D are combined to create a 1-point item, where 1 score point is awarded if all parts are correct (part A is an example)

S061142A, S10_09 – Item parts A, B, and C are combined to create a 1-point item, where 1 score point is awarded if all parts are correct

S051138Z, S11_03 – Item parts A and B are combined to create a 1-point item, where 1 score point is awarded if both parts are correct (part C was deleted)

S061124, S14_11 – Item parts B, C, D, and E are combined to create a 1-point item, where 1 score point is awarded if all parts are correct (part A is an example)

S061116, S14_12 – Item parts B, C, D, and E are combined to create a 1-point item, where 1 score point is awarded if all parts are correct (part A is an example)

TIMSS Eighth Grade Mathematics

M062208, M02_01 – Item parts A, B, C, and D are combined to create a 1-point item, where 1 score point is awarded if all parts are correct
M042229Z, M05_10 – Item parts A and B are combined to create a 2-point item, where 2 score points are awarded if both parts A and B are correct, 1 score point is awarded if only part A or only part B is correct, and 0 score points are awarded if both parts A and B are incorrect

TIMSS Eighth Grade Science

S062189, S02_01 – Item parts A, B, D, and E are combined to create a 2-point item, where 2 score points are awarded if all parts are correct, 1 score point is awarded if 3 parts are correct, and 0 score points are awarded if 2 or fewer parts are correct (part C was deleted)
S062010, S02_05 – Item parts A, B, C, and D are combined to create a 1-point item, where 1 score point is awarded if all parts are correct
S052092Z, S03_02 – Item parts A, B, C, and D were combined to create a 2-point item, where 2 score points are awarded if all parts are correct, 1 score point is awarded if 2 or 3 parts are correct, and 0 score points are awarded if 1 or 0 parts are correct
S052043Z, S03_07 – Item parts A, B, C, and D are combined to create a 1-point item, where 1 score point is awarded if all parts are correct
S062018, S04_08 – Item parts A, B, C, D, and E are combined to create a 2-point item, where 2 points are awarded if all parts are correct, 1 point is awarded if 4 parts are correct, and 0 score points are awarded if 3 or fewer parts are correct
S062173A, S10_13 – Item parts A, B, C, and D are combined to create a 1-point item, where 1 score point is awarded if all parts are correct
S052015Z, S11_05 – Item parts A, B, C, D, E, and F are combined to create a 1-point item, where 1 score point is awarded if all parts are correct
S062242, S12_15 – Item parts A, B, D, and E are combined to create a 1-point item, where 1 score point is awarded if all parts are correct (part C was deleted)
S052095Z, S13_05 – Item parts B, C, and D are combined to create a 1-point item, where 1 score point is awarded if all parts are correct (part A is an example)
S062047, S14_07 – Item parts A, B, and C are combined to create a 1-point item, where 1 score point is awarded if all parts are correct
S062022, S14_14 – Item parts A, B, C, and D are combined to create a 1-point item, where 1 score point is awarded if all parts are correct

CHAPTER 12

TIMSS 2015 Achievement Scaling Methodology[1]

The TIMSS approach to scaling the achievement data, based on item response theory (IRT) scaling with marginal estimation, was developed originally by Educational Testing Service for use in the U.S. National Assessment of Educational Progress (NAEP). It is based on psychometric models that were first used in the field of educational measurement in the 1950s and have become popular since the 1970s for use in large-scale surveys, test construction, and computer adaptive testing.[2]

Three distinct IRT models, depending on item type and scoring procedure, were used in the analysis of the TIMSS 2015 assessment data. Each is a "latent variable" model that describes the probability that a student will respond in a specific way to an item in terms of the student's proficiency, which is an unobserved or "latent" trait, and various characteristics (or "parameters") of the item. A three-parameter model was used with multiple-choice items, which were scored as correct or incorrect, and a two-parameter model for constructed response items with just two response options, which also were scored as correct or incorrect. Since each of these item types has just two response categories, they are known as dichotomous items. A partial credit model was used with polytomous constructed response items, i.e., those with more than two response options.

Two- and Three-Parameter IRT Models for Dichotomous Items

The fundamental equation of the three-parameter (3PL) model gives the probability that a student whose proficiency on a scale k is characterized by the unobservable variable θ_k will respond correctly to item i as:

$$P\left(x_i=1\middle|\,\theta_k,a_i,b_i,c_i\right)=c_i+\frac{1-c_i}{1+\exp\left(-1.7\cdot a_i\cdot(\theta_k-b_i)\right)}\equiv P_{i,1}\left(\theta_k\right) \qquad (1)$$

1 This description of the TIMSS achievement scaling methodology has been adapted with permission from the TIMSS 1999 Technical Report (Yamamoto and Kulick, 2000).

2 For a description of IRT scaling see Birnbaum (1968); Lord and Novick (1968); Lord (1980); Van Der Linden and Hambleton (1996). The theoretical underpinning of the multiple imputation methodology was developed by Rubin (1987), applied to large-scale assessment by Mislevy (1991), and studied further by Mislevy, Johnson and Muraki (1992) and Beaton and Johnson (1992). For a recent overview, see von Davier and Sinharay (2014) and von Davier (2014). The procedures used in TIMSS have been used in several other large-scale surveys, including the U.S. National Assessment of Educational Progress (NAEP), the U.S. National Adult Literacy Survey (NALS), the International Adult Literacy Survey (IALS), and the International Adult Literacy and Life Skills Survey (IALLS).

where

x_i is the response to item i, 1 if correct and 0 if incorrect;

θ_k is the proficiency of a student on a scale k (note that a student with higher proficiency has a greater probability of responding correctly);

a_i is the slope parameter of item i, characterizing its discriminating power;

b_i is the location parameter of item i, characterizing its difficulty;

c_i is the lower asymptote parameter of item i, reflecting the chances of students with very low proficiency selecting the correct answer.

The probability of an incorrect response to the item is defined as:

$$P_{i,0} = P\left(x_i = 0 \,\middle|\, \theta_k, a_i, b_i, c_i\right) = 1 - P_{i,1}\left(\theta_k\right) \tag{2}$$

The two-parameter (2PL) model was used for the constructed response items that were scored as either correct or incorrect. The form of the 2PL model is the same as Equations (1) and (2) with the c_i parameter fixed at zero.

IRT Model for Polytomous Items

In TIMSS, constructed response items requiring an extended response were scored for partial credit, with 0, 1, and 2 as the possible score levels. These polytomous items were scaled using a generalized partial credit model (Muraki, 1992). The fundamental equation of this model gives the probability that a student with proficiency θ_k on scale k will have, for the i^{th} item, a response x_i that is scored in the l^{th} of m_i ordered score categories as:

$$P\left(x_i = l \,\middle|\, \theta_k, a_i, b_i, d_{i,1}, \cdots, d_{i,m_i-1}\right) = \frac{\exp\left(\sum_{v=0}^{l} 1.7 \cdot a_i \cdot \left(\theta_k - b_i + d_{i,v}\right)\right)}{\sum_{g=0}^{m_i-1} \exp\left(\sum_{v=0}^{g} 1.7 \cdot a_i \cdot \left(\theta_k - b_i + d_{i,v}\right)\right)} = P_{i,l}\left(\theta_k\right) \tag{3}$$

where

m_i is the number of response categories for item i, usually 3;

x_i is the response to item i, ranging between 0 and $m_i - 1$;

θ_k is the proficiency of a student on a scale k;

a_i is the slope parameter of item i;

b_i is its location parameter, characterizing its difficulty;

$d_{i,l}$ is the category l threshold parameter.

The indeterminacy of model parameters in the polytomous model is resolved by setting $d_{i,0} = 0$ and $\sum_{j=1}^{m_i-1} d_{i,j} = 0$.

For all of the IRT models there is a linear indeterminacy between the values of item parameters and proficiency parameters, i.e., mathematically equivalent but different values of item parameters can be estimated on an arbitrarily linearly transformed proficiency scale. This linear indeterminacy can be resolved by setting the origin and unit size of the proficiency scale to arbitrary constants, such as a mean of 500 and a standard deviation of 100, as was done originally for TIMSS in 1995. The indeterminacy is most apparent when the scale is set for the first time.

IRT modeling relies on a number of assumptions, the most important being conditional independence. Under this assumption, item response probabilities depend only on θ_k (a measure of a student's proficiency) and the specified parameters of the item, and are unaffected by the demographic characteristics or unique experiences of the students, the data collection conditions, or the other items presented in the test. Under this assumption, the joint probability of a particular response pattern x across a set of n items is given by:

$$P\left(x \middle| \theta_k, \textit{item parameters}\right) = \prod_{i=1}^{n} \prod_{l=0}^{m_i - 1} P_{i,l}\left(\theta_k\right)^{u_{i,l}} \tag{4}$$

where $P_{i,l}(\theta_k)$ is of the form appropriate to the type of item (dichotomous or polytomous), m_i is equal to 2 for dichotomously scored items, and $u_{i,l}$ is an indicator variable defined as:

$$u_{i,l} = \begin{cases} 1 \textit{ if response is } x_i \textit{ is in category } l; \\ 0 \textit{ otherwise} \end{cases} \tag{5}$$

Replacing the hypothetical response pattern with the real scored data, the above function can be viewed as a likelihood function to be maximized by a given set of item parameters. In TIMSS, the item parameters for each scale are estimated independently of the parameters of other scales. Once items were calibrated in this manner, a likelihood function for the proficiency θ_k was induced from student responses to the calibrated items. This likelihood function for the proficiency θ_k is called the posterior distribution of the θ's for each student.

Proficiency Estimation Using Plausible Values

Most cognitive skills testing is concerned with accurately assessing the performance of individual students for the purposes of diagnosis, selection, or placement. Regardless of the measurement model used, whether classical test theory or item response theory, the accuracy of these measurements can be improved—that is, the amount of measurement error can be reduced—by increasing the number of items given to the individual. Thus, it is common to see achievement tests designed to provide information on individual students that contain more than 70 items. Since the uncertainty associated with each θ in such tests is negligible, the distribution of θ, or the joint distribution of θ with other variables, can be approximated using each individual's estimated θ.

For the distribution of proficiencies in large populations, however, more efficient estimates can be obtained from a matrix-sampling design like that used in TIMSS. This design solicits relatively few responses from each sampled student while maintaining a wide range of content representation when responses are aggregated across all students. With this approach, however, the advantage of estimating population characteristics more efficiently is offset by the inability to make precise statements about individuals. Indeed, the uncertainty associated with individual θ estimates becomes too large to be ignored. In this situation, aggregations of individual student scores can lead to seriously biased estimates of population characteristics (Wingersky, Kaplan, & Beaton, 1987).

Plausible values methodology was developed as a way to address this issue. Instead of first computing estimates of individual θ's and then aggregating these to estimate population parameters, the plausible values approach uses all available data, students' responses to the items they were administered together with all background data, to estimate directly the characteristics of student populations and subpopulations. Although these directly estimated population characteristics could be used for reporting purposes, instead the usual plausible values approach is to generate multiple imputed scores, called plausible values, from the estimated ability distributions and to use these in analyses and reporting, making use of standard statistical software. By including all available background data in the model, a process known as "conditioning", relationships between these background variables and the estimated proficiencies will be appropriately accounted for in the plausible values. Because of this, analyses conducted using plausible values will provide an accurate representation of these underlying relationships. A detailed review of the plausible values methodology is given in Mislevy (1991).[3]

The following is a brief overview of the plausible values approach. Let y represent the responses of all sampled students to background questions or background data of sampled students collected from other sources, and let θ represent the proficiency of interest. If θ were known for all sampled students, it would be possible to compute a statistic $t(\theta,y)$, such as a sample mean or sample percentile point, to estimate a corresponding population quantity T.

Because of the latent nature of the proficiency, however, θ values are not known even for sampled students. The solution to this problem is to follow Rubin (1987) by considering θ as "missing data" and approximate $t(\theta,y)$ by its expectation given (x,y), the data that actually were observed, as follows:

$$\begin{aligned} t^*(x,y) &= E\left[\, t(\underline{\theta},\underline{y}) \,|\, \underline{x},\underline{y} \,\right] \\ &= \int t(\underline{\theta},\underline{y})\, p(\underline{\theta} \,|\, \underline{x},\underline{y})\, d\underline{\theta} \end{aligned} \tag{6}$$

3 Along with theoretical justifications, Mislevy presents comparisons with standard procedures; discusses biases that arise in some secondary analyses; and offers numerical examples.

It is possible to approximate t^* using random draws from the conditional distribution of the scale proficiencies given the student's item responses x_j, the student's background variables y_j, and model parameters for the items. These values are referred to as imputations in the sampling literature, and as plausible values in large-scale surveys such as PIRLS, TIMSS, NAEP, NALS, and IALLS. The value of θ for any student that would enter into the computation of t is thus replaced by a randomly selected value from his or her conditional distribution. Rubin (1987) proposed repeating this process several times so that the uncertainly associated with imputation can be quantified. For example, the average of multiple estimates of t, each computed from a different set of plausible values, is a numerical approximation of t^* of the above equation; the variance among them reflects the uncertainty due to not observing $\underline{\theta}$. It should be noted that this variance does not include the variability of sampling from the population. That variability is estimated separately by a jackknife variance estimation procedure.

Plausible values are not intended to be estimates of individual student scores, but rather are imputed scores for like students—students with similar response patterns and background characteristics in the sampled population—that may be used to estimate population characteristics correctly. When the underlying model is correctly specified, plausible values will provide consistent estimates of population characteristics, even though they are generally biased estimates of the proficiencies of the individuals with whom they are associated. Taking the average of the plausible values still will not yield suitable estimates of individual student scores.[4]

Plausible values for each student j are drawn from the conditional distribution $P\left(\theta_j \middle| x_j, y_j, \Gamma, \Sigma\right)$, where Γ is a matrix of regression coefficients for the background variables, and Σ is a common variance matrix of residuals. Using standard rules of probability, the conditional probability of proficiency can be represented as:

$$P\left(\theta_j \middle| x_j, y_j, \Gamma, \Sigma\right) \propto P\left(x_j \middle| \theta_j, y_j, \Gamma, \Sigma\right) P\left(\theta_j \middle| y_j, \Gamma, \Sigma\right) = P\left(x_j \middle| \theta_j\right) P\left(\theta_j \middle| y_j, \Gamma, \Sigma\right) \qquad (7)$$

where θ_j is a vector of scale values, $P(x_j|\theta_j)$ is the product over the scales of the independent likelihoods induced by responses to items within each scale, and $P(\theta_j|y_j, \Gamma, \Sigma)$ is the multivariate joint density of proficiencies for the scales, conditional on the observed values y_j of background responses and parameters Γ and Σ. Item parameter estimates are fixed and regarded as population values in the computations described in this section.

4 For further discussion, see Mislevy, Beaton, Kaplan, and Sheehan (1992).

Conditioning

A multivariate normal distribution was assumed for $P(\theta_j|y_j, \Gamma, \Sigma)$, with a common variance Σ, and with a mean given by a linear model with regression parameters Γ. Since in large-scale studies like TIMSS there are many hundreds of background variables, it is customary to conduct a principal components analysis to reduce the number of variables to be used in Γ. Typically, components accounting for 90 percent of the variance in the data are selected. These principal components are referred to as the conditioning variables and denoted as y^c. The following model is then fit to the data:

$$\theta = \Gamma' y^c + \varepsilon \tag{8}$$

where ε is normally distributed with mean zero and variance Σ. As in a regression analysis, Γ is a matrix each of whose columns is the effects for each scale and Σ is the matrix of residual variance between scales.

Note that in order to be strictly correct for all functions Γ of θ, it is necessary that $P(\theta|y)$ be correctly specified for all background variables in the survey. Estimates of functions Γ involving background variables not conditioned in this manner are subject to estimation error due to misspecification. The nature of these errors is discussed in detail in Mislevy (1991). In TIMSS, however, the principal components account for almost all of the variance in the student background variables, so that the computation of marginal means and percentile points of θ for these variables is nearly optimal.

The basic method for estimating Γ and Σ with the Expectation and Maximization (EM) procedure is described in Mislevy (1985) for a single scale case. The EM algorithm requires the computation of the mean θ, and variance Σ, of the posterior distribution in Equation (7).

Generating Proficiency Scores

After completing the EM algorithm, plausible values for all sampled students are drawn from the joint distribution of the values of Γ in a three-step process. First, a value of Γ is drawn from a normal approximation to $P(\Gamma,\Sigma\,|x_j, y_j)$ that fixes Σ at the value $\hat{\Sigma}$ (Thomas, 1993). Second, conditional on the generated value of Γ (and the fixed value of $\Sigma=\hat{\Sigma}$), the mean θ_j and variance Σ_j^p of the posterior distribution in Equation (7), where p is the number of scales, are computed using the methods applied in the EM algorithm. In the third step, the proficiency values are drawn independently from a multivariate normal distribution with mean θ_j and variance Σ_j^p. These three steps are repeated five times, producing five imputations of θ_j for each sampled student.

For students with an insufficient number of responses, the Γ's and Σ's described in the previous paragraph are fixed. Hence, all students—regardless of the number of items attempted—are assigned a set of plausible values.

The plausible values can then be employed to evaluate Equation (6) for an arbitrary function T as follows:

- Using the first vector of plausible values for each student, evaluate T as if the plausible values were the true values of θ. Denote the result as T_1
- Evaluate the sampling variance of T_1, or Var_1, with respect to students' first vector of plausible values
- Carry out steps 1 and 2 for the second through fifth vectors of plausible values, thus obtaining T_u and Var_u, for $u = 2, \ldots, 5$
- The best estimate of T obtainable from the plausible values is the average of the five values obtained from the different sets of plausible values:

$$\hat{T} = \frac{\sum_u T_u}{5} \tag{9}$$

- An estimate of the variance of $\hat{T}$ is the sum of two components: an estimate of Var_u obtained by averaging as in the previous step, and the variance among the T_u's

Let $\overline{U} = \frac{\sum_u Var_u}{M}$, and let $B_M = \frac{\sum_u (T_u - \hat{T})^2}{M-1}$ be the variance among the M plausible values

Then the estimate of the total variance of $\hat{T}$ is:

$$Var(\hat{T}) = \overline{U} + (1 + M^{-1}) B_M \tag{10}$$

The first component in $Var(\hat{T})$ reflects the uncertainty due to sampling students from the population; the second reflects the uncertainty due to the fact that sampled students' θ's are not known precisely, but only indirectly through x and y.

Working with Plausible Values

The plausible values methodology is used in TIMSS to ensure the accuracy of estimates of the proficiency distributions for the TIMSS populations as a whole and particularly for comparisons between subpopulations. A further advantage of this method is that the variation between the five plausible values generated for each student reflects the uncertainty associated with proficiency estimates for individual students. However, retaining this component of uncertainty requires that additional analytical procedures be used to estimate students' proficiencies.

If the θ values were observed for all sampled students, the statistic $(t-T)/U^{\frac{1}{2}}$ would follow a t-distribution with d degrees of freedom. Then the incomplete-data statistic $(T-\hat{T})/\left[Var(\hat{T})\right]^{\frac{1}{2}}$ is approximately t-distributed, with degrees of freedom (Johnson & Rust, 1993) given by:

$$v = \frac{1}{\frac{f_M^{\ 2}}{M-1} + \frac{(1-f_M)^2}{d}} \tag{11}$$

where d is the degrees of freedom for the complete-data statistic, and f_M is the proportion of total variance due to not observing the values:

$$f_M = \frac{(1+M^{-1})\, B_M}{Var(\hat{T})} \tag{12}$$

When B_M is small relative to $\overline{U}$, the reference distribution for the incomplete-data statistic differs little from the reference distribution for the corresponding complete-data statistic. If, in addition, d is large, the normal approximation can be used instead of the t-distribution.

For a k-dimensional function T, such as the k coefficients in a multiple regression analysis, each U and $\overline{U}$ is a covariance matrix, and B_M is an average of squares and cross-products rather than simply an average of squares. In this case, the quantity $(\underline{T}-\underline{\hat{T}})\ Var^{-1}(\underline{\hat{T}})\ (\underline{T}-\underline{\hat{T}})'$ is approximately F-distributed with degrees of freedom equal to k and v, with v defined as above but with a matrix generalization of f_M:

$$f_M = (1+M^{-1})\ \text{Trace}\left[B_M\ Var^{-1}(\hat{T})\right]/k \tag{13}$$

For the same reason that the normal distribution can approximate the t-distribution, a chi-square distribution with k degrees of freedom can be used in place of the F-distribution for evaluating the significance of the above quantity $(\underline{T}-\underline{\hat{T}})\ Var^{-1}(\underline{\hat{T}})\ (\underline{T}-\underline{\hat{T}})'$.

Statistics $\hat{T}$, the estimates of proficiency conditional on responses to cognitive items and background variables, are consistent estimates of the corresponding population values T, as long as background variables are included in the conditioning variables. The consequences of violating this restriction are described by Beaton and Johnson (1992), Mislevy (1991), and Mislevy and Sheehan (1987). To avoid such biases, the TIMSS analyses include nearly all student background variables, in the form of principal components, as well as the class means to preserve between-class differences—the between-classroom and within-classroom variance structure essential for hierarchical modeling.

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CHAPTER 13

Scaling the TIMSS 2015 Achievement Data

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Overview

The TIMSS assessments cover a wide range of topics in mathematics and science across two grade levels. Given this broad coverage, a matrix-sampling booklet design is used such that each student is administered only a subset of the entire TIMSS mathematics and science item pools (see Chapter 4 of *TIMSS 2015 Assessment Frameworks*). Given the complexities of the data collection and the need to have student scores on the entirety of each assessment for analysis and reporting purposes, TIMSS relies on item response theory (IRT) scaling to describe student achievement and to provide accurate measures of trends. As each student responded to only a part of the assessment item pool, the TIMSS scaling approach uses multiple imputation—or plausible values—methodology to obtain proficiency scores in mathematics and science for all students. To enhance the reliability of the student scores, the TIMSS scaling approach uses conditioning, a process in which student responses to the items are combined with information about students' backgrounds.

This scaling chapter begins with a general description of the scaling approach and its use of plausible values. It then describes the concurrent calibration method used specifically to measure trends. Next, it explains how the proficiency scores are generated through the use of conditioning and describes the process of transforming the proficiency scores to place them on the metrics used to measure trends. A special section describes how the TIMSS Numeracy 2015 achievement data were scaled and placed on the TIMSS fourth grade mathematics reporting scale. A description of the technical details involved in the scaling can be found in Chapter 12: TIMSS 2015 Achievement Scaling Methodology.

Implementing the TIMSS Scaling Procedures

The application of IRT scaling and plausible values methodology to the data from the TIMSS assessments involves four major tasks: calibrating the achievement items (estimating model parameters for each item), creating principal components from the student questionnaire data for use in conditioning, generating proficiency scores for mathematics and science, and placing these proficiency scores on the metrics used to report trend results from previous assessments. TIMSS has separate scales for mathematics and science at both fourth and eighth grades. New for TIMSS 2015, the TIMSS Numeracy achievement results will be reported on the TIMSS fourth grade mathematics scale. The scaling procedures also generate proficiency scores for the domains of the overall subjects: the content and cognitive domains of mathematics and science.

Linking Assessments Cycles with Concurrent Calibration

The metric of the TIMSS reporting scales for overall mathematics and science at each grade level were originally established in TIMSS 1995 by setting the mean of the national average scores for all countries that participated in TIMSS 1995 to 500 and the standard deviation to 100. To enable measurement of trends over time, achievement data from successive TIMSS assessments were transformed to these same metrics. This is done by concurrently scaling the data from each successive assessment with the data from the previous assessment—a process known as concurrent calibration—and applying linear transformations to place the results from each successive assessment on the same scale as the results from the previous assessment. This procedure enables TIMSS to measure trends across all six assessment cycles: 1995, 1999, 2003, 2007, 2011, and 2015.[1]

The first step in linking the assessments for trend scaling is to estimate (calibrate) the item parameters for the items in the current assessment through a concurrent calibration of the data from the current assessment and from the previous assessment. In 2015, the TIMSS concurrent calibration consisted of combining achievement data from the 2015 and 2011 assessments.

In linking successive assessments, concurrent calibration relies on having a large proportion of trend items, items that are retained from one assessment to the next. The TIMSS assessment consists of 14 mathematics item blocks and 14 science item blocks at each grade. In TIMSS 2015, 6 of the mathematics blocks and 6 of the science blocks consisted of newly developed items. The remaining 8 mathematics blocks and 8 science blocks were carried forward from the TIMSS 2011 assessment and are the basis for linking TIMSS 2015 to the TIMSS achievement scale and maintaining trends over time. Exhibits 13.1 through 13.4 list the number of items present for TIMSS concurrent calibration by item type and content and cognitive domain for both grades and subjects, respectively.

1 See Mazzeo and von Davier (2014) for a discussion of the linking procedure used by TIMSS.

Exhibit 13.1: TIMSS 2015 Mathematics Items for Concurrent Calibration at the Fourth Grade

Item Type	Points	Items Released in 2011		Items Common in 2011 and 2015		Items Introduced in 2015		Total	
		Items	Points	Items	Points	Items	Points	Items	Points
Multiple-Choice	1	36	36	57	57	30	30	123	123
Constructed Response	1	31	31	42	42	31	31	104	104
	2	6	12	3	6	6	12	15	30
Total		**73**	**79**	**102**	**105**	**67**	**73**	**242**	**257**

TIMSS 2015 Fourth Grade Mathematics Items for Concurrent Calibration by Content and Cognitive Domains

Mathematics Content Domains	Items Released in 2011		Items Common in 2011 and 2015		Items Introduced in 2015		Total	
	Items	Points	Items	Points	Items	Points	Items	Points
Number	40	43	48	49	41	45	129	137
Geometric Shapes and Measures	24	27	37	38	19	21	80	86
Data Display	9	9	17	18	7	7	33	34
Mathematics Cognitive Domains	**Items Released in 2011**		**Items Common in 2011 and 2015**		**Items Introduced in 2015**		**Total**	
	Items	Points	Items	Points	Items	Points	Items	Points
Knowing	29	32	41	41	23	24	93	97
Applying	29	30	42	44	30	32	101	106
Reasoning	15	17	19	20	14	17	48	54
Total	**73**	**79**	**102**	**105**	**67**	**73**	**242**	**257**

Exhibit 13.2: TIMSS 2015 Science Items for Concurrent Calibration at the Fourth Grade

Item Type	Points	Items Released in 2011		Items Common in 2011 and 2015		Items Introduced in 2015		Total	
		Items	Points	Items	Points	Items	Points	Items	Points
Multiple-Choice	1	42	42	47	47	35	35	124	124
Constructed Response	1	25	25	40	40	34	34	99	99
	2	5	10	8	16	4	8	17	34
Total		**72**	**77**	**95**	**103**	**73**	**77**	**240**	**257**

TIMSS 2015 Fourth Grade Science Items for Concurrent Calibration by Content and Cognitive Domains

Science Content Domains	Items Released in 2011		Items Common in 2011 and 2015		Items Introduced in 2015		Total	
	Items	Points	Items	Points	Items	Points	Items	Points
Life Science	30	32	44	49	30	33	104	114
Physical Science	28	29	32	32	29	30	89	91
Earth Science	14	16	19	22	14	14	47	52
Science Cognitive Domains	**Items Released in 2011**		**Items Common in 2011 and 2015**		**Items Introduced in 2015**		**Total**	
	Items	Points	Items	Points	Items	Points	Items	Points
Knowing	30	34	38	41	29	32	97	107
Applying	31	32	39	42	27	28	97	102
Reasoning	11	11	18	20	17	17	46	48
Total	**72**	**77**	**95**	**103**	**73**	**77**	**240**	**257**

Exhibit 13.3: TIMSS 2015 Mathematics Items for Concurrent Calibration at the Eighth Grade

Item Type	Points	Items Released in 2011		Items Common in 2011 and 2015		Items Introduced in 2015		Total	
		Items	Points	Items	Points	Items	Points	Items	Points
Multiple-Choice	1	48	48	70	70	41	41	159	159
Constructed Response	1	30	30	52	52	34	34	116	116
	2	10	20	5	10	7	14	22	44
Total		**88**	**98**	**127**	**132**	**82**	**89**	**297**	**319**

TIMSS 2015 Eighth Grade Mathematics Items for Concurrent Calibration by Content and Cognitive Domains

Mathematics Content Domains	Items Released in 2011		Items Common in 2011 and 2015		Items Introduced in 2015		Total	
	Items	Points	Items	Points	Items	Points	Items	Points
Number	20	21	40	44	24	25	84	90
Algebra	30	35	40	41	21	22	91	98
Geometry	20	22	22	22	21	25	63	69
Data and Chance	18	20	25	25	16	17	59	62
Mathematics Cognitive Domains	**Items Released in 2011**		**Items Common in 2011 and 2015**		**Items Introduced in 2015**		**Total**	
	Items	Points	Items	Points	Items	Points	Items	Points
Knowing	34	36	45	45	24	24	103	105
Applying	30	34	54	57	40	44	124	135
Reasoning	24	28	28	30	18	21	70	79
Total	**88**	**98**	**127**	**132**	**82**	**89**	**297**	**319**

Exhibit 13.4: TIMSS 2015 Science Items for Concurrent Calibration at the Eighth Grade

Item Type	Points	Items Released in 2011		Items Common in 2011 and 2015		Items Introduced in 2015		Total	
		Items	Points	Items	Points	Items	Points	Items	Points
Multiple-Choice	1	46	46	63	63	43	43	152	152
Constructed Response	1	33	33	57	57	34	34	124	124
	2	11	22	6	12	12	24	29	58
Total		**90**	**101**	**126**	**132**	**89**	**101**	**305**	**334**

TIMSS 2015 Eighth Grade Science Items for Concurrent Calibration by Content and Cognitive Domains

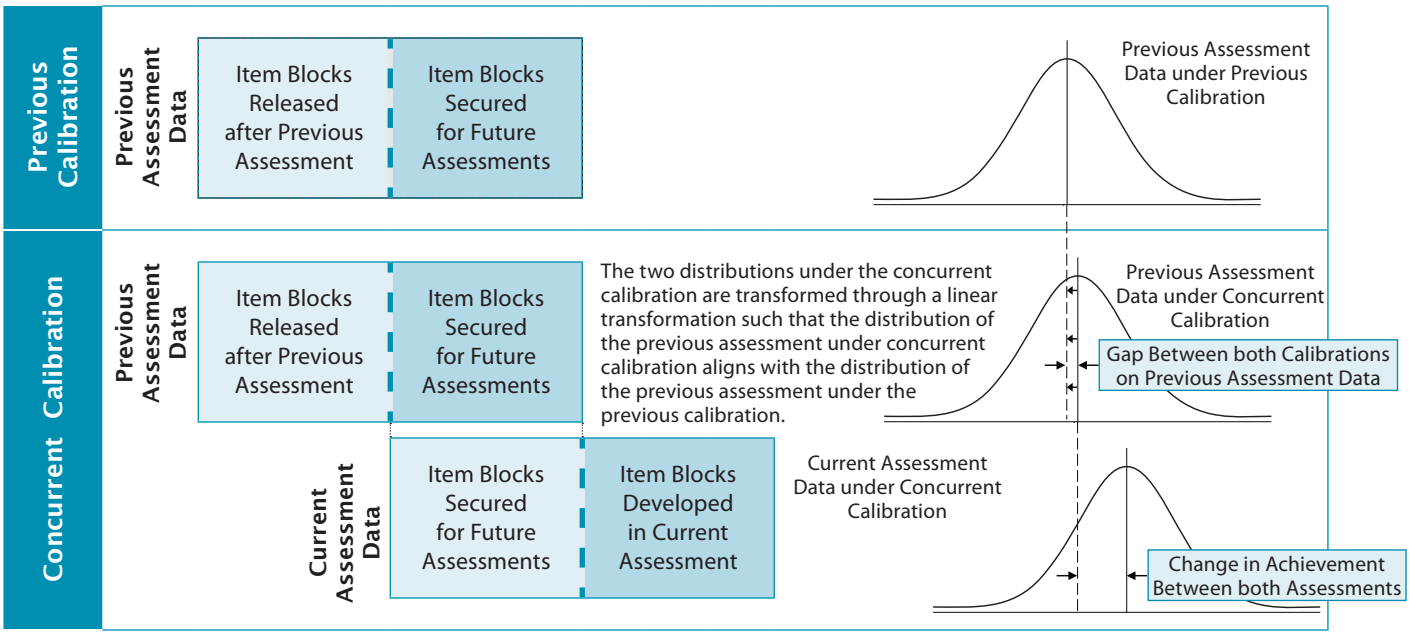
Science Content Domains	Items Released in 2011		Items Common in 2011 and 2015		Items Introduced in 2015		Total	
	Items	Points	Items	Points	Items	Points	Items	Points
Biology	32	36	47	51	28	36	107	123
Chemistry	18	20	25	26	18	19	61	65
Physics	24	27	31	31	22	22	77	80
Earth Science	16	18	23	24	21	24	60	66
Science Cognitive Domains	**Items Released in 2011**		**Items Common in 2011 and 2015**		**Items Introduced in 2015**		**Total**	
	Items	Points	Items	Points	Items	Points	Items	Points
Knowing	33	35	40	41	35	42	108	118
Applying	35	43	56	59	32	35	123	137
Reasoning	22	23	30	32	22	24	74	79
Total	**90**	**101**	**126**	**132**	**89**	**101**	**305**	**334**

In concurrent calibration, item parameters for the current assessment are estimated based on the data from both the current and previous assessments, recognizing that some items (the trend items) are common to both. It is then possible to estimate the latent ability distributions of students in both assessments using the item parameters from the concurrent calibration. The difference between these two distributions is the change in achievement between the previous and current assessments.

After the calibration, the next step is to find a linear transformation that transforms the distribution of the previous assessment data under the concurrent calibration to match the distribution of these same data under the calibration that was done in the previous assessment. The final step entails applying this linear transformation to the current assessment data scaled using the concurrent calibration. This places the current assessment data on the trend scale.

Exhibit 13.5 illustrates how the concurrent calibration approach is applied in the context of TIMSS trend scaling. The gap between the distributions of the previous assessment data under the previous calibration and under the concurrent calibration is typically small and is the result of slight differences in the item parameter estimates from the two calibrations (Exhibit 13.5, second panel). The linear transformation removes this gap by shifting the two distributions from the concurrent calibration such that the distribution of the previous assessment data from the concurrent calibration aligns with the distribution of the previous assessment data from the previous calibration,[2] while preserving the gap between the previous and current assessment data under the concurrent calibration. This latter gap is the change in achievement between the previous and current assessments that TIMSS sets out to measure as trend.

Exhibit 13.5: Concurrent Calibration Model Used for TIMSS



Calibrating the TIMSS 2015 Assessment Data

Item calibration was conducted by the TIMSS & PIRLS International Study Center using the commercially-available Parscale software (Muraki & Bock, 1991) and included data from the previous assessment (TIMSS 2011) and data from the 2015 assessment for countries that participated in both assessment cycles. The calibration used all available item response data from each country's student samples and from both current and previous assessments. All student samples were weighted so that each country contributed equally to the item calibration. Exhibits 13.6 and 13.7 show the sample sizes for scaling the TIMSS 2015 data. A total of 41

2 The difference between the ability distributions of the previous assessment data under the two calibrations is a measure of the linkage error in the trend scaling procedure.

countries from TIMSS 2015 contributed to the concurrent calibration at the fourth grade; 34 countries contributed at the eighth grade. Norway's data at the fourth and eighth grades were included in the concurrent calibrations.

Exhibit 13.6: TIMSS 2015 Sample Sizes for Scaling the Fourth Grade Data

Country	Concurrent Calibration		Proficiency Estimation	
	2015	2011	2015	2011
Australia	6,057	6,146	6,057	6,146
Bahrain	4,146	4,083	4,146	4,083
Belgium (Flemish)	5,404	4,849	5,404	4,849
Bulgaria	—	—	4,228	—
Canada	—	—	12,283	—
Chile	4,756	5,585	4,756	5,585
Chinese Taipei	4,291	4,284	4,291	4,284
Croatia	3,985	4,584	3,985	4,584
Cyprus	—	—	4,125	—
Czech Republic	5,202	4,578	5,202	4,578
Denmark	3,710	3,987	3,710	3,987
England	4,006	3,397	4,006	3,397
Finland	5,015	4,638	5,015	4,638
France	—	—	4,873	—
Georgia	3,919	4,799	3,919	4,799
Germany	3,948	3,995	3,948	3,995
Hong Kong SAR	3,600	3,957	3,600	3,957
Hungary	5,036	5,204	5,036	5,204
Indonesia	—	—	4,025	—
Iran, Islamic Rep. of	3,823	5,760	3,823	5,760
Ireland	4,344	4,560	4,344	4,560
Italy	4,373	4,200	4,373	4,200
Japan	4,383	4,411	4,383	4,411
Kazakhstan	4,702	4,382	4,702	4,382
Korea, Rep. of	4,669	4,334	4,669	4,334
Kuwait	2,397	4,142	3,593	4,142
Lithuania	2,837	4,688	4,529	4,688
Morocco	5,068	7,841	5,068	7,841
Netherlands	4,515	3,229	4,515	3,229
New Zealand	6,322	5,572	6,322	5,572

Exhibit 13.6 TIMSS 2015 Sample Sizes for Scaling the Fourth Grade Data (Continued)

Country	Concurrent Calibration		Proficiency Estimation	
	2015	2011	2015	2011
Northern Ireland	3,116	3,571	3,116	3,571
Norway (5)	—	—	4,329	—
Oman	9,105	10,411	9,105	10,411
Poland	—	—	4,747	—
Portugal	4,693	4,042	4,693	4,042
Qatar	5,194	4,117	5,194	4,117
Russian Federation	4,921	4,467	4,921	4,467
Saudi Arabia	4,337	4,515	4,337	4,515
Serbia	4,036	4,379	4,036	4,379
Singapore	6,517	6,368	6,517	6,368
Slovak Republic	5,773	5,616	5,773	5,616
Slovenia	4,445	4,492	4,445	4,492
Spain	7,764	4,183	7,764	4,183
Sweden	4,142	4,663	4,142	4,663
Turkey	6,456	7,479	6,456	7,479
United Arab Emirates	21,177	14,720	21,177	14,720
United States	10,029	12,569	10,029	12,569
Benchmarking Participants				
Buenos Aires, Argentina	—	—	3,104	—
Ontario, Canada	—	—	4,574	—
Quebec, Canada	—	—	2,798	—
Norway (4)	4,164	3,121	4,164	3,121
Abu Dhabi, UAE	—	—	5,001	—
Dubai, UAE	—	—	7,453	—
Florida, US	—	—	2,025	—
Total	**216,377**	**215,918**	**288,305**	**215,918**

Exhibit 13.7: TIMSS 2015 Sample Sizes for Scaling the Eighth Grade Data

Country	Concurrent Calibration		Proficiency Estimation	
	2015	2011	2015	2011
Australia	10,338	7,556	10,338	7,556
Bahrain	4,918	4,640	4,918	4,640
Botswana (9)	5,964	5,400	5,964	5,400
Canada	—	—	8,757	—
Chile	4,849	5,835	4,849	5,835
Chinese Taipei	5,711	5,042	5,711	5,042
Egypt	—	—	7,822	—
England	4,814	3,842	4,814	3,842
Georgia	4,035	4,563	4,035	4,563
Hong Kong SAR	4,155	4,015	4,155	4,015
Hungary	4,893	5,178	4,893	5,178
Iran, Islamic Rep. of	6,130	6,029	6,130	6,029
Ireland	—	—	4,704	—
Israel	5,512	4,699	5,512	4,699
Italy	4,481	3,979	4,481	3,979
Japan	4,745	4,414	4,745	4,414
Jordan	7,865	7,694	7,865	7,694
Kazakhstan	4,887	4,390	4,887	4,390
Korea, Rep. of	5,309	5,166	5,309	5,166
Kuwait	—	—	4,503	—
Lebanon	3,873	3,974	3,873	3,974
Lithuania	2,933	4,747	4,347	4,747
Malaysia	9,726	5,733	9,726	5,733
Malta	—	—	3,817	—
Morocco	13,035	8,986	13,035	8,986
New Zealand	8,142	5,336	8,142	5,336
Norway (9)	—	—	4,697	—
Oman	8,883	9,542	8,883	9,542
Qatar	5,403	4,422	5,403	4,422
Russian Federation	4,780	4,893	4,780	4,893
Saudi Arabia	3,759	4,344	3,759	4,344
Singapore	6,116	5,927	6,116	5,927
Slovenia	4,257	4,415	4,257	4,415
South Africa (9)	12,514	11,969	12,514	11,969
Sweden	4,090	5,573	4,090	5,573

Exhibit 13.7: TIMSS 2015 Sample Sizes for Scaling the Eighth Grade Data (Continued)

Country	Concurrent Calibration		Proficiency Estimation	
	2015	2011	2015	2011
Thailand	6,482	6,124	6,482	6,124
Turkey	6,079	6,928	6,079	6,928
United Arab Emirates	18,012	14,089	18,012	14,089
United States	10,221	10,477	10,221	10,477
Benchmarking Participants				
Buenos Aires, Argentina	—	—	3,253	—
Ontario, Canada	—	—	4,520	—
Quebec, Canada	—	—	3,950	—
Norway (8)	4,795	3,862	4,795	3,862
Abu Dhabi, UAE	—	—	4,838	—
Dubai, UAE	—	—	6,149	—
Florida, US	—	—	2,074	—
Total	**221,706**	**203,783**	**282,204**	**203,783**

The item parameters estimated from these concurrent calibrations, based on the countries that have participated in both the previous and current assessments, were used to estimate student proficiency for all countries and benchmarking entities participating in the TIMSS 2015 assessments. These item parameters were also used to estimate student proficiency in the mathematics and science content and cognitive domains. At the fourth grade, student proficiency was estimated for a total of 47 countries and seven benchmarking participants, as shown in Exhibit 13.6. At the eighth grade, it was estimated for 39 countries and seven benchmarking participants. The item parameters estimated from the TIMSS concurrent calibrations at the fourth and eighth grades and for mathematics and science are presented in Appendix 13A-13D.

Treatment of Omitted and Not-Reached Responses

Given the matrix-sampling design used by TIMSS, whereby a student is administered only a sample of the assessment blocks (two mathematics and two science blocks) most items are missing by design for each student. However, missing data can also result from a student not answering an item, which can occur when the student does not know the answer, omits the item by mistake, or does not have sufficient time to attempt the item. An item is considered "not reached" when—within part 1 or part 2 of a booklet[3]—the item itself and the item immediately preceding it are not answered, and there are no other items completed in the remainder of that part of the booklet.

3 The TIMSS assessment booklets consist of two parts, with a break in between.

Not-reached items are treated differently in estimating item parameters and in generating student proficiency scores. In estimating the values of the item parameters, items in the assessment booklets that are considered not to have been reached by students are treated as if they have not been administered. This approach is considered optimal for parameter estimation. However, not-reached items are always considered as incorrect responses when student proficiency scores are generated.

Evaluating Fit of IRT Models to the TIMSS Assessment Data

After the item calibrations were completed, checks were performed to verify that the item parameters obtained from Parscale adequately reproduce the observed distribution of student responses across the proficiency continuum. The fit of the IRT models to the TIMSS assessment data is examined by comparing the item response function curves generated using the item parameters estimated from the data with the empirical item response functions calculated from the latent abilities estimated for each student that responded to the item. When the empirical results for an item fall near the fitted curves, the IRT model fits the data well and provides an accurate and reliable measurement of the underlying proficiency scale. Graphical plots of these response function curves are called item characteristic curves (ICC).

The plots in the Exhibits 13.8 and 13.9 show examples of the empirical and fitted item response functions for dichotomously scored (right/wrong) multiple-choice and constructed response items, respectively. In each plot, the horizontal axis represents the proficiency scale, and the vertical axis represents the probability of a correct response. The fitted curve based on the estimated item parameters is shown as a solid line. Empirical results are represented by circles. The empirical results are obtained by first dividing the proficiency scale into intervals of equal size and then counting the number of students responding to the item whose estimated latent abilities (EAP scores) from Parscale fall in each interval. Then the proportion of students in each interval that responded correctly to the item is calculated. In the exhibits, the center of each circle represents this empirical proportion of correct responses. The size of each circle is proportional to the number of students contributing to the estimation of the empirical proportion correct.

Exhibit 13.8: Example of Item Response Function for a Dichotomous Multiple-Choice Item from the TIMSS 2015 Fourth Grade Mathematics Assessment

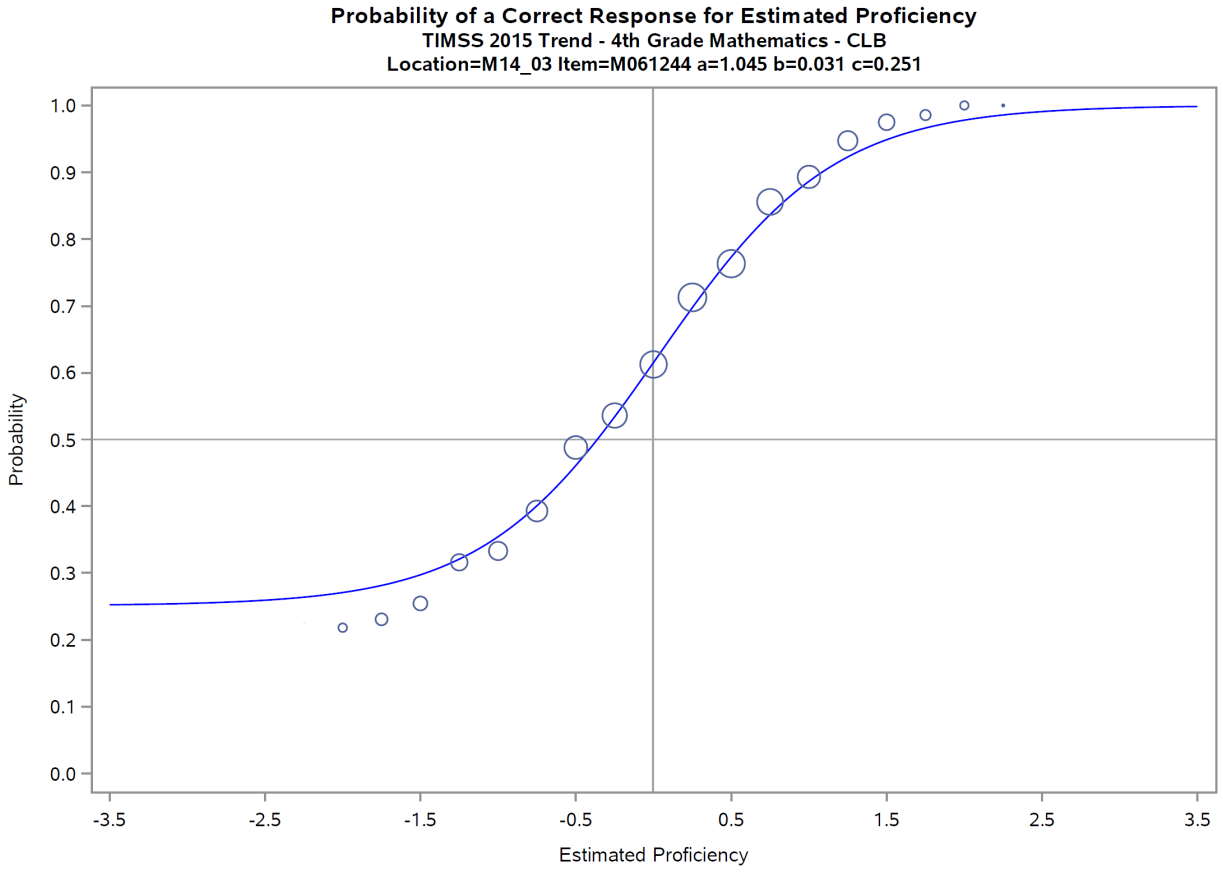
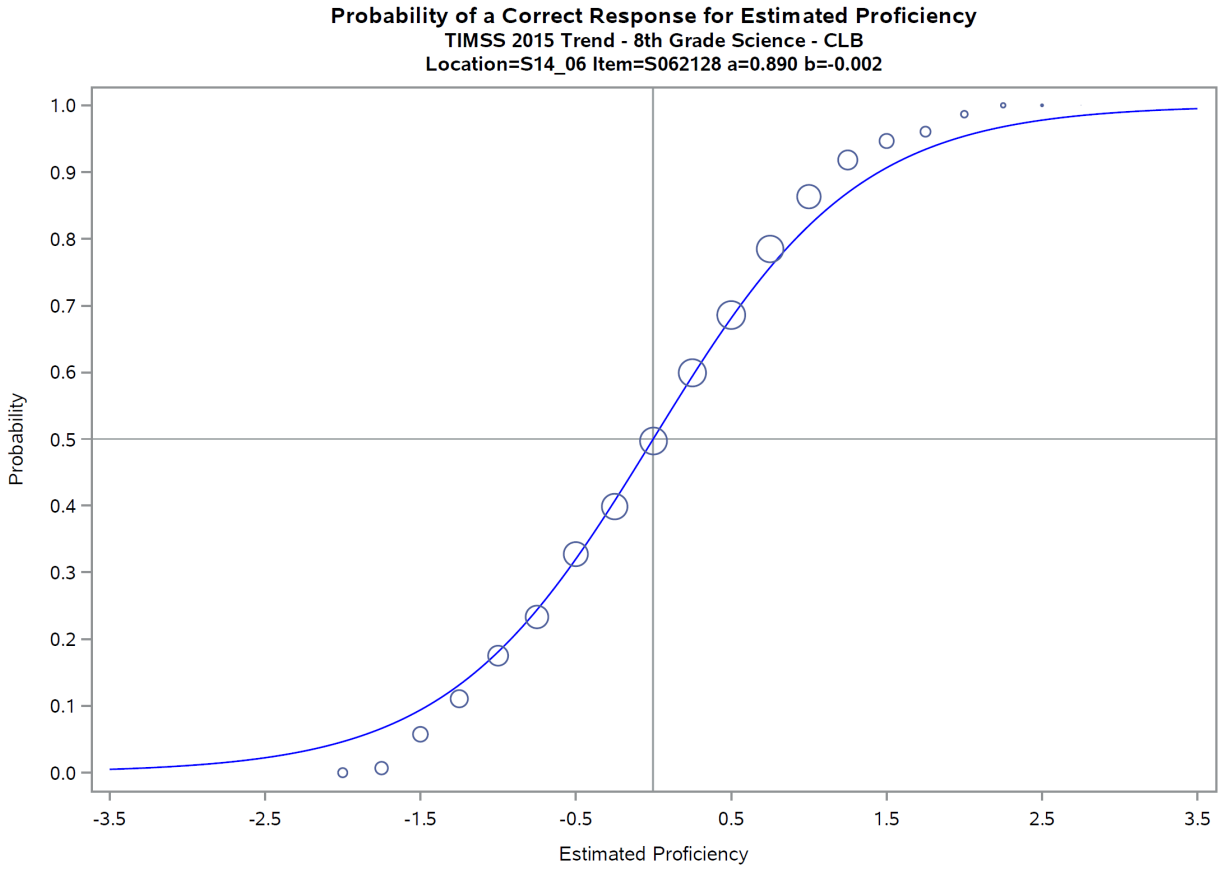
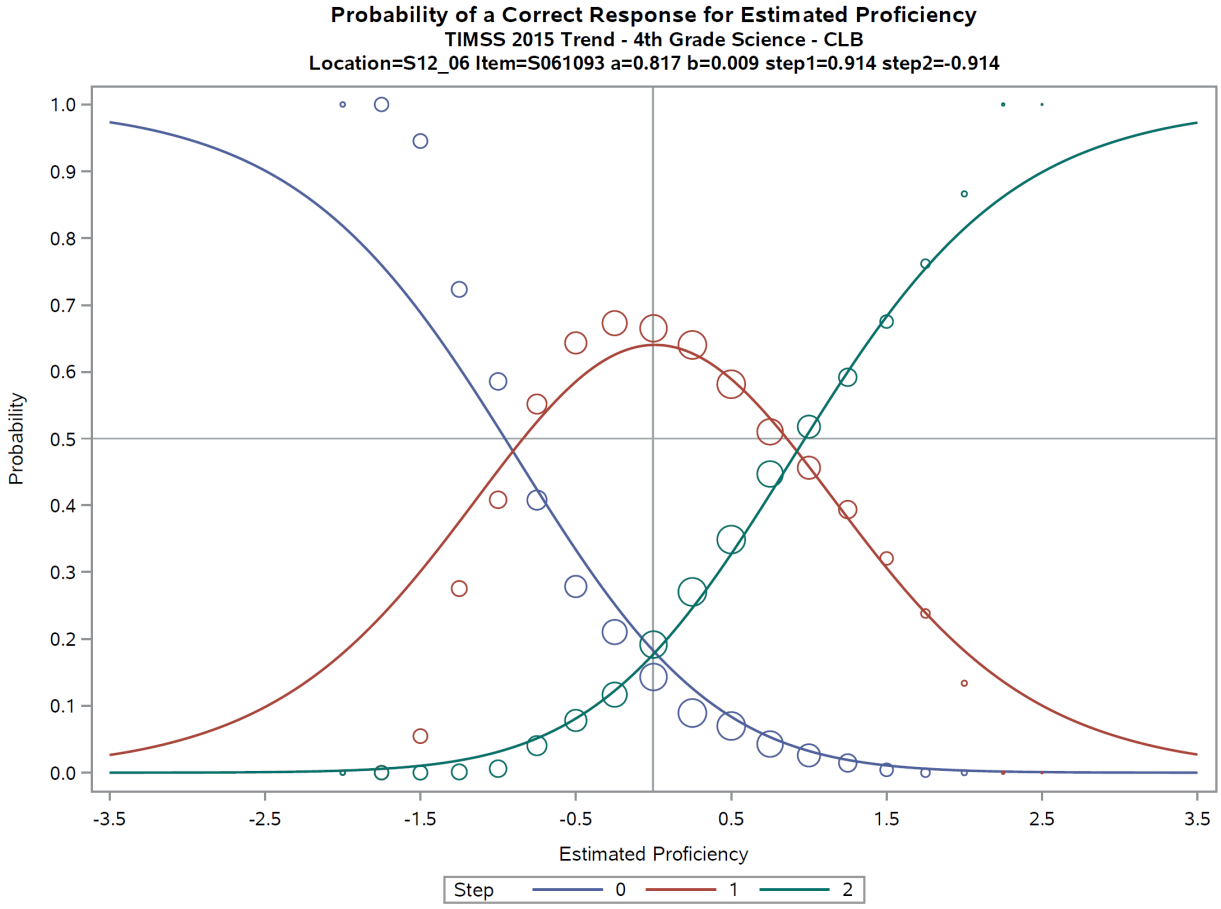


Exhibit 13.9: Example of Item Response Function for a Dichotomous Constructed Response Item from the TIMSS 2015 Eighth Grade Science Assessment



The plot in Exhibit 13.10 shows the empirical and fitted item response functions for a polytomous item (scored 0, 1, or 2). As for the dichotomous item plots, the horizontal axis represents the proficiency scale, but in this example the vertical axis represents the probability of having a response in a given response category. The fitted curves based on the estimated item parameters are shown as solid lines and again the empirical results are represented by circles. The interpretation of the circles is the same as in Exhibits 13.8 and 13.9. The curve starting at the top left of the chart plots the probability of a score of zero on the item. This probability decreases as proficiency increases. The bell-shaped curve shows the probability of a score of one point—partial credit, starting low for low-ability students, reaching a maximum for medium-ability students, and decreasing for high-ability students. The curve ending at the top right corner of the chart shows the probability of a score of two points—full credit, starting low for low-ability students and increasing as proficiency increases.

Exhibit 13.10: Example of Item Response Function for a Polytomous Constructed Response Item from the TIMSS 2015 Fourth Grade Science Assessment



Variables for Conditioning the TIMSS Assessment Data

Conditioning is the practice of using all available students' background information to improve the reliability of the estimated student proficiency scores. Ideally all background data would be included in the conditioning model, but because TIMSS has so many student background variables that could be used in conditioning, the TIMSS & PIRLS International Study Center follows the practice established by NAEP and followed by other large-scale studies of using principal components analysis to reduce the number of variables while explaining most of their common variance. Principal components for the TIMSS student background variables (including parent background variables at the fourth grade) were constructed as follows:

- For categorical variables (questions with a small number of fixed response options), a dummy coded variable was created for each response option, with a value of one if the option is chosen and zero otherwise. If a student omitted or was not administered

a particular question, all dummy coded variables associated with that question were assigned the value zero.

- Background variables with numerous response options (such as year of birth) were recoded using criterion scaling.[4] This was done by replacing the response option with the mean interim achievement score of all students choosing that option. Criterion scaling maximizes the correlation between the scaled variable and achievement. For TIMSS, the interim achievement score was the average of the mathematics and science EAP scores produced from the item calibrations.
- Separately for each country, all the dummy-coded and criterion-scaled variables were included in a principal components analysis. Those principal components accounting for 90 percent of the variance of the background variables were retained for use as conditioning variables.[5] Because the principal components analysis was performed separately for each country, different numbers of principal components were required to account for 90% of the common variance in each country's background variables.

In addition to the principal components, student gender (dummy coded), the language of the test (dummy coded), an indicator of the classroom in the school to which a student belongs (criterion scaled), and an optional country-specific variable (dummy coded) were included as primary conditioning variables, thereby accounting for most of the variance between students and preserving the between-classroom and within-classroom variance structure in the scaling model. For information on principal components conditioning, readers are referred to Exhibits 13.11 and 13.12, which provide details on the conditioning models used for proficiency estimation at the fourth and eighth grades, respectively.

4 The process of generating criterion-scaled variables is described in Beaton (1969).

5 The number of principal components retained is limited to no more than 5% of a country's student sample size, thereby possibly reducing the percentage of variance accounted for, to avoid over-specification of the conditioning model.

Exhibit 13.11: TIMSS 2015 Conditioning Models for Proficiency Estimation at the Fourth Grade

Country	2015				2011			
	Number of Primary Conditioning Variables	Number of Principal Components Available	Number of Principal Components Retained	Percentage of Variance Explained	Number of Primary Conditioning Variables	Number of Principal Components Available	Number of Principal Components Retained	Percentage of Variance Explained
Australia	2	633	302	89	2	233	129	90
Bahrain	3	637	207	75	3	239	139	90
Belgium (Flemish)	2	629	270	84	2	235	129	90
Bulgaria	2	617	211	78	—	—	—	—
Canada	5	619	321	90	—	—	—	—
Chile	2	610	237	80	2	239	138	90
Chinese Taipei	2	636	214	78	2	237	128	90
Croatia	3	637	199	76	2	235	128	90
Cyprus	2	637	206	74	—	—	—	—
Czech Republic	2	636	260	84	2	239	129	90
Denmark	2	628	185	73	2	239	132	90
England	2	336	179	90	2	239	131	90
Finland	3	634	250	83	3	237	125	90
France	2	637	243	81	—	—	—	—
Georgia	2	637	195	74	2	235	137	90
Germany	2	637	197	76	2	239	130	90
Hong Kong SAR	3	637	180	73	3	239	128	90
Hungary	2	613	251	82	2	239	131	90
Indonesia	2	617	201	75	—	—	—	—
Iran, Islamic Rep. of	2	637	191	73	2	239	139	90
Ireland	3	637	217	78	3	237	129	90
Italy	2	631	218	77	3	239	132	90
Japan	2	635	219	79	2	239	129	90
Kazakhstan	3	608	235	81	3	239	133	90
Korea, Rep. of	2	636	233	81	2	239	127	90
Kuwait	3	629	179	71	2	239	148	90
Lithuania	4	630	226	79	2	239	131	90
Morocco	2	637	253	80	2	239	146	90
Netherlands	2	619	225	82	2	227	129	90
New Zealand	8	633	314	90	7	239	134	90
Northern Ireland	3	589	155	71	3	239	129	90
Norway (5)	3	636	216	80	—	—	—	—
Oman	3	637	353	90	3	239	142	90
Poland	2	616	237	81	—	—	—	—

Exhibit 13.11: TIMSS 2015 Conditioning Models for Proficiency Estimation at the Fourth Grade (Continued)

Country	2015				2011			
	Number of Primary Conditioning Variables	Number of Principal Components Available	Number of Principal Components Retained	Percentage of Variance Explained	Number of Primary Conditioning Variables	Number of Principal Components Available	Number of Principal Components Retained	Percentage of Variance Explained
Portugal	2	636	234	79	2	235	127	90
Qatar	3	632	259	83	3	231	136	90
Russian Federation	2	613	246	81	2	239	132	90
Saudi Arabia	3	637	216	75	3	239	138	90
Serbia	2	628	201	76	2	227	125	90
Singapore	2	637	322	90	2	239	129	90
Slovak Republic	3	633	288	86	3	235	129	90
Slovenia	2	636	222	81	2	236	129	90
Spain	5	628	319	90	5	229	130	90
Sweden	2	611	207	78	2	237	128	90
Turkey	2	612	322	89	2	237	139	90
United Arab Emirates	5	637	346	90	5	235	138	90
United States	10	330	184	90	9	233	133	90
Benchmarking Participants								
Buenos Aires, Argentina	2	630	155	77	—	—	—	—
Ontario, Canada	3	619	228	80	3	239	133	90
Quebec, Canada	3	619	139	68	3	239	130	90
Norway (4)	3	636	208	79	3	239	129	90
Abu Dhabi, UAE	3	637	250	81	3	235	136	90
Dubai, UAE	3	637	333	90	3	235	134	90
Florida, US	10	330	101	72	—	233	130	90

Exhibit 13.12: TIMSS 2015 Conditioning Models for Proficiency Estimation at the Eighth Grade

Country	2015				2011			
	Number of Primary Conditioning Variables	Number of Principal Components Available	Number of Principal Components Retained	Percentage of Variance Explained	Number of Primary Conditioning Variables	Number of Principal Components Available	Number of Principal Components Retained	Percentage of Variance Explained
Australia	2	478	245	90	2	363	187	90
Bahrain	3	482	245	89	3	366	197	90
Botswana (9)	2	480	275	90	2	369	212	90
Canada	5	480	247	90	—	—	—	—
Chile	2	481	242	89	2	369	202	90
Chinese Taipei	2	481	231	90	2	369	184	90
Egypt	2	482	276	90	—	—	—	—
England	2	482	240	89	2	368	189	90
Georgia	2	850	201	72	2	825	228	76
Hong Kong SAR	2	482	207	87	2	369	185	90
Hungary	2	850	244	75	2	829	258	78
Iran, Islamic Rep. of	2	482	261	90	2	369	204	90
Ireland	3	482	235	88	—	—	—	—
Israel	3	436	230	90	3	339	181	90
Italy	2	482	224	87	3	369	190	90
Japan	2	480	234	90	2	366	184	90
Jordan	2	482	263	90	2	369	207	90
Kazakhstan	3	849	244	80	3	826	219	77
Korea, Rep. of	2	481	227	90	2	366	182	90
Kuwait	3	474	225	85	—	—	—	—
Lebanon	3	724	193	71	3	677	198	75
Lithuania	4	845	217	73	2	829	237	76
Malaysia	2	473	248	90	2	365	196	90
Malta	2	850	190	70	—	—	—	—
Morocco	2	850	463	90	2	823	412	90
New Zealand	8	478	245	90	7	369	192	90
Norway (9)	3	482	234	89	—	—	—	—
Oman	3	482	271	90	3	366	208	90
Qatar	3	477	244	90	3	358	190	90
Russian Federation	2	849	239	76	2	826	244	77
Saudi Arabia	3	482	187	79	3	365	200	90
Singapore	2	482	246	90	2	369	188	90
Slovenia	2	850	212	74	2	829	220	76
South Africa (9)	3	482	276	90	3	369	214	90

Exhibit 13.12: TIMSS 2015 Conditioning Models for Proficiency Estimation at the Eighth Grade (Continued)

Country	2015				2011			
	Number of Primary Conditioning Variables	Number of Principal Components Available	Number of Principal Components Retained	Percentage of Variance Explained	Number of Primary Conditioning Variables	Number of Principal Components Available	Number of Principal Components Retained	Percentage of Variance Explained
Sweden	2	726	204	77	2	827	278	84
Thailand	2	481	252	90	2	366	198	90
Turkey	2	481	257	90	2	364	200	90
United Arab Emirates	5	482	258	90	5	365	202	90
United States	10	475	248	90	9	363	195	90
Benchmarking Participants								
Buenos Aires, Argentina	2	481	162	75	—	—	—	—
Ontario, Canada	3	480	226	88	3	369	188	90
Quebec, Canada	3	480	197	85	3	369	193	90
Norway (8)	3	482	239	90	3	369	189	90
Abu Dhabi, UAE	3	482	241	89	3	365	197	90
Dubai, UAE	3	482	252	90	3	365	196	90
Florida, US	10	475	103	66	9	363	85	65

Generating IRT Proficiency Scores for the TIMSS Assessment Data

Educational Testing Service's MGROUP program (Sheehan, 1985) was used to generate the IRT proficiency scores. This program takes as input the students' responses to the items they were given, the item parameters estimated at the calibration stage, and the conditioning variables, and generates as output the plausible values that represent student proficiency. A useful feature of MGROUP is its ability to perform multi-dimensional scaling using the responses to all items across the proficiency scales and the correlations among the scales to improve the reliability of each individual scale. TIMSS capitalizes on this feature to simultaneously estimate overall mathematics and overall science proficiency using a two-dimensional MGROUP run.

The multi-dimensional scaling feature of MGROUP also was used to generate proficiency scores for the TIMSS 2015 content and cognitive domains. The estimation of proficiency scores for the mathematics and science content and cognitive domains relied on multidimensional IRT models using the item parameters estimated for the overall mathematics and overall science scales as well the same conditioning variables. At the fourth grade, the content domain scaling used two three-dimensional models, one to estimate proficiency scores for the three content domains in mathematics and a second for the three science content domains. At the eighth grade, the content

domain scaling required two four-dimensional models because of the four content domains in each subject. The cognitive domain scaling relied on four three-dimensional models to estimate the three cognitive domains in mathematics and science at both fourth and eighth grades.

In addition to generating plausible values on the overall mathematics and science scales for the 2015 assessment data, the item parameters estimated at the calibration stage also were used to generate plausible values for the TIMSS 2011 assessment for the countries included in the concurrent calibration at the fourth and eighth grades. These additional plausible values were used to establish the linear transformation necessary to place the 2015 assessment data on the appropriate trend scales.

Transforming the Overall Scores to Measure Trends

To provide results for the TIMSS 2015 assessments on the existing TIMSS achievement scales, the 2015 proficiency scores (plausible values) for overall mathematics and overall science had to be transformed to the TIMSS reporting metric. This was accomplished through a set of linear transformations as part of the concurrent calibration approach. These linear transformations were given by:

$$PV^{*}_{k,i} = A_{k,i} + B_{k,i} \times PV_{k,i}$$

where

$PV_{k,i}$ is the TIMSS 2015 plausible value i of scale k prior to transformation;
$PV^{*}_{k,i}$ is the TIMSS 2015 plausible value i of scale k after transformation; and
$A_{k,i}$ and $B_{k,i}$ are the linear transformation constants.

The linear transformation constants were obtained by first computing the international means and standard deviations of the proficiency scores for the overall mathematics and science scales using the plausible values produced in 2011 based on the 2011 item calibrations for the trend countries. These were the plausible values published in 2011. Next, the same calculations were done using the plausible values from the re-scaled TIMSS 2011 assessment data based on the 2015 concurrent item calibrations for the same set of countries. From these calculations, the linear transformation constants were defined as:

$$B_{k,i} = \sigma_{k,i} / \sigma^{*}_{k,i}$$

$$A_{k,i} = \mu_{k,i} - B_{k,i} \cdot \mu^{*}_{k,i}$$

where

$\mu_{k,i}$ is the international mean of scale k based on plausible value i published in 2011;
$\mu^{*}_{k,i}$ is the international mean of scale k based on plausible value i from the 2011 assessment based on the 2015 concurrent calibration;

$\sigma_{k,i}$ is the international standard deviation of scale k based on plausible value i published in 2011;

$\sigma^{*}_{k,i}$ is the international standard deviation of scale k based on plausible value i from the 2011 assessment based on the 2015 concurrent calibration.

There are five sets of transformation constants for each scale, one for each plausible value. The trend countries contributed equally in the calculation of these transformation constants. Exhibits 13.13 and 13.14 show the TIMSS 2015 transformation constants for both subjects at the fourth grade and eighth grade, respectively.

Exhibit 13.13: TIMSS 2015 Linear Transformation Constants for Achievement Scores at the Fourth Grade

Overall Mathematics	TIMSS 2011 Published Scores		TIMSS 2011 Re-Scaled Scores		$A_{k,i}$	$B_{k,i}$
	Mean	Standard Deviation	Mean	Standard Deviation		
PV1	501.91552	103.54133	-0.04936	1.00427	507.00466	103.10157
PV2	502.00544	103.94119	-0.04786	1.00299	506.96561	103.63170
PV3	502.35389	102.68220	-0.04820	1.00351	507.28627	102.32346
PV4	501.84105	103.49324	-0.04773	1.00347	506.76322	103.13524
PV5	501.65257	103.64052	-0.04757	1.00426	506.56219	103.20051

Overall Science	TIMSS 2011 Published Scores		TIMSS 2011 Re-Scaled Scores		$A_{k,i}$	$B_{k,i}$
	Mean	Standard Deviation	Mean	Standard Deviation		
PV1	499.45160	105.78445	-0.04165	1.00373	503.84141	105.39178
PV2	497.56584	106.72416	-0.04269	1.00417	502.10293	106.28087
PV3	498.16387	106.63119	-0.04116	1.00347	502.53750	106.26254
PV4	497.34909	106.68599	-0.04078	1.00064	501.69694	106.61724
PV5	499.15420	106.17634	-0.04151	1.00259	503.54985	105.90178

Exhibit 13.14: TIMSS 2015 Linear Transformation Constants for Achievement Scores at the Eighth Grade

Overall Mathematics	TIMSS 2011 Published Scores		TIMSS 2011 Re-Scaled Scores		$A_{k,i}$	$B_{k,i}$
	Mean	Standard Deviation	Mean	Standard Deviation		
PV1	473.42229	111.72611	-0.03549	0.99024	477.42708	112.82747
PV2	473.75171	112.62466	-0.03610	0.99166	477.85132	113.57130
PV3	473.63844	113.27223	-0.03601	0.99136	477.75261	114.25951
PV4	473.10247	113.46924	-0.03444	0.99066	477.04681	114.53935
PV5	473.67012	113.04213	-0.03540	0.99170	477.70540	113.98864

Overall Science	TIMSS 2011 Published Scores		TIMSS 2011 Re-Scaled Scores		$A_{k,i}$	$B_{k,i}$
	Mean	Standard Deviation	Mean	Standard Deviation		
PV1	482.10953	107.52913	-0.00234	0.92492	482.38202	116.25820
PV2	482.14011	107.21152	-0.00113	0.92745	482.27044	115.59787
PV3	483.14479	106.44266	-0.00367	0.92707	483.56607	114.81597
PV4	481.87213	107.83798	-0.00133	0.92584	482.02702	116.47632
PV5	482.89696	107.25956	-0.00132	0.92636	483.04972	115.78622

These linear transformation constants were applied to the overall proficiency scores—mathematics and science—at both grades and for all participating countries and benchmarking participants. This provided student achievement scores for the TIMSS 2015 assessments that are directly comparable to the scores from all previous assessments.

The linear transformation constants for the overall scales also were applied to the scales for the content and cognitive domains. The transformation constants for mathematics were applied to the proficiency scores of the mathematics content domains and cognitive domains, and the transformation constants for science were applied to the proficiency scores of the science content domains and cognitive domains. In this approach to measuring trends in content and cognitive domains, achievement changes over time are established in the context of achievement in each subject overall. Trends are not established separately for each content or cognitive domain; rather differential changes in performance in the domains are considered in the light of trends in the subject overall.

Scaling the TIMSS Numeracy 2015 Achievement Data

TIMSS Numeracy was introduced in 2015 to assess the fundamental mathematical knowledge, procedures, and problem-solving strategies that are prerequisites for success on TIMSS mathematics at the fourth grade. TIMSS Numeracy asks students to answer questions and work problems similar to TIMSS mathematics at the fourth grade, with easier numbers and more straightforward procedures.

The TIMSS Numeracy assessment was designed to allow the mathematics achievement of participating countries to be reported on the TIMSS fourth grade mathematics trend scale. To that end, two of the TIMSS fourth grade item blocks were included in the TIMSS Numeracy assessment, along with eight mathematics item blocks dedicated to TIMSS Numeracy. The two shared TIMSS item blocks provided the link to place TIMSS Numeracy achievement on the TIMSS fourth grade mathematics scale. Exhibit 13.15 shows the number of items present in the TIMSS Numeracy 2015 assessment by item type and domain. There was a total of 124 items in the Numeracy assessment, 22 of them from the TIMSS fourth grade mathematics assessment.

Exhibit 13.15: TIMSS Numeracy 2015 Items for Calibration

Item Type	Points	TIMSS Items		Numeracy Items		Total	
		Items	Points	Items	Points	Items	Points
Multiple-Choice	1	11	11	45	45	56	56
Constructed Response	1	9	9	53	53	62	62
	2	2	4	4	8	6	12
Total		22	24	102	106	124	130

TIMSS Numeracy 2015 Mathematics Items for Calibration by Content and Cognitive Domains

Mathematics Content Domains	TIMSS Items		Numeracy Items		Total	
	Items	Points	Items	Points	Items	Points
Number	13	15	68	69	81	84
Geometric Shapes and Measures	7	7	24	9	31	16
Data Display	2	2	10	3	12	5
Mathematics Cognitive Domains	**TIMSS Items**		**Numeracy Items**		**Total**	
	Items	Points	Items	Points	Items	Points
Knowing	7	8	55	55	62	63
Applying	10	10	35	36	45	46
Reasoning	5	6	12	15	17	21
Total	22	24	102	106	124	130

Much like the normal TIMSS scaling procedure, the TIMSS Numeracy scaling approach involved the same four tasks of calibrating the achievement items, creating principal components for conditioning, generating proficiency scores, and placing these proficiency scores on the TIMSS fourth grade mathematics reporting scale. Exhibit 13.16 shows the sample sizes for scaling the TIMSS Numeracy data. A total of seven countries participated, as well as one benchmarking participant.

Exhibit 13.16: TIMSS Numeracy 2015 Sample Sizes for Scaling

Country	Item Calibration	Proficiency Estimation
Bahrain	4,429	4,429
Indonesia	4,294	4,294
Iran, Islamic Rep. of	4,105	4,105
Jordan	7,861	7,861
Kuwait	3,703	3,703
Morocco	5,360	5,360
South Africa (5)	10,932	10,932
Benchmarking Participants		
Buenos Aires, Argentina	—	3,331
Total	**40,684**	**44,015**

The item calibration step was based on a straightforward calibration of the TIMSS Numeracy 2015 achievement items from the seven participating countries. The item parameters for the TIMSS Numeracy items were placed on the TIMSS fourth grade mathematics metric by fixing the parameters of the items in the two shared TIMSS 2015 item blocks to the values estimated from the TIMSS 2015 concurrent calibration. The two shared item blocks consisted of 22 items, 21 of which were used for linking the TIMSS Numeracy assessment to the TIMSS fourth grade mathematics assessment. One item—N04_08A (M061265A)—did not behave the same across both assessments and had its item parameters re-estimated as part of the TIMSS Numeracy item calibration. The item parameters estimated from the TIMSS Numeracy item calibration are presented in Appendix 13E. The 21 link items, whose item parameters were fixed, are marked with asterisks.

The conditioning for TIMSS Numeracy was done in exactly the same way as for TIMSS, as was the estimation of proficiency scores using the MGROUP software. This included overall mathematics scores for the TIMSS Numeracy countries and scores for the TIMSS fourth grade mathematics content and cognitive domains. Exhibit 13.17 provides details on the conditioning models used for the TIMSS Numeracy proficiency estimation.

Exhibit 13.17: TIMSS Numeracy 2015 Mathematics Conditioning Models for Proficiency Estimation

Country	2015			
	Number of Primary Conditioning Variables	Number of Principal Components Available	Number of Principal Components Retained	Percentage of Variance Explained
Bahrain	3	637	221	77
Indonesia	2	617	214	76
Iran, Islamic Rep. of	2	637	205	75
Jordan	2	637	334	90
Kuwait	3	629	185	72
Morocco	2	637	268	82
South Africa (5)	3	533	301	90
Benchmarking Participants				
Buenos Aires, Argentina	2	620	166	78

The final step in the process consisted of placing students' performance on the TIMSS Numeracy 2015 assessment on the TIMSS fourth grade mathematics reporting scale. This was done by applying the appropriate linear transformation to the estimated proficiency scores. The TIMSS Numeracy item calibration resulted in item parameters on the same metric as the TIMSS fourth grade mathematics metric—by fixing the parameters of the 21 link items. Thus, placing the TIMSS Numeracy achievement scores on the TIMSS fourth grade mathematics scale was accomplished by using the TIMSS fourth grade mathematics linear transformation constants, as presented in Exhibit 13.13. These linear transformation constants were applied to the overall mathematics achievement scores, as well as the achievement scores on the content and cognitive domains.

References

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Appendix 13A: TIMSS 2015 Fourth Grade Mathematics Item Parameters from Concurrent Calibration

TIMSS 2015 Fourth Grade Mathematics Item Parameters from Concurrent Calibration

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
Items Released in 2011:						
M01_01A	M031346A	1.675 (0.064)	-0.334 (0.020)			
M01_01B	M031346B	1.818 (0.072)	0.494 (0.018)			
M01_01C	M031346C	1.465 (0.049)	0.260 (0.014)		0.408 (0.022)	-0.408 (0.023)
M01_02	M031379	1.113 (0.050)	0.834 (0.031)			
M01_03	M031380	1.165 (0.055)	1.091 (0.037)			
M01_05	M031313	0.653 (0.033)	-1.187 (0.060)			
M01_06	M031083	0.969 (0.068)	-0.496 (0.082)	0.210 (0.036)		
M01_07	M031071	1.003 (0.089)	0.647 (0.055)	0.206 (0.022)		
M01_08	M031185	1.720 (0.119)	0.199 (0.035)	0.235 (0.019)		
M02_01	M051305	0.957 (0.067)	-0.162 (0.068)	0.183 (0.029)		
M02_02	M051091	1.508 (0.107)	0.514 (0.034)	0.188 (0.016)		
M02_03	M051001	1.055 (0.046)	0.702 (0.030)			
M02_04	M051007	1.153 (0.144)	1.275 (0.063)	0.266 (0.016)		
M02_05	M051203	0.561 (0.030)	0.413 (0.045)			
M02_06	M051601	1.002 (0.040)	-0.261 (0.028)			
M02_07A	M051064A	0.856 (0.036)	-0.155 (0.031)			
M02_07B	M051064B	0.902 (0.038)	-0.719 (0.036)			
M02_08	M051015	0.671 (0.032)	0.221 (0.037)			
M02_09	M051123	0.567 (0.074)	0.854 (0.115)	0.190 (0.036)		
M02_10	M051109	1.127 (0.044)	-0.229 (0.025)			
M02_11	M051117	0.987 (0.087)	0.305 (0.067)	0.271 (0.026)		
M03_01	M041010	0.921 (0.071)	-0.452 (0.095)	0.267 (0.038)		
M03_02	M041098	1.839 (0.143)	0.596 (0.032)	0.250 (0.015)		
M03_03	M041064	0.712 (0.032)	-0.538 (0.040)			
M03_04	M041003	0.828 (0.036)	-0.018 (0.031)			
M03_05	M041104	1.071 (0.043)	-0.074 (0.026)			
M03_06	M041299	1.303 (0.056)	0.784 (0.027)			
M03_07	M041329	1.055 (0.093)	0.069 (0.075)	0.343 (0.029)		
M03_08	M041143	0.331 (0.011)	-0.632 (0.045)		-1.833 (0.111)	1.833 (0.103)
M03_09	M041158	0.853 (0.063)	-0.314 (0.086)	0.189 (0.035)		
M03_10	M041328	0.905 (0.038)	-0.274 (0.030)			
M03_11	M041155	0.986 (0.070)	0.244 (0.052)	0.139 (0.022)		
M03_12	M041284	0.741 (0.029)	0.678 (0.027)		0.420 (0.037)	-0.420 (0.047)

TIMSS 2015 Fourth Grade Mathematics Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
M03_13	M041335	0.769 (0.052)	-1.179 (0.120)	0.154 (0.048)		
M03_14	M041184	0.899 (0.066)	-0.726 (0.101)	0.222 (0.042)		
M05_01	M031128	0.534 (0.029)	-1.247 (0.071)			
M05_02	M031016	1.295 (0.055)	0.719 (0.026)			
M05_03	M031183	0.864 (0.030)	0.147 (0.022)		0.656 (0.034)	-0.656 (0.035)
M05_05	M031187	0.749 (0.058)	-0.776 (0.129)	0.213 (0.048)		
M05_06	M031251	1.473 (0.112)	0.501 (0.038)	0.237 (0.017)		
M05_07	M031294	1.355 (0.080)	-0.035 (0.039)	0.138 (0.020)		
M05_08	M031297	0.824 (0.039)	0.735 (0.037)			
M05_09	M031218	1.402 (0.087)	0.069 (0.039)	0.162 (0.019)		
M05_10	M031109	0.674 (0.060)	-0.319 (0.129)	0.208 (0.044)		
M05_11	M031159	1.059 (0.076)	-0.263 (0.070)	0.236 (0.031)		
M05_12	M031133	0.854 (0.039)	-1.289 (0.051)			
M06_01	M041107	0.991 (0.062)	-1.006 (0.083)	0.150 (0.037)		
M06_02	M041011	1.301 (0.085)	-0.199 (0.052)	0.228 (0.026)		
M06_03	M041122	0.483 (0.016)	0.576 (0.032)		-0.778 (0.065)	0.778 (0.071)
M06_04	M041041	1.151 (0.104)	0.345 (0.063)	0.353 (0.025)		
M06_05	M041320	1.694 (0.111)	0.408 (0.030)	0.179 (0.016)		
M06_06A	M041115A	0.871 (0.037)	-0.377 (0.033)			
M06_06B	M041115B	1.173 (0.047)	0.142 (0.023)			
M06_07A	M041160A	1.087 (0.047)	-1.133 (0.041)			
M06_07B	M041160B	1.345 (0.059)	-1.159 (0.036)			
M06_08	M041327	0.533 (0.029)	0.001 (0.045)			
M06_09	M041148	0.374 (0.019)	-0.059 (0.041)		0.354 (0.076)	-0.354 (0.073)
M06_10	M041265	0.886 (0.076)	0.816 (0.053)	0.123 (0.019)		
M06_11	M041175	0.881 (0.060)	-1.144 (0.111)	0.180 (0.047)		
M06_12	M041199	1.249 (0.083)	-0.614 (0.067)	0.243 (0.033)		
M07_01	M031210	1.599 (0.150)	0.813 (0.040)	0.310 (0.016)		
M07_02	M031009	1.016 (0.044)	0.525 (0.028)			
M07_03	M031252	1.099 (0.070)	-0.244 (0.058)	0.170 (0.027)		
M07_04	M031316	0.802 (0.038)	-1.574 (0.063)			
M07_05	M031317	1.479 (0.099)	0.600 (0.031)	0.131 (0.014)		
M07_06B	M031079B	1.269 (0.050)	-0.639 (0.028)			
M07_06C	M031079C	0.799 (0.037)	0.396 (0.032)			
M07_07	M031004	1.217 (0.099)	1.036 (0.040)	0.108 (0.013)		

TIMSS 2015 Fourth Grade Mathematics Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
M07_08	M031043	1.456 (0.094)	0.263 (0.036)	0.175 (0.018)		
M07_09	M031325	0.907 (0.041)	0.637 (0.032)			
M07_10	M031088	0.925 (0.068)	-0.436 (0.089)	0.225 (0.037)		
M07_11	M031093	0.583 (0.109)	1.016 (0.159)	0.389 (0.040)		
M07_12	M031155	1.301 (0.105)	0.335 (0.050)	0.294 (0.022)		
Items Common in 2011 and 2015:						
M01_01	M041004	0.987 (0.050)	-1.314 (0.084)	0.210 (0.040)		
M01_02	M041023	1.650 (0.070)	-0.693 (0.033)	0.182 (0.020)		
M01_03	M041034	0.949 (0.045)	-0.068 (0.045)	0.139 (0.020)		
M01_04	M041087	0.808 (0.025)	-0.072 (0.022)			
M01_05	M041124	0.964 (0.028)	-0.199 (0.020)			
M01_06A	M041302A	1.037 (0.047)	-0.604 (0.052)	0.165 (0.025)		
M01_06B	M041302B	0.628 (0.021)	-0.296 (0.029)			
M01_06C	M041302C	1.071 (0.030)	-0.312 (0.019)			
M01_07	M041254	0.775 (0.052)	0.306 (0.064)	0.223 (0.024)		
M01_08	M041153	1.100 (0.053)	0.224 (0.034)	0.148 (0.016)		
M01_09	M041132	0.460 (0.041)	0.800 (0.100)	0.111 (0.030)		
M01_10	M041165	0.375 (0.010)	0.411 (0.027)		-0.866 (0.057)	0.866 (0.060)
M01_11	M041174	1.136 (0.032)	-0.689 (0.022)			
M01_12	M041191	1.025 (0.059)	-1.045 (0.089)	0.337 (0.038)		
M03_01	M051205	0.691 (0.023)	-0.325 (0.027)			
M03_02	M051039	1.186 (0.033)	-0.094 (0.017)			
M03_03	M051055	1.166 (0.037)	0.889 (0.022)			
M03_04	M051006	0.539 (0.014)	1.070 (0.028)		-0.560 (0.042)	0.560 (0.051)
M03_05	M051070	1.462 (0.088)	0.922 (0.026)	0.185 (0.010)		
M03_06	M051018	0.944 (0.063)	0.573 (0.046)	0.243 (0.018)		
M03_07	M051407	0.942 (0.053)	0.165 (0.049)	0.203 (0.020)		
M03_08	M051410	0.962 (0.058)	0.576 (0.040)	0.176 (0.016)		
M03_09	M051059	0.750 (0.025)	-1.128 (0.037)			
M03_10	M051093	0.814 (0.056)	0.720 (0.048)	0.169 (0.018)		
M03_11	M051134	1.277 (0.036)	0.363 (0.016)			
M03_12	M051077	1.236 (0.052)	0.190 (0.026)	0.090 (0.012)		
M05_01	M041291	0.705 (0.023)	-0.727 (0.032)			
M05_02	M041289	1.156 (0.066)	0.200 (0.043)	0.292 (0.018)		
M05_03	M041068	1.261 (0.056)	0.574 (0.023)	0.081 (0.010)		

TIMSS 2015 Fourth Grade Mathematics Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
M05_04A	M041065A	1.625 (0.081)	0.643 (0.022)	0.172 (0.010)		
M05_04B	M041065B	1.067 (0.035)	1.015 (0.025)			
M05_05	M041096	1.079 (0.052)	0.489 (0.029)	0.103 (0.013)		
M05_06	M041125	1.209 (0.072)	0.791 (0.031)	0.195 (0.012)		
M05_07	M041135	0.832 (0.060)	-0.466 (0.107)	0.422 (0.034)		
M05_08	M041257	0.772 (0.025)	0.331 (0.023)			
M05_09	M041268	2.022 (0.129)	1.008 (0.022)	0.232 (0.009)		
M05_10	M041151	0.519 (0.042)	-0.314 (0.158)	0.208 (0.046)		
M05_11	M041264	0.545 (0.052)	0.561 (0.110)	0.221 (0.033)		
M05_12	M041182	0.818 (0.028)	-1.611 (0.045)			
M05_13	M041200	0.472 (0.013)	-0.556 (0.027)		-0.209 (0.050)	0.209 (0.043)
M06_01	M051140	0.665 (0.044)	0.214 (0.074)	0.160 (0.026)		
M06_02	M051017	0.994 (0.071)	0.656 (0.046)	0.295 (0.017)		
M06_03	M051111	0.696 (0.026)	0.992 (0.035)			
M06_04	M051089	1.211 (0.036)	0.693 (0.018)			
M06_05	M051094	1.235 (0.068)	0.490 (0.032)	0.220 (0.014)		
M06_06	M051227	1.101 (0.037)	1.126 (0.027)			
M06_07	M051060	0.578 (0.046)	0.538 (0.083)	0.151 (0.028)		
M06_08Z	M051061Z	0.735 (0.025)	0.687 (0.028)			
M06_09	M051129	0.748 (0.049)	-0.060 (0.081)	0.241 (0.029)		
M06_10	M051236	0.897 (0.027)	0.077 (0.020)			
M06_11A	M051125A	0.825 (0.028)	-1.633 (0.046)			
M06_11B	M051125B	0.669 (0.050)	0.085 (0.096)	0.251 (0.032)		
M07_01	M041298	1.021 (0.055)	-0.537 (0.065)	0.285 (0.028)		
M07_02	M041007	0.877 (0.053)	0.425 (0.046)	0.182 (0.019)		
M07_03	M041280	0.877 (0.065)	0.801 (0.048)	0.238 (0.017)		
M07_04	M041059	0.699 (0.023)	-0.143 (0.025)			
M07_05	M041046	1.335 (0.058)	0.288 (0.025)	0.118 (0.012)		
M07_06	M041048	1.556 (0.092)	0.631 (0.028)	0.287 (0.012)		
M07_07	M041169	1.066 (0.058)	0.187 (0.042)	0.222 (0.018)		
M07_08	M041333	1.083 (0.058)	0.648 (0.031)	0.137 (0.013)		
M07_09	M041262	0.938 (0.070)	0.993 (0.043)	0.209 (0.015)		
M07_10	M041267	0.598 (0.023)	0.751 (0.035)			
M07_11	M041177	0.882 (0.044)	-0.432 (0.060)	0.152 (0.026)		
M07_12	M041271	0.935 (0.042)	-0.491 (0.051)	0.121 (0.023)		

TIMSS 2015 Fourth Grade Mathematics Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
M07_13A	M041276A	1.032 (0.030)	0.119 (0.018)			
M07_13B	M041276B	0.911 (0.029)	0.674 (0.023)			
M09_01	M051206	0.646 (0.022)	-0.720 (0.034)			
M09_02	M051052	1.021 (0.066)	0.268 (0.053)	0.331 (0.020)		
M09_03	M051049	1.499 (0.064)	0.098 (0.025)	0.152 (0.013)		
M09_04	M051045	1.176 (0.033)	0.056 (0.017)			
M09_05	M051098	1.067 (0.059)	0.736 (0.031)	0.132 (0.013)		
M09_06	M051030	1.019 (0.035)	1.161 (0.029)			
M09_07	M051502	0.975 (0.068)	1.099 (0.039)	0.154 (0.013)		
M09_08	M051224	1.015 (0.060)	0.159 (0.051)	0.280 (0.021)		
M09_09	M051207	0.952 (0.085)	0.898 (0.056)	0.377 (0.017)		
M09_10	M051427	1.135 (0.064)	0.717 (0.031)	0.165 (0.013)		
M09_11	M051533	1.134 (0.032)	0.184 (0.017)			
M09_12	M051080	1.073 (0.031)	-0.066 (0.018)			
M11_01	M051401	0.865 (0.028)	0.566 (0.023)			
M11_02	M051075	1.597 (0.126)	1.075 (0.032)	0.342 (0.010)		
M11_03	M051402	1.061 (0.031)	0.401 (0.018)			
M11_04	M051226	1.361 (0.080)	0.595 (0.031)	0.264 (0.013)		
M11_05	M051131	0.777 (0.024)	-0.022 (0.023)			
M11_06	M051103	1.470 (0.081)	0.326 (0.031)	0.301 (0.015)		
M11_07	M051217	1.210 (0.036)	0.609 (0.018)			
M11_08	M051079	0.887 (0.027)	0.378 (0.021)			
M11_09	M051211	0.868 (0.052)	-0.044 (0.064)	0.246 (0.025)		
M11_10	M051102	1.223 (0.072)	0.723 (0.031)	0.203 (0.013)		
M11_11	M051009	0.881 (0.027)	0.049 (0.021)			
M11_12	M051100	0.724 (0.051)	0.317 (0.070)	0.208 (0.025)		
M13_01	M051043	0.544 (0.021)	-0.007 (0.031)			
M13_02	M051040	1.219 (0.079)	0.039 (0.054)	0.436 (0.020)		
M13_03	M051008	1.220 (0.038)	0.948 (0.022)			
M13_04A	M051031A	1.490 (0.040)	0.166 (0.014)			
M13_04B	M051031B	1.662 (0.045)	0.258 (0.013)			
M13_05	M051508	1.295 (0.036)	0.179 (0.015)			
M13_06A	M051216A	1.292 (0.070)	0.480 (0.031)	0.226 (0.014)		
M13_06B	M051216B	0.552 (0.041)	-1.034 (0.197)	0.250 (0.060)		
M13_07	M051221	0.649 (0.039)	-0.726 (0.114)	0.172 (0.041)		

TIMSS 2015 Fourth Grade Mathematics Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
M13_08	M051115	0.612 (0.059)	1.641 (0.075)	0.100 (0.017)		
M13_09A	M051507A	0.748 (0.024)	-0.513 (0.028)			
M13_09B	M051507B	1.152 (0.036)	0.825 (0.021)			
Items Introduced in 2015:						
M02_01	M061272	0.910 (0.038)	0.121 (0.028)			
M02_02	M061243	0.477 (0.015)	-0.220 (0.031)		-0.923 (0.072)	0.923 (0.068)
M02_03	M061029	1.151 (0.072)	-0.226 (0.055)	0.139 (0.027)		
M02_04	M061031	1.497 (0.087)	0.563 (0.027)	0.066 (0.012)		
M02_05	M061050	1.427 (0.104)	0.596 (0.036)	0.184 (0.017)		
M02_06	M061167	0.730 (0.033)	-0.826 (0.047)			
M02_07	M061206	0.723 (0.069)	0.755 (0.070)	0.105 (0.027)		
M02_08A	M061265A	0.989 (0.042)	0.485 (0.028)			
M02_08B	M061265B	0.991 (0.103)	1.125 (0.057)	0.183 (0.019)		
M02_09	M061185	0.980 (0.063)	-0.503 (0.076)	0.114 (0.036)		
M02_10	M061239	1.408 (0.056)	-0.587 (0.026)			
M04_01	M061275	0.764 (0.065)	-0.479 (0.132)	0.192 (0.053)		
M04_02	M061027	0.941 (0.039)	-0.423 (0.032)			
M04_03	M061255	0.842 (0.027)	0.561 (0.021)		-0.210 (0.038)	0.210 (0.042)
M04_04	M061021	0.835 (0.039)	0.715 (0.035)			
M04_05	M061043	1.385 (0.054)	0.358 (0.021)			
M04_06	M061151	1.295 (0.080)	-0.012 (0.044)	0.143 (0.023)		
M04_07	M061172	1.556 (0.113)	0.830 (0.031)	0.135 (0.013)		
M04_08	M061223	0.739 (0.055)	-0.678 (0.122)	0.066 (0.053)		
M04_09	M061269	0.818 (0.058)	-0.439 (0.093)	0.085 (0.041)		
M04_10A	M061081A	1.115 (0.049)	0.742 (0.029)			
M04_10B	M061081B	0.801 (0.041)	1.002 (0.044)			
M08_01	M061026	0.920 (0.055)	-0.764 (0.079)	0.043 (0.038)		
M08_02	M061273	0.815 (0.065)	0.246 (0.073)	0.119 (0.031)		
M08_03	M061034	1.230 (0.051)	0.673 (0.025)			
M08_04	M061040	1.711 (0.117)	0.601 (0.030)	0.169 (0.015)		
M08_05	M061228	0.780 (0.026)	0.878 (0.026)		-0.309 (0.042)	0.309 (0.050)
M08_06	M061166	1.141 (0.045)	-0.158 (0.025)			
M08_07	M061171	1.316 (0.086)	-0.240 (0.054)	0.201 (0.028)		
M08_08	M061080	0.854 (0.039)	0.598 (0.033)			
M08_09	M061222	0.904 (0.094)	0.401 (0.089)	0.326 (0.032)		

TIMSS 2015 Fourth Grade Mathematics Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
M08_10	M061076	0.583 (0.030)	-0.477 (0.048)			
M08_11	M061084	1.119 (0.050)	0.869 (0.031)			
M10_01	M061018	0.889 (0.038)	0.147 (0.029)			
M10_02	M061274	0.791 (0.070)	-0.396 (0.132)	0.249 (0.051)		
M10_03	M061248	0.932 (0.033)	0.431 (0.020)		0.400 (0.031)	-0.400 (0.035)
M10_04	M061039	1.224 (0.049)	0.354 (0.023)			
M10_05	M061079	1.324 (0.055)	0.724 (0.025)			
M10_06	M061179	1.225 (0.080)	0.122 (0.046)	0.158 (0.023)		
M10_07	M061052	1.049 (0.064)	0.121 (0.046)	0.075 (0.022)		
M10_08	M061207	1.537 (0.092)	0.316 (0.031)	0.115 (0.016)		
M10_09	M061236	0.788 (0.036)	0.318 (0.032)			
M10_10	M061266	0.494 (0.017)	0.750 (0.033)		-0.820 (0.066)	0.820 (0.073)
M10_11	M061106	1.065 (0.081)	0.038 (0.067)	0.229 (0.030)		
M12_01	M061178	0.866 (0.037)	0.144 (0.029)			
M12_02	M061246	1.065 (0.066)	0.151 (0.045)	0.086 (0.021)		
M12_03	M061271	0.700 (0.032)	-0.544 (0.042)			
M12_04	M061256	0.933 (0.039)	0.212 (0.028)			
M12_05	M061182	1.188 (0.056)	1.140 (0.035)			
M12_06	M061049	0.971 (0.080)	-0.362 (0.100)	0.301 (0.041)		
M12_07	M061232	0.859 (0.091)	0.604 (0.082)	0.285 (0.029)		
M12_08	M061095	0.951 (0.039)	-0.015 (0.028)			
M12_09	M061264	0.636 (0.023)	0.473 (0.026)		-0.126 (0.046)	0.126 (0.051)
M12_10	M061108	0.564 (0.071)	0.548 (0.142)	0.161 (0.047)		
M12_11A	M061211A	1.290 (0.051)	0.224 (0.022)			
M12_11B	M061211B	1.514 (0.121)	0.624 (0.039)	0.254 (0.018)		
M14_01	M061240	0.795 (0.037)	0.631 (0.035)			
M14_02	M061254	0.882 (0.037)	0.086 (0.029)			
M14_03	M061244	1.045 (0.081)	0.031 (0.072)	0.251 (0.031)		
M14_04	M061041	1.374 (0.136)	1.104 (0.045)	0.242 (0.016)		
M14_05	M061173	0.737 (0.033)	-0.222 (0.036)			
M14_06	M061252	1.327 (0.092)	0.669 (0.035)	0.132 (0.016)		
M14_07	M061261	1.337 (0.051)	0.195 (0.021)			
M14_08	M061224	0.872 (0.039)	0.622 (0.032)			
M14_09	M061077	0.879 (0.058)	-0.038 (0.064)	0.069 (0.028)		
M14_10A	M061069A	0.741 (0.034)	-0.713 (0.045)			
M14_10B	M061069B	0.743 (0.034)	-0.055 (0.035)			

Appendix 13B: TIMSS 2015 Fourth Grade Science Item Parameters from Concurrent Calibration

TIMSS 2015 Fourth Grade Science Item Parameters from Concurrent Calibration

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
Items Released in 2011:						
S01_01	S031356	1.128 (0.101)	-0.924 (0.117)	0.485 (0.039)		
S01_02	S031291	1.368 (0.090)	-0.780 (0.064)	0.260 (0.031)		
S01_03	S031230	0.770 (0.060)	-1.374 (0.155)	0.231 (0.053)		
S01_04	S031325	0.620 (0.034)	0.440 (0.041)			
S01_05	S031068	1.163 (0.108)	0.589 (0.051)	0.276 (0.022)		
S01_06	S031418	0.807 (0.072)	0.551 (0.062)	0.152 (0.024)		
S01_07Z	S031197Z	0.441 (0.016)	-0.873 (0.046)		-0.548 (0.083)	0.548 (0.067)
S01_08	S031371	0.790 (0.079)	0.588 (0.070)	0.193 (0.027)		
S01_09	S031376	1.197 (0.121)	0.917 (0.047)	0.220 (0.018)		
S01_10	S031044	0.635 (0.033)	-0.023 (0.038)			
S01_11Z	S031390Z	0.760 (0.030)	0.195 (0.022)		0.399 (0.038)	-0.399 (0.038)
S02_01	S051057	0.692 (0.034)	-0.092 (0.036)			
S02_02	S051032	0.962 (0.081)	0.400 (0.057)	0.199 (0.024)		
S02_03Z	S051049Z	0.328 (0.027)	0.599 (0.080)			
S02_04	S051033	0.791 (0.111)	0.941 (0.085)	0.304 (0.028)		
S02_05	S051173	0.914 (0.050)	1.120 (0.047)			
S02_06	S051086	0.757 (0.063)	-0.757 (0.128)	0.248 (0.044)		
S02_07	S051179	0.883 (0.063)	-0.815 (0.098)	0.209 (0.038)		
S02_08	S051074	0.452 (0.033)	1.252 (0.091)			
S02_09	S051119	0.634 (0.038)	1.039 (0.059)			
S02_10	S051071	0.890 (0.086)	0.644 (0.060)	0.196 (0.024)		
S02_11	S051100	1.353 (0.128)	1.040 (0.041)	0.148 (0.014)		
S02_12	S051156	1.420 (0.169)	1.275 (0.052)	0.185 (0.013)		
S03_01	S041117	0.558 (0.051)	-2.428 (0.318)	0.282 (0.092)		
S03_02	S041120	1.784 (0.276)	1.166 (0.054)	0.436 (0.014)		
S03_03	S041003	0.603 (0.032)	0.010 (0.040)			
S03_04	S041224	0.869 (0.033)	0.433 (0.021)		0.380 (0.032)	-0.380 (0.037)
S03_05	S041163	0.566 (0.140)	1.784 (0.196)	0.278 (0.033)		
S03_06	S041039	0.788 (0.037)	-0.032 (0.032)			
S03_07	S041014	1.739 (0.239)	1.317 (0.052)	0.250 (0.013)		
S03_08	S041181	0.601 (0.031)	-0.533 (0.048)			
S03_09	S041174	0.821 (0.040)	0.455 (0.032)			
S03_10	S041049	1.041 (0.089)	0.461 (0.054)	0.212 (0.024)		

TIMSS 2015 Fourth Grade Science Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
S03_11	S041208	0.259 (0.074)	1.138 (0.521)	0.277 (0.086)		
S03_12	S041060	1.008 (0.056)	1.138 (0.046)			
S03_13A	S041201A	1.181 (0.050)	0.200 (0.023)			
S03_13B	S041201B	1.187 (0.054)	0.444 (0.024)			
S05_01	S031340	0.810 (0.086)	0.692 (0.070)	0.213 (0.026)		
S05_02	S031236	0.743 (0.061)	-0.584 (0.117)	0.222 (0.040)		
S05_03Z	S031391Z	0.557 (0.024)	0.287 (0.028)		0.141 (0.050)	-0.141 (0.052)
S05_04	S031361	0.790 (0.088)	0.441 (0.090)	0.301 (0.031)		
S05_05	S031001	1.113 (0.071)	-0.775 (0.071)	0.192 (0.031)		
S05_07	S031410	0.473 (0.070)	-0.047 (0.248)	0.305 (0.058)		
S05_08	S031421	0.513 (0.029)	-0.622 (0.058)			
S05_09	S031298	1.262 (0.207)	1.468 (0.081)	0.266 (0.016)		
S05_10	S031076	0.700 (0.037)	0.520 (0.038)			
S05_11	S031275	0.899 (0.152)	1.484 (0.100)	0.242 (0.021)		
S06_01	S041311	0.594 (0.052)	-2.574 (0.314)	0.298 (0.095)		
S06_02	S041178	1.170 (0.143)	0.830 (0.060)	0.380 (0.021)		
S06_03	S041182	0.692 (0.035)	0.285 (0.035)			
S06_04	S041180	1.452 (0.098)	0.180 (0.039)	0.220 (0.021)		
S06_05	S041187	1.189 (0.229)	1.698 (0.117)	0.224 (0.015)		
S06_06A	S041013A	0.586 (0.036)	0.890 (0.056)			
S06_06B	S041013B	0.577 (0.040)	1.431 (0.086)			
S06_07	S041067	0.929 (0.040)	-0.326 (0.032)			
S06_08	S041305	1.276 (0.121)	0.743 (0.045)	0.261 (0.019)		
S06_09	S041048	0.901 (0.041)	0.259 (0.028)			
S06_10	S041110	0.698 (0.034)	-0.249 (0.038)			
S06_11	S041069	1.152 (0.111)	0.431 (0.060)	0.350 (0.024)		
S06_12	S041100	1.314 (0.098)	0.495 (0.038)	0.185 (0.019)		
S06_13	S041092	0.843 (0.082)	0.232 (0.085)	0.288 (0.031)		
S07_01	S031254	0.644 (0.113)	0.930 (0.128)	0.381 (0.035)		
S07_02	S031266	1.210 (0.079)	0.158 (0.042)	0.158 (0.020)		
S07_03	S031233	0.644 (0.032)	-0.446 (0.044)			
S07_04	S031204	0.652 (0.035)	0.495 (0.040)			
S07_05	S031273	1.451 (0.108)	0.284 (0.041)	0.261 (0.021)		
S07_06	S031299	0.563 (0.033)	0.502 (0.046)			
S07_07	S031281	0.965 (0.069)	-0.982 (0.100)	0.238 (0.039)		

TIMSS 2015 Fourth Grade Science Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
S07_08	S031077	0.710 (0.072)	-0.375 (0.143)	0.332 (0.043)		
S07_09	S031311	1.200 (0.093)	0.085 (0.057)	0.290 (0.026)		
S07_10Z	S031088Z	0.583 (0.017)	0.136 (0.034)		1.498 (0.052)	-1.498 (0.053)
S07_11	S031389	1.229 (0.131)	0.943 (0.048)	0.240 (0.018)		
Items Common in 2011 and 2015:						
S01_01	S041010	1.003 (0.052)	-0.763 (0.066)	0.253 (0.028)		
S01_02	S041034	0.631 (0.048)	-0.167 (0.108)	0.259 (0.034)		
S01_03	S041017	0.978 (0.085)	1.031 (0.045)	0.256 (0.016)		
S01_04	S041124	1.128 (0.087)	0.882 (0.038)	0.276 (0.015)		
S01_05	S041186	0.643 (0.028)	1.086 (0.042)			
S01_06	S041037	0.568 (0.015)	-0.101 (0.020)		-0.104 (0.038)	0.104 (0.035)
S01_07	S041119	1.115 (0.077)	0.112 (0.058)	0.438 (0.021)		
S01_08	S041105	0.957 (0.047)	-0.105 (0.045)	0.157 (0.020)		
S01_10Z	S041149Z	0.632 (0.015)	0.969 (0.021)		-1.015 (0.043)	1.015 (0.049)
S01_11	S041032	0.886 (0.029)	-1.284 (0.040)			
S01_12	S041068	0.768 (0.027)	0.283 (0.023)			
S01_13	S041303	0.708 (0.066)	0.777 (0.069)	0.258 (0.024)		
S03_01	S051041	0.987 (0.084)	0.726 (0.051)	0.359 (0.018)		
S03_02	S051037	0.804 (0.027)	0.073 (0.022)			
S03_03	S051008	0.917 (0.035)	1.120 (0.032)			
S03_04	S051004	1.422 (0.068)	-0.031 (0.033)	0.254 (0.018)		
S03_05Z	S051026Z	0.538 (0.024)	0.810 (0.040)			
S03_06	S051130	0.580 (0.028)	1.384 (0.058)			
S03_07	S051114	1.283 (0.082)	0.640 (0.032)	0.262 (0.015)		
S03_08Z	S051121Z	0.398 (0.020)	0.191 (0.041)			
S03_09	S051147	0.821 (0.031)	0.972 (0.031)			
S03_10	S051105	1.025 (0.063)	-0.076 (0.059)	0.341 (0.023)		
S03_11	S051110	0.936 (0.053)	0.082 (0.049)	0.207 (0.021)		
S03_12	S051111	1.198 (0.083)	0.382 (0.046)	0.386 (0.018)		
S05_01	S041009	0.842 (0.049)	-0.764 (0.086)	0.283 (0.031)		
S05_02	S041223	1.101 (0.071)	0.385 (0.042)	0.301 (0.018)		
S05_03	S041026	0.532 (0.042)	0.337 (0.085)	0.126 (0.027)		
S05_04	S041177	0.370 (0.015)	1.186 (0.046)		0.325 (0.049)	-0.325 (0.066)
S05_05	S041183	0.660 (0.015)	0.236 (0.020)		1.114 (0.031)	-1.114 (0.033)
S05_06	S041008	1.172 (0.078)	0.706 (0.034)	0.239 (0.014)		

TIMSS 2015 Fourth Grade Science Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
S05_08	S041195	0.675 (0.032)	1.460 (0.056)			
S05_09A	S041134A	0.868 (0.033)	0.967 (0.030)			
S05_09B	S041134B	0.802 (0.027)	0.137 (0.022)			
S05_09C	S041134C	0.797 (0.055)	0.509 (0.051)	0.193 (0.020)		
S05_10	S041191	0.946 (0.088)	0.924 (0.051)	0.322 (0.017)		
S05_11	S041107	0.394 (0.010)	-0.849 (0.034)		-0.940 (0.066)	0.940 (0.056)
S05_12	S041113	0.837 (0.029)	0.414 (0.022)			
S06_01	S051185	1.092 (0.057)	0.362 (0.033)	0.165 (0.015)		
S06_02	S051048	0.653 (0.018)	0.110 (0.017)		0.168 (0.032)	-0.168 (0.031)
S06_03	S051164	0.912 (0.042)	1.585 (0.052)			
S06_04	S051186	0.622 (0.022)	-0.939 (0.041)			
S06_05	S051137	0.720 (0.040)	-0.930 (0.095)	0.165 (0.034)		
S06_06	S051007	0.894 (0.028)	-0.048 (0.021)			
S06_07	S051087	1.091 (0.056)	-0.420 (0.054)	0.278 (0.023)		
S06_08Z	S051188Z	0.602 (0.023)	0.277 (0.028)			
S06_10	S051201	0.715 (0.026)	0.419 (0.025)			
S06_11	S051102	0.923 (0.057)	0.175 (0.052)	0.249 (0.021)		
S06_12	S051095	0.585 (0.022)	-0.364 (0.033)			
S07_01	S041027	0.727 (0.025)	-1.765 (0.055)			
S07_02	S041043	0.626 (0.022)	-0.557 (0.034)			
S07_03	S041050	0.457 (0.049)	0.614 (0.127)	0.180 (0.037)		
S07_04	S041070	0.930 (0.059)	0.452 (0.045)	0.215 (0.019)		
S07_05	S041006	0.463 (0.016)	0.646 (0.027)		0.302 (0.040)	-0.302 (0.047)
S07_06	S041052	1.036 (0.064)	-0.225 (0.065)	0.381 (0.025)		
S07_07	S041301	0.657 (0.027)	0.915 (0.036)			
S07_09	S041033	0.884 (0.034)	1.049 (0.031)			
S07_11	S041077	0.749 (0.027)	0.348 (0.024)			
S07_12	S041209	0.707 (0.057)	0.763 (0.057)	0.172 (0.021)		
S07_13	S041081	0.535 (0.014)	0.514 (0.020)		-0.408 (0.040)	0.408 (0.043)
S07_14	S041102	0.982 (0.055)	-0.120 (0.054)	0.244 (0.023)		
S09_01	S051044	0.524 (0.022)	0.178 (0.032)			
S09_03	S051003	0.765 (0.041)	-0.024 (0.051)	0.112 (0.020)		
S09_04	S051168	0.778 (0.026)	-0.076 (0.023)			
S09_05	S051010	0.830 (0.027)	0.093 (0.021)			
S09_06	S051035	1.462 (0.137)	1.283 (0.039)	0.250 (0.010)		

TIMSS 2015 Fourth Grade Science Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
S09_07	S051059	0.632 (0.024)	0.193 (0.027)			
S09_08	S051142	0.954 (0.063)	0.613 (0.040)	0.197 (0.017)		
S09_09A	S051131A	1.099 (0.055)	-0.002 (0.040)	0.205 (0.019)		
S09_09B	S051131B	1.154 (0.072)	0.632 (0.033)	0.210 (0.015)		
S09_10	S051151	0.998 (0.031)	-0.976 (0.031)			
S09_11	S051157	0.839 (0.070)	0.956 (0.048)	0.200 (0.017)		
S11_01	S051161	0.495 (0.054)	0.683 (0.114)	0.207 (0.034)		
S11_02	S051051	1.821 (0.191)	1.349 (0.037)	0.311 (0.009)		
S11_03Z	S051138Z	0.592 (0.023)	0.378 (0.029)			
S11_04	S051194	1.004 (0.036)	1.014 (0.027)			
S11_05	S051029	0.527 (0.070)	1.330 (0.095)	0.216 (0.028)		
S11_06	S051077	0.842 (0.027)	-0.154 (0.023)			
S11_07	S051200	0.737 (0.031)	1.156 (0.040)			
S11_08	S051075	0.749 (0.025)	-0.471 (0.029)			
S11_09	S051065	1.026 (0.065)	-0.015 (0.059)	0.352 (0.023)		
S11_10	S051191	1.348 (0.075)	0.552 (0.028)	0.204 (0.014)		
S11_11	S051099	0.927 (0.057)	0.298 (0.049)	0.222 (0.020)		
S11_12	S051175	0.912 (0.034)	0.946 (0.028)			
S13_01	S051054	1.026 (0.051)	-0.387 (0.052)	0.223 (0.023)		
S13_02	S051024	0.689 (0.026)	0.646 (0.028)			
S13_03A	S051132A	0.975 (0.037)	1.163 (0.032)			
S13_03B	S051132B	0.864 (0.033)	0.977 (0.030)			
S13_04	S051040	0.430 (0.021)	0.553 (0.042)			
S13_05	S051193	1.043 (0.062)	0.035 (0.051)	0.307 (0.021)		
S13_06	S051063	1.263 (0.083)	0.810 (0.030)	0.220 (0.013)		
S13_07	S051012	1.149 (0.068)	0.323 (0.039)	0.272 (0.018)		
S13_08	S051115	1.216 (0.036)	0.142 (0.016)			
S13_09	S051180	1.014 (0.073)	0.228 (0.059)	0.395 (0.021)		
S13_10	S051106	1.150 (0.080)	0.785 (0.035)	0.240 (0.015)		
S13_11	S051148	1.145 (0.068)	0.277 (0.041)	0.276 (0.018)		
Items Introduced in 2015:						
S02_01	S061105	0.685 (0.094)	0.184 (0.166)	0.416 (0.045)		
S02_02	S061010	0.431 (0.028)	0.023 (0.053)			
S02_03	S061028	0.931 (0.141)	1.183 (0.079)	0.326 (0.024)		
S02_04	S061065	1.076 (0.076)	-0.144 (0.065)	0.214 (0.031)		

TIMSS 2015 Fourth Grade Science Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
S02_05	S061130	0.856 (0.041)	0.433 (0.030)			
S02_06	S061081	0.979 (0.047)	0.762 (0.032)			
S02_07	S061060	0.851 (0.039)	0.024 (0.030)			
S02_08	S061075	0.584 (0.055)	-0.371 (0.154)	0.088 (0.053)		
S02_09	S061031	1.085 (0.051)	0.817 (0.030)			
S02_10A	S061049A	0.682 (0.048)	-0.473 (0.093)	0.017 (0.034)		
S02_10B	S061049B	0.584 (0.064)	0.235 (0.129)	0.130 (0.045)		
S02_11	S061098	0.836 (0.130)	1.257 (0.086)	0.276 (0.026)		
S02_12	S061172	0.628 (0.038)	1.015 (0.056)			
S04_01	S061135	0.734 (0.066)	-0.690 (0.149)	0.246 (0.052)		
S04_02	S061069	0.400 (0.026)	-0.365 (0.064)			
S04_03	S061134	0.634 (0.057)	0.124 (0.096)	0.086 (0.035)		
S04_04	S061140	1.031 (0.103)	0.586 (0.063)	0.296 (0.025)		
S04_05	S061019	0.892 (0.046)	0.934 (0.039)			
S04_06	S061022	0.639 (0.075)	0.301 (0.129)	0.245 (0.042)		
S04_07	S061036	0.997 (0.048)	0.852 (0.033)			
S04_08	S061160	0.748 (0.035)	-0.885 (0.050)			
S04_09	S061159	0.907 (0.040)	-0.715 (0.041)			
S04_10	S061091	0.444 (0.022)	1.207 (0.055)		-0.162 (0.062)	0.162 (0.082)
S04_11	S061118	1.080 (0.101)	0.641 (0.054)	0.245 (0.023)		
S04_12	S061097	0.825 (0.095)	0.584 (0.087)	0.300 (0.032)		
S08_01	S061141	1.416 (0.123)	0.524 (0.045)	0.305 (0.021)		
S08_02	S061023	0.777 (0.037)	0.178 (0.031)			
S08_03	S061054	0.470 (0.016)	0.738 (0.040)		1.567 (0.055)	-1.567 (0.074)
S08_04	S061007	0.680 (0.060)	-0.235 (0.118)	0.130 (0.044)		
S08_05	S061006	0.897 (0.040)	-0.566 (0.038)			
S08_06	S061108	1.090 (0.102)	0.266 (0.071)	0.345 (0.029)		
S08_07	S061109	0.525 (0.080)	0.605 (0.166)	0.210 (0.052)		
S08_08	S061080	0.986 (0.088)	0.258 (0.072)	0.273 (0.030)		
S08_09	S061088	0.756 (0.045)	1.252 (0.059)			
S08_10	S061151	0.987 (0.045)	0.473 (0.027)			
S08_11	S061150	0.711 (0.037)	0.458 (0.036)			
S08_12	S061169	1.133 (0.093)	0.191 (0.062)	0.273 (0.028)		
S10_01	S061071	0.375 (0.035)	-0.951 (0.122)	0.250 (0.000)		
S10_02	S061138	0.689 (0.034)	-0.023 (0.036)			

TIMSS 2015 Fourth Grade Science Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
S10_03A	S061016A	0.939 (0.083)	0.397 (0.064)	0.210 (0.028)		
S10_03B	S061016B	1.032 (0.047)	0.570 (0.027)			
S10_04	S061011	0.823 (0.037)	-0.393 (0.036)			
S10_06	S061083	0.723 (0.034)	-0.872 (0.051)			
S10_07	S061034	0.832 (0.047)	1.120 (0.049)			
S10_08	S061044	0.800 (0.040)	0.568 (0.034)			
S10_09A	S061142A	0.678 (0.036)	0.451 (0.037)			
S10_09B	S061142B	0.841 (0.046)	0.992 (0.044)			
S10_10A	S061115A	1.649 (0.128)	0.419 (0.038)	0.282 (0.020)		
S10_10B	S061115B	1.465 (0.141)	0.669 (0.044)	0.325 (0.020)		
S12_01	S061132	0.794 (0.087)	0.654 (0.078)	0.222 (0.030)		
S12_02	S061120	1.033 (0.086)	0.411 (0.057)	0.212 (0.026)		
S12_03	S061025	0.556 (0.030)	-0.445 (0.051)			
S12_04A	S061133A	1.417 (0.110)	0.263 (0.048)	0.303 (0.024)		
S12_04B	S061133B	1.835 (0.131)	0.824 (0.025)	0.120 (0.012)		
S12_05	S061074	0.860 (0.040)	0.227 (0.029)			
S12_06	S061093	0.817 (0.027)	0.009 (0.024)		0.914 (0.040)	-0.914 (0.034)
S12_07	S061161	0.693 (0.038)	0.686 (0.040)			
S12_08A	S061042A	1.493 (0.136)	0.801 (0.038)	0.250 (0.018)		
S12_08B	S061042B	0.812 (0.078)	0.672 (0.064)	0.141 (0.026)		
S12_09A	S061041A	0.903 (0.041)	0.127 (0.028)			
S12_09B	S061041B	0.836 (0.040)	0.236 (0.030)			
S12_10	S061155	0.809 (0.077)	-0.453 (0.138)	0.305 (0.049)		
S14_02	S061014	0.521 (0.022)	-0.646 (0.037)		0.853 (0.066)	-0.853 (0.047)
S14_03	S061056	0.951 (0.041)	-0.682 (0.038)			
S14_04	S061015	0.786 (0.036)	-0.304 (0.036)			
S14_05	S061113	0.829 (0.043)	0.866 (0.039)			
S14_06	S061107	1.017 (0.090)	0.677 (0.051)	0.180 (0.022)		
S14_07	S061046	1.220 (0.118)	0.842 (0.046)	0.233 (0.019)		
S14_08	S061047	0.849 (0.081)	-0.380 (0.126)	0.366 (0.043)		
S14_09	S061048	1.466 (0.120)	0.590 (0.039)	0.252 (0.019)		
S14_10	S061096	1.221 (0.116)	0.730 (0.048)	0.264 (0.021)		
S14_11	S061124	0.628 (0.039)	1.201 (0.065)			
S14_12	S061116	0.707 (0.036)	0.192 (0.034)			

Appendix 13C: TIMSS 2015 Eighth Grade Mathematics Item Parameters from Concurrent Calibration

TIMSS 2015 Eighth Grade Mathematics Item Parameters from Concurrent Calibration

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
Items Released in 2011:						
M01_01	M032166	1.015 (0.079)	0.060 (0.068)	0.188 (0.029)		
M01_02	M032721	0.941 (0.126)	1.280 (0.078)	0.269 (0.021)		
M01_03	M032757	0.540 (0.016)	-0.347 (0.030)		-1.922 (0.100)	1.922 (0.097)
M01_04A	M032760A	1.040 (0.031)	0.546 (0.019)		-1.082 (0.064)	1.082 (0.066)
M01_04B	M032760B	1.747 (0.080)	0.876 (0.025)			
M01_04C	M032760C	1.888 (0.094)	1.108 (0.027)			
M01_05	M032761	1.381 (0.052)	1.085 (0.022)		-0.096 (0.033)	0.096 (0.042)
M01_06	M032692	0.688 (0.022)	0.924 (0.030)		-1.302 (0.077)	1.302 (0.084)
M01_07	M032626	0.934 (0.075)	0.303 (0.066)	0.154 (0.027)		
M01_08	M032595	1.550 (0.102)	0.220 (0.036)	0.137 (0.017)		
M01_09	M032673	1.451 (0.110)	0.414 (0.042)	0.201 (0.019)		
M02_01	M052216	1.333 (0.100)	-0.294 (0.062)	0.262 (0.030)		
M02_02	M052231	0.699 (0.037)	-1.182 (0.059)			
M02_03	M052061	0.992 (0.043)	0.249 (0.030)			
M02_04	M052228	1.475 (0.098)	0.569 (0.033)	0.098 (0.013)		
M02_05	M052214	1.193 (0.130)	1.057 (0.058)	0.262 (0.018)		
M02_06	M052173	2.602 (0.242)	1.335 (0.029)	0.076 (0.007)		
M02_07	M052302	1.078 (0.077)	-0.486 (0.076)	0.185 (0.036)		
M02_08	M052002	1.083 (0.039)	1.230 (0.027)		-0.507 (0.050)	0.507 (0.060)
M02_09	M052362	1.093 (0.046)	0.281 (0.028)			
M02_10	M052408	0.899 (0.042)	0.624 (0.036)			
M02_11	M052084	1.579 (0.106)	0.311 (0.035)	0.143 (0.016)		
M02_12	M052206	1.088 (0.050)	0.865 (0.035)			
M02_13	M052429	0.941 (0.080)	0.476 (0.064)	0.168 (0.025)		
M02_14A	M052503A	0.645 (0.039)	1.482 (0.079)			
M02_14B	M052503B	0.563 (0.041)	1.833 (0.113)			
M03_01	M042032	0.911 (0.074)	-0.464 (0.103)	0.227 (0.044)		
M03_02	M042031	1.670 (0.136)	0.474 (0.040)	0.259 (0.017)		
M03_03	M042186	1.087 (0.046)	0.182 (0.028)			
M03_04	M042059	0.852 (0.027)	-0.023 (0.022)		-0.209 (0.043)	0.209 (0.043)
M03_05	M042236	1.532 (0.117)	0.221 (0.044)	0.243 (0.020)		

TIMSS 2015 Eighth Grade Mathematics Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
M03_06	M042226	1.421 (0.058)	0.163 (0.023)			
M03_07	M042103	0.985 (0.052)	1.341 (0.052)			
M03_08	M042086	1.258 (0.054)	0.530 (0.028)			
M03_09	M042228	0.808 (0.038)	0.521 (0.039)			
M03_10	M042245	1.871 (0.158)	1.080 (0.034)	0.127 (0.010)		
M03_11	M042270	0.944 (0.041)	0.043 (0.031)			
M03_12	M042201	1.359 (0.056)	0.119 (0.024)			
M03_13	M042152	0.723 (0.083)	0.716 (0.099)	0.218 (0.033)		
M03_14	M042269	0.745 (0.083)	0.207 (0.127)	0.292 (0.041)		
M03_15	M042179	0.851 (0.067)	-0.010 (0.081)	0.149 (0.033)		
M03_16	M042177	1.059 (0.084)	0.113 (0.065)	0.207 (0.028)		
M03_17	M042207	0.403 (0.012)	-0.210 (0.036)		-2.851 (0.137)	2.851 (0.135)
M05_01	M032094	1.334 (0.105)	0.038 (0.057)	0.282 (0.026)		
M05_02	M032662	2.085 (0.200)	1.282 (0.034)	0.130 (0.009)		
M05_03	M032064	1.438 (0.063)	0.698 (0.026)			
M05_04	M032419	1.490 (0.136)	0.768 (0.044)	0.263 (0.017)		
M05_05	M032477	1.878 (0.149)	0.575 (0.034)	0.232 (0.015)		
M05_06	M032538	1.400 (0.058)	0.226 (0.024)			
M05_07	M032324	1.300 (0.113)	0.847 (0.044)	0.182 (0.016)		
M05_08	M032116	1.336 (0.128)	0.810 (0.050)	0.271 (0.018)		
M05_09	M032100	1.043 (0.078)	0.314 (0.055)	0.144 (0.023)		
M05_10	M032402	0.921 (0.110)	0.827 (0.081)	0.315 (0.026)		
M05_11	M032734	0.787 (0.036)	-0.471 (0.039)			
M05_12	M032397	1.150 (0.102)	0.645 (0.054)	0.219 (0.021)		
M05_13	M032695	0.593 (0.018)	-0.148 (0.028)		-0.927 (0.069)	0.927 (0.067)
M05_14	M032132	0.697 (0.062)	0.275 (0.093)	0.128 (0.033)		
M06_01	M042041	1.452 (0.112)	-0.234 (0.057)	0.297 (0.028)		
M06_02	M042024	1.612 (0.106)	0.051 (0.037)	0.167 (0.019)		
M06_03	M042016	0.882 (0.086)	0.491 (0.078)	0.232 (0.028)		
M06_04	M042002	0.761 (0.039)	0.884 (0.047)			
M06_05A	M042198A	1.205 (0.052)	-0.767 (0.032)			
M06_05B	M042198B	1.071 (0.046)	0.250 (0.028)			
M06_05C	M042198C	1.882 (0.091)	1.014 (0.026)			
M06_06	M042077	1.621 (0.131)	0.487 (0.040)	0.252 (0.018)		
M06_07	M042235	1.586 (0.100)	0.181 (0.033)	0.123 (0.016)		

TIMSS 2015 Eighth Grade Mathematics Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
M06_08	M042067	2.243 (0.248)	1.122 (0.037)	0.285 (0.013)		
M06_09	M042150	0.834 (0.089)	0.827 (0.074)	0.198 (0.025)		
M06_10Z	M042300Z	0.814 (0.026)	0.316 (0.023)		-0.352 (0.046)	0.352 (0.048)
M06_11	M042260	0.997 (0.090)	-0.065 (0.090)	0.307 (0.035)		
M06_12A	M042169A	1.240 (0.052)	0.187 (0.025)			
M06_12B	M042169B	0.349 (0.029)	1.137 (0.110)			
M06_12C	M042169C	0.818 (0.050)	1.572 (0.072)			
M07_01	M032352	1.474 (0.140)	0.356 (0.056)	0.391 (0.022)		
M07_02	M032725	1.305 (0.059)	0.804 (0.030)			
M07_03	M032683	0.638 (0.020)	0.767 (0.030)		-1.196 (0.073)	1.196 (0.079)
M07_04	M032738	1.450 (0.105)	-0.169 (0.050)	0.234 (0.026)		
M07_05	M032295	1.489 (0.113)	-0.420 (0.059)	0.290 (0.030)		
M07_06	M032331	2.251 (0.231)	1.209 (0.035)	0.188 (0.011)		
M07_07	M032623	1.911 (0.133)	0.613 (0.028)	0.126 (0.012)		
M07_08	M032679	1.261 (0.098)	0.285 (0.050)	0.216 (0.022)		
M07_09	M032047	2.155 (0.281)	1.095 (0.046)	0.426 (0.014)		
M07_10	M032398	1.683 (0.168)	0.838 (0.045)	0.320 (0.016)		
M07_11	M032507	1.840 (0.166)	1.013 (0.036)	0.187 (0.012)		
M07_12	M032424	1.217 (0.090)	0.352 (0.046)	0.161 (0.020)		
M07_13A	M032681A	0.519 (0.030)	-0.720 (0.060)			
M07_13B	M032681B	0.551 (0.033)	0.889 (0.064)			
M07_13C	M032681C	1.067 (0.048)	0.400 (0.030)			
Items Common in 2011 and 2015:						
M01_01	M042182	1.660 (0.105)	0.280 (0.035)	0.375 (0.015)		
M01_02	M042081	0.912 (0.030)	0.676 (0.026)			
M01_03	M042049	1.177 (0.073)	0.108 (0.049)	0.308 (0.020)		
M01_04	M042052	1.809 (0.080)	-0.043 (0.023)	0.134 (0.013)		
M01_05	M042076	1.202 (0.071)	0.515 (0.036)	0.207 (0.015)		
M01_06A	M042302A	0.951 (0.022)	0.381 (0.015)		-0.203 (0.028)	0.203 (0.030)
M01_06B	M042302B	0.937 (0.020)	0.477 (0.015)		-0.633 (0.034)	0.633 (0.036)
M01_06C	M042302C	0.527 (0.015)	1.639 (0.042)		-1.036 (0.059)	1.036 (0.076)
M01_07	M042100	1.391 (0.079)	0.183 (0.037)	0.270 (0.017)		
M01_08	M042202	1.599 (0.095)	0.479 (0.030)	0.274 (0.013)		
M01_09	M042240	1.408 (0.066)	0.169 (0.028)	0.137 (0.014)		
M01_10	M042093	1.743 (0.062)	1.112 (0.020)			

TIMSS 2015 Eighth Grade Mathematics Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
M01_11	M042271	1.143 (0.057)	0.256 (0.034)	0.122 (0.015)		
M01_12	M042268	1.530 (0.095)	1.037 (0.027)	0.151 (0.009)		
M01_13	M042159	0.474 (0.021)	-0.834 (0.049)			
M01_14	M042164	1.393 (0.043)	0.507 (0.018)			
M01_15	M042167	1.371 (0.045)	0.803 (0.020)			
M03_01	M052209	1.459 (0.068)	-0.052 (0.031)	0.157 (0.016)		
M03_02	M052142	1.030 (0.064)	0.818 (0.037)	0.144 (0.014)		
M03_03	M052006	1.481 (0.112)	1.016 (0.035)	0.303 (0.011)		
M03_04	M052035	1.473 (0.043)	0.318 (0.016)			
M03_05	M052016	1.487 (0.043)	0.400 (0.016)			
M03_06	M052064	1.536 (0.090)	0.613 (0.030)	0.240 (0.012)		
M03_07	M052126	1.861 (0.065)	1.115 (0.019)			
M03_08	M052103	1.126 (0.058)	0.247 (0.037)	0.140 (0.016)		
M03_09	M052066	1.408 (0.077)	0.440 (0.031)	0.212 (0.014)		
M03_10	M052041	1.230 (0.044)	1.280 (0.029)			
M03_11	M052057	0.659 (0.045)	0.048 (0.093)	0.151 (0.034)		
M03_12	M052417	0.962 (0.030)	0.298 (0.022)			
M03_13	M052501	0.874 (0.031)	1.000 (0.031)			
M03_14	M052410	0.848 (0.068)	0.599 (0.067)	0.286 (0.023)		
M03_15	M052170	1.143 (0.098)	1.221 (0.045)	0.270 (0.013)		
M05_01	M042183	0.681 (0.044)	-0.105 (0.091)	0.143 (0.034)		
M05_02	M042060	1.333 (0.066)	0.112 (0.033)	0.169 (0.016)		
M05_03	M042019	0.765 (0.026)	0.488 (0.028)			
M05_04	M042023	1.286 (0.038)	0.490 (0.019)			
M05_05	M042197	1.084 (0.036)	0.928 (0.026)			
M05_06	M042234	1.470 (0.074)	0.300 (0.029)	0.176 (0.014)		
M05_07	M042066	0.683 (0.024)	0.253 (0.029)			
M05_08	M042243	1.926 (0.084)	0.358 (0.019)	0.095 (0.009)		
M05_09	M042248	1.508 (0.046)	0.682 (0.018)			
M05_10Z	M042229Z	1.187 (0.028)	0.759 (0.014)		-0.300 (0.027)	0.300 (0.030)
M05_11A	M042080A	0.752 (0.026)	0.499 (0.028)			
M05_11B	M042080B	1.313 (0.048)	1.313 (0.028)			
M05_12	M042120	1.075 (0.067)	0.023 (0.058)	0.295 (0.023)		
M05_13	M042203	1.512 (0.072)	0.123 (0.028)	0.154 (0.014)		
M05_14	M042264	0.837 (0.032)	1.281 (0.039)			

TIMSS 2015 Eighth Grade Mathematics Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
M05_15	M042255	0.657 (0.041)	-0.367 (0.101)	0.134 (0.038)		
M05_16	M042224	0.915 (0.029)	-0.075 (0.023)			
M06_01	M052017	1.238 (0.065)	0.126 (0.038)	0.187 (0.017)		
M06_02	M052217	1.368 (0.043)	0.777 (0.020)			
M06_03	M052021	1.025 (0.023)	0.627 (0.015)		-0.332 (0.029)	0.332 (0.032)
M06_04	M052095	1.636 (0.048)	0.442 (0.016)			
M06_05	M052094	1.189 (0.041)	1.126 (0.027)			
M06_06	M052131	1.256 (0.084)	0.829 (0.036)	0.241 (0.013)		
M06_07	M052090	1.276 (0.086)	0.881 (0.036)	0.227 (0.013)		
M06_08A	M052121A	1.045 (0.052)	0.260 (0.036)	0.098 (0.016)		
M06_08B	M052121B	1.890 (0.079)	1.472 (0.025)			
M06_09	M052042	0.910 (0.029)	0.533 (0.025)			
M06_10	M052047	1.136 (0.034)	0.342 (0.020)			
M06_11	M052044	1.636 (0.151)	1.157 (0.039)	0.398 (0.011)		
M06_12A	M052422A	0.825 (0.063)	0.054 (0.090)	0.318 (0.031)		
M06_12B	M052422B	0.705 (0.048)	0.266 (0.076)	0.143 (0.028)		
M06_13	M052505	1.165 (0.065)	-0.831 (0.069)	0.242 (0.037)		
M07_01	M042015	0.947 (0.050)	-0.432 (0.064)	0.158 (0.029)		
M07_02	M042196	1.098 (0.050)	0.013 (0.036)	0.091 (0.016)		
M07_03	M042194	1.184 (0.035)	-0.441 (0.020)			
M07_04A	M042114A	1.537 (0.044)	-0.055 (0.016)			
M07_04B	M042114B	1.549 (0.045)	0.205 (0.015)			
M07_05	M042112	0.869 (0.085)	1.113 (0.062)	0.318 (0.018)		
M07_06	M042109	1.656 (0.110)	1.020 (0.029)	0.222 (0.010)		
M07_07	M042050	1.152 (0.036)	0.684 (0.021)			
M07_08A	M042074A	1.067 (0.033)	0.556 (0.022)			
M07_08B	M042074B	0.970 (0.032)	0.739 (0.025)			
M07_08C	M042074C	1.754 (0.058)	0.977 (0.018)			
M07_09	M042151	0.892 (0.028)	0.014 (0.023)			
M07_10	M042132	1.847 (0.127)	1.158 (0.027)	0.200 (0.009)		
M07_11	M042257	0.708 (0.054)	0.855 (0.060)	0.132 (0.021)		
M07_12	M042158	0.782 (0.066)	0.310 (0.091)	0.337 (0.029)		
M07_13	M042252	1.141 (0.071)	0.798 (0.036)	0.175 (0.013)	(0.013)	
M07_14	M042261	0.692 (0.045)	-0.079 (0.088)	0.142 (0.033)		
M09_01	M052413	1.194 (0.070)	0.096 (0.046)	0.276 (0.020)		

TIMSS 2015 Eighth Grade Mathematics Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
M09_02	M052134	1.227 (0.060)	-0.156 (0.039)	0.159 (0.020)		
M09_03	M052078	1.052 (0.071)	0.926 (0.040)	0.181 (0.014)		
M09_04	M052034	1.406 (0.092)	0.634 (0.036)	0.301 (0.014)		
M09_05A	M052174A	1.088 (0.033)	0.284 (0.020)			
M09_05B	M052174B	1.167 (0.039)	1.055 (0.026)			
M09_06	M052130	1.289 (0.078)	0.949 (0.031)	0.151 (0.011)		
M09_07	M052073	1.486 (0.075)	0.521 (0.026)	0.146 (0.011)		
M09_08	M052110	1.527 (0.047)	0.682 (0.018)			
M09_09	M052105	1.144 (0.044)	1.490 (0.036)			
M09_10	M052407	1.294 (0.092)	0.399 (0.048)	0.404 (0.017)		
M09_11	M052036	0.756 (0.026)	0.420 (0.027)			
M09_12	M052502	1.146 (0.034)	-0.237 (0.020)			
M09_13	M052117	0.580 (0.031)	2.163 (0.095)			
M09_14	M052426	0.794 (0.045)	-0.833 (0.099)	0.168 (0.044)		
M11_01	M052079	1.057 (0.074)	0.529 (0.050)	0.296 (0.018)		
M11_02	M052204	0.855 (0.057)	0.505 (0.054)	0.179 (0.021)		
M11_03	M052364	1.135 (0.033)	0.023 (0.019)			
M11_04	M052215	0.853 (0.027)	-0.186 (0.024)			
M11_05	M052147	1.586 (0.104)	0.820 (0.031)	0.273 (0.011)		
M11_06	M052067	1.083 (0.063)	0.125 (0.049)	0.237 (0.021)		
M11_07	M052068	1.475 (0.095)	1.236 (0.030)	0.125 (0.008)		
M11_08	M052087	1.591 (0.056)	1.156 (0.022)			
M11_09	M052048	1.006 (0.036)	1.166 (0.031)			
M11_10	M052039	1.292 (0.038)	0.341 (0.018)			
M11_11	M052208	2.351 (0.131)	1.128 (0.019)	0.077 (0.005)		
M11_12A	M052419A	0.912 (0.042)	-0.237 (0.047)	0.077 (0.021)		
M11_12B	M052419B	1.419 (0.063)	-0.546 (0.036)	0.124 (0.021)		
M11_13	M052115	1.800 (0.078)	0.398 (0.019)	0.085 (0.009)		
M11_14	M052421	0.802 (0.027)	0.640 (0.028)			
M13_01	M052024	1.628 (0.091)	0.530 (0.027)	0.228 (0.012)		
M13_02A	M052058A	1.226 (0.036)	-0.259 (0.019)			
M13_02B	M052058B	1.529 (0.050)	0.998 (0.020)			
M13_03	M052125	1.344 (0.067)	0.652 (0.026)	0.109 (0.011)		
M13_04	M052229	0.960 (0.029)	0.095 (0.021)			
M13_05	M052063	1.316 (0.075)	0.635 (0.031)	0.186 (0.013)		

TIMSS 2015 Eighth Grade Mathematics Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
M13_06	M052072	1.043 (0.054)	0.048 (0.043)	0.138 (0.020)		
M13_07A	M052146A	0.849 (0.027)	0.247 (0.024)			
M13_07B	M052146B	1.655 (0.059)	1.221 (0.022)			
M13_08	M052092	1.198 (0.095)	1.499 (0.042)	0.139 (0.009)		
M13_09	M052046	1.148 (0.101)	1.517 (0.047)	0.186 (0.010)		
M13_10	M052083	1.553 (0.090)	0.900 (0.026)	0.159 (0.010)		
M13_11	M052082	1.185 (0.064)	0.248 (0.038)	0.181 (0.017)		
M13_12	M052161	1.163 (0.062)	-0.093 (0.046)	0.203 (0.022)		
M13_13A	M052418A	1.976 (0.108)	0.742 (0.022)	0.165 (0.009)		
M13_13B	M052418B	1.738 (0.102)	0.611 (0.027)	0.244 (0.012)		
Items Introduced in 2015:						
M02_01	M062208	1.027 (0.043)	-0.102 (0.029)			
M02_02	M062153	0.927 (0.090)	0.551 (0.075)	0.209 (0.029)		
M02_03A	M062111A	1.376 (0.056)	0.164 (0.023)			
M02_03B	M062111B	1.676 (0.072)	0.646 (0.022)			
M02_04	M062237	1.731 (0.084)	1.050 (0.027)			
M02_05	M062314	1.127 (0.056)	1.166 (0.039)			
M02_06	M062074	1.112 (0.145)	1.248 (0.067)	0.295 (0.019)		
M02_07	M062183	0.955 (0.042)	0.259 (0.031)			
M02_08	M062202	1.135 (0.087)	-0.035 (0.068)	0.189 (0.033)		
M02_09	M062246	2.166 (0.197)	1.105 (0.031)	0.172 (0.011)		
M02_10	M062286	1.083 (0.043)	1.354 (0.030)		-0.174 (0.041)	0.174 (0.056)
M02_11	M062325	0.887 (0.134)	1.062 (0.097)	0.378 (0.028)		
M02_12	M062106	0.504 (0.051)	1.101 (0.101)	0.250 (0.000)		
M02_13	M062124	1.444 (0.104)	0.607 (0.037)	0.122 (0.016)		
M04_01	M062329	0.809 (0.079)	-0.615 (0.173)	0.240 (0.072)		
M04_02	M062151	1.251 (0.055)	0.813 (0.030)			
M04_03	M062346	1.136 (0.050)	0.779 (0.031)			
M04_04	M062212	1.344 (0.117)	1.170 (0.042)	0.113 (0.012)		
M04_05	M062056	1.326 (0.064)	1.127 (0.034)			
M04_06	M062317	1.419 (0.063)	0.871 (0.028)			
M04_07	M062350	1.342 (0.153)	1.588 (0.057)	0.124 (0.011)		
M04_08	M062078	1.599 (0.069)	0.704 (0.024)			
M04_09	M062284	0.674 (0.094)	0.463 (0.163)	0.306 (0.050)		
M04_10	M062245	1.277 (0.108)	0.710 (0.047)	0.192 (0.019)		
M04_11	M062287	1.237 (0.067)	1.450 (0.045)			

TIMSS 2015 Eighth Grade Mathematics Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
M04_12A	M062345A	0.584 (0.025)	0.569 (0.033)		0.297 (0.051)	-0.297 (0.060)
M04_13	M062115	1.577 (0.179)	1.397 (0.047)	0.199 (0.013)		
M08_01	M062005	0.843 (0.097)	0.491 (0.106)	0.308 (0.036)		
M08_02	M062139	1.008 (0.045)	0.636 (0.033)			
M08_03	M062164	1.389 (0.099)	0.154 (0.046)	0.180 (0.023)		
M08_04	M062142	0.912 (0.040)	-0.224 (0.033)			
M08_05	M062084	1.398 (0.167)	1.582 (0.057)	0.151 (0.012)		
M08_06	M062351	0.797 (0.125)	1.643 (0.098)	0.194 (0.022)		
M08_07	M062223	1.306 (0.092)	-0.140 (0.056)	0.175 (0.029)		
M08_08	M062027	0.765 (0.037)	0.606 (0.040)			
M08_09	M062174	1.521 (0.156)	0.891 (0.049)	0.324 (0.017)		
M08_10	M062244	0.990 (0.043)	0.483 (0.031)			
M08_11	M062261	1.706 (0.183)	1.498 (0.044)	0.128 (0.010)		
M08_12	M062300	0.738 (0.023)	0.472 (0.025)		-0.500 (0.051)	0.500 (0.055)
M08_13	M062254	0.651 (0.042)	1.739 (0.091)			
M08_14A	M062132A	1.186 (0.050)	-0.251 (0.028)			
M08_14B	M062132B	1.123 (0.116)	0.858 (0.061)	0.258 (0.022)		
M10_01	M062150	1.136 (0.047)	-0.174 (0.027)			
M10_02	M062335	1.418 (0.096)	-0.067 (0.048)	0.159 (0.025)		
M10_03	M062219	2.076 (0.179)	0.883 (0.032)	0.224 (0.013)		
M10_04	M062002	0.698 (0.035)	0.670 (0.044)			
M10_05	M062149	1.204 (0.091)	0.613 (0.044)	0.126 (0.019)		
M10_06	M062241	1.764 (0.076)	0.674 (0.022)			
M10_08	M062105	0.800 (0.025)	0.906 (0.026)		-1.435 (0.082)	1.435 (0.086)
M10_09	M062040	0.882 (0.103)	0.967 (0.077)	0.236 (0.026)		
M10_10	M062288	0.809 (0.027)	1.137 (0.030)		-0.842 (0.062)	0.842 (0.071)
M10_11	M062173	1.151 (0.052)	0.819 (0.032)			
M10_12	M062133	1.350 (0.119)	0.722 (0.048)	0.240 (0.019)		
M10_13A	M062123A	1.741 (0.149)	0.436 (0.044)	0.320 (0.020)		
M10_13B	M062123B	1.545 (0.116)	0.752 (0.036)	0.138 (0.014)		
M12_01	M062271	1.631 (0.132)	0.583 (0.041)	0.247 (0.018)		
M12_02	M062152	1.130 (0.048)	0.448 (0.028)			
M12_03	M062215	0.855 (0.029)	0.744 (0.025)		-0.194 (0.042)	0.194 (0.049)
M12_04	M062143	1.650 (0.074)	0.887 (0.025)			
M12_05	M062230	1.624 (0.187)	1.414 (0.048)	0.218 (0.012)		

TIMSS 2015 Eighth Grade Mathematics Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
M12_06	M062095	1.674 (0.133)	0.615 (0.038)	0.224 (0.017)		
M12_07	M062076	1.806 (0.145)	0.319 (0.041)	0.294 (0.020)		
M12_08	M062030	0.513 (0.030)	0.039 (0.050)			
M12_09	M062171	0.821 (0.065)	-0.231 (0.102)	0.083 (0.047)		
M12_10	M062301	1.147 (0.054)	1.050 (0.036)			
M12_11	M062194	1.002 (0.088)	-0.308 (0.106)	0.261 (0.047)		
M12_12	M062344	0.890 (0.044)	1.106 (0.045)			
M12_13	M062320	1.886 (0.122)	0.566 (0.028)	0.097 (0.012)		
M12_14	M062296	1.168 (0.049)	0.221 (0.027)			
M14_01	M062001	1.025 (0.127)	0.915 (0.076)	0.346 (0.024)		
M14_02	M062214	1.158 (0.049)	0.453 (0.028)			
M14_03	M062146	1.399 (0.106)	0.759 (0.037)	0.126 (0.015)		
M14_04	M062154	1.352 (0.054)	-0.030 (0.024)			
M14_05	M062067	1.212 (0.112)	0.173 (0.073)	0.344 (0.029)		
M14_06	M062341	1.036 (0.166)	1.727 (0.092)	0.235 (0.017)		
M14_07	M062242	1.248 (0.090)	0.190 (0.051)	0.161 (0.024)		
M14_08A	M062250A	1.175 (0.048)	0.186 (0.026)			
M14_08B	M062250B	1.388 (0.063)	0.885 (0.028)			
M14_09	M062170	0.524 (0.025)	0.990 (0.044)		0.645 (0.053)	-0.645 (0.074)
M14_10	M062192	1.058 (0.053)	1.178 (0.042)			
M14_11	M062072	1.018 (0.043)	0.204 (0.029)			
M14_13	M062120	1.274 (0.099)	0.540 (0.045)	0.162 (0.020)		

Appendix 13D: TIMSS 2015 Eighth Grade Science Item Parameters from Concurrent Calibration

TIMSS 2015 Eighth Grade Science Item Parameters from Concurrent Calibration

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
Items Released in 2011:						
S01_01	S032611	1.027 (0.141)	1.240 (0.069)	0.229 (0.020)		
S01_02	S032614	0.805 (0.039)	-0.155 (0.036)			
S01_03	S032451	0.637 (0.019)	0.012 (0.025)		-1.232 (0.072)	1.232 (0.071)
S01_04	S032156	1.160 (0.120)	0.722 (0.055)	0.259 (0.022)		
S01_05	S032056	0.871 (0.043)	0.407 (0.033)			
S01_06	S032087	0.927 (0.099)	0.739 (0.065)	0.201 (0.025)		
S01_07	S032279	0.768 (0.117)	1.395 (0.094)	0.179 (0.024)		
S01_08	S032238	1.326 (0.118)	0.723 (0.043)	0.191 (0.018)		
S01_09	S032369	0.597 (0.024)	0.702 (0.032)		-0.297 (0.055)	0.297 (0.063)
S01_10	S032160	0.856 (0.097)	0.295 (0.102)	0.340 (0.035)		
S01_11	S032654	0.958 (0.093)	0.588 (0.064)	0.205 (0.025)		
S01_12	S032126	0.764 (0.038)	0.050 (0.036)			
S01_13	S032510	0.965 (0.086)	-0.069 (0.089)	0.295 (0.035)		
S01_14	S032158	0.949 (0.099)	0.268 (0.088)	0.329 (0.032)		
S02_01	S052093	0.579 (0.061)	-1.426 (0.272)	0.299 (0.078)		
S02_02	S052088	0.999 (0.080)	-0.156 (0.078)	0.237 (0.033)		
S02_03	S052030	0.821 (0.113)	0.944 (0.084)	0.268 (0.028)		
S02_04	S052080	0.665 (0.084)	0.255 (0.142)	0.303 (0.044)		
S02_05	S052091	0.834 (0.041)	0.169 (0.033)			
S02_06	S052152	1.500 (0.129)	0.781 (0.037)	0.169 (0.016)		
S02_07	S052136	0.830 (0.041)	0.157 (0.033)			
S02_08	S052046	1.585 (0.123)	-0.447 (0.061)	0.353 (0.032)		
S02_09	S052254	0.826 (0.112)	1.120 (0.078)	0.206 (0.025)		
S02_10	S052207	1.065 (0.051)	0.651 (0.031)			
S02_11A	S052165A	0.867 (0.054)	1.385 (0.065)			
S02_11B	S052165B	0.718 (0.044)	1.124 (0.060)			
S02_11C	S052165C	0.889 (0.047)	0.864 (0.041)			
S02_12	S052297	0.831 (0.087)	0.251 (0.097)	0.277 (0.035)		
S02_13	S052032	1.156 (0.062)	1.101 (0.040)			
S02_14	S052106	0.748 (0.045)	0.948 (0.052)			

TIMSS 2015 Eighth Grade Science Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
S03_01	S042304	0.769 (0.063)	-0.059 (0.086)	0.148 (0.033)		
S03_02	S042038	0.902 (0.080)	0.472 (0.063)	0.160 (0.026)		
S03_03	S042298	1.066 (0.051)	0.679 (0.032)			
S03_04	S042261	0.915 (0.049)	0.929 (0.043)			
S03_05A	S042051A	0.762 (0.038)	0.018 (0.036)			
S03_05B	S042051B	1.323 (0.061)	0.683 (0.027)			
S03_06	S042076	1.020 (0.049)	0.622 (0.032)			
S03_07	S042404	0.934 (0.042)	1.216 (0.035)		0.049 (0.038)	-0.049 (0.057)
S03_08	S042306	1.132 (0.141)	0.986 (0.060)	0.268 (0.021)		
S03_09	S042403	0.963 (0.049)	0.801 (0.037)			
S03_10	S042272	0.902 (0.088)	0.221 (0.085)	0.269 (0.033)		
S03_11	S042100	0.508 (0.023)	0.545 (0.036)		-0.051 (0.060)	0.051 (0.068)
S03_12A	S042238A	0.733 (0.082)	0.793 (0.078)	0.155 (0.028)		
S03_12B	S042238B	0.775 (0.047)	1.166 (0.060)			
S03_12C	S042238C	0.904 (0.043)	-0.600 (0.039)			
S03_13	S042141	0.792 (0.072)	-0.196 (0.110)	0.242 (0.041)		
S03_14	S042215	0.751 (0.167)	1.794 (0.163)	0.237 (0.025)		
S05_01	S032542	1.360 (0.137)	0.692 (0.049)	0.293 (0.020)		
S05_02	S032645	1.014 (0.121)	0.755 (0.070)	0.307 (0.025)		
S05_03Z	S032530Z	0.547 (0.023)	0.348 (0.035)		0.956 (0.054)	-0.956 (0.060)
S05_04	S032007	0.842 (0.041)	0.355 (0.034)			
S05_05	S032502	0.997 (0.089)	0.549 (0.057)	0.172 (0.024)		
S05_06	S032679	0.812 (0.052)	1.429 (0.070)			
S05_07	S032184	0.361 (0.078)	1.376 (0.236)	0.180 (0.056)		
S05_08	S032394	0.981 (0.106)	0.598 (0.071)	0.277 (0.027)		
S05_09	S032151	1.106 (0.101)	0.648 (0.051)	0.179 (0.022)		
S05_10A	S032651A	1.206 (0.053)	0.353 (0.025)			
S05_10B	S032651B	1.031 (0.057)	1.148 (0.046)			
S05_11A	S032665A	0.947 (0.046)	0.505 (0.032)			
S05_11B	S032665B	1.076 (0.056)	0.985 (0.039)			
S05_11C	S032665C	0.990 (0.054)	0.919 (0.040)			
S06_01	S042073	0.764 (0.091)	-0.715 (0.206)	0.507 (0.052)		
S06_02	S042017	1.073 (0.132)	1.130 (0.061)	0.216 (0.019)		
S06_03	S042007	1.349 (0.125)	0.786 (0.043)	0.201 (0.018)		
S06_04	S042024	1.286 (0.185)	1.310 (0.065)	0.273 (0.017)		

TIMSS 2015 Eighth Grade Science Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
S06_05	S042095	1.036 (0.075)	-0.282 (0.071)	0.199 (0.032)		
S06_06	S042022	0.918 (0.044)	0.493 (0.033)			
S06_07	S042063	1.016 (0.093)	-1.154 (0.139)	0.401 (0.052)		
S06_08	S042197	1.098 (0.113)	0.791 (0.055)	0.219 (0.021)		
S06_09	S042297	0.548 (0.021)	1.167 (0.044)		-0.959 (0.073)	0.959 (0.087)
S06_10	S042305	0.556 (0.029)	1.190 (0.051)		0.320 (0.053)	-0.320 (0.078)
S06_11	S042112	0.450 (0.057)	-0.012 (0.213)	0.185 (0.056)		
S06_12Z	S042173Z	0.447 (0.019)	-0.667 (0.046)		1.354 (0.084)	-1.354 (0.062)
S06_13	S042407	0.528 (0.034)	0.769 (0.062)			
S06_14	S042278	0.804 (0.043)	0.758 (0.042)			
S06_15	S042274	1.450 (0.183)	1.269 (0.053)	0.222 (0.014)		
S06_17	S042317	0.617 (0.021)	-0.097 (0.027)		-0.471 (0.059)	0.471 (0.056)
S07_01	S032465	0.840 (0.083)	0.153 (0.095)	0.270 (0.035)		
S07_02	S032315	0.862 (0.087)	0.590 (0.071)	0.196 (0.027)		
S07_03	S032306	0.527 (0.017)	0.466 (0.030)		-1.229 (0.076)	1.229 (0.080)
S07_04	S032640	0.590 (0.033)	-0.215 (0.046)			
S07_05	S032579	1.254 (0.188)	1.278 (0.067)	0.305 (0.018)		
S07_06	S032570	0.971 (0.046)	0.501 (0.031)			
S07_07	S032024	1.074 (0.157)	1.265 (0.073)	0.252 (0.020)		
S07_08	S032272	1.142 (0.068)	1.369 (0.052)			
S07_09	S032141	2.043 (0.198)	1.005 (0.032)	0.189 (0.013)		
S07_10	S032060	1.168 (0.051)	-0.434 (0.030)			
S07_11	S032463	1.383 (0.109)	0.255 (0.048)	0.238 (0.023)		
S07_12Z	S032650Z	0.757 (0.030)	0.087 (0.024)		0.164 (0.044)	-0.164 (0.043)
S07_13	S032514	0.605 (0.089)	0.856 (0.121)	0.223 (0.038)		
Items Common in 2011 and 2015:						
S01_01	S042258	0.803 (0.069)	0.990 (0.053)	0.175 (0.019)		
S01_02	S042005	0.341 (0.008)	0.469 (0.030)		-2.474 (0.089)	2.474 (0.091)
S01_03	S042016	1.019 (0.087)	1.310 (0.045)	0.137 (0.012)		
S01_04A	S042300A	1.389 (0.041)	0.103 (0.016)			
S01_04B	S042300B	0.589 (0.030)	1.603 (0.071)			
S01_04C	S042300C	1.136 (0.035)	0.182 (0.018)			
S01_05	S042319	1.320 (0.044)	0.815 (0.020)			
S01_06	S042068	1.329 (0.098)	0.973 (0.033)	0.216 (0.012)		
S01_07	S042216	1.140 (0.085)	0.494 (0.049)	0.348 (0.019)		

TIMSS 2015 Eighth Grade Science Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
S01_08	S042249	0.858 (0.062)	0.620 (0.051)	0.185 (0.020)		
S01_09	S042094	0.836 (0.031)	0.788 (0.029)			
S01_10A	S042293A	0.910 (0.030)	-0.320 (0.024)			
S01_10B	S042293B	0.902 (0.045)	1.796 (0.063)			
S01_11	S042195	0.658 (0.034)	1.761 (0.074)			
S01_12	S042400	1.063 (0.039)	0.991 (0.027)			
S01_14	S042164	1.047 (0.063)	0.548 (0.037)	0.145 (0.016)		
S03_01	S052261	0.981 (0.075)	0.754 (0.046)	0.234 (0.018)		
S03_02Z	S052092Z	0.340 (0.013)	0.577 (0.038)		1.011 (0.058)	-1.011 (0.067)
S03_03A	S052263A	1.386 (0.054)	1.277 (0.028)			
S03_03B	S052263B	1.627 (0.057)	1.018 (0.020)			
S03_04	S052265	0.810 (0.031)	0.905 (0.032)			
S03_05	S052280	0.976 (0.069)	0.453 (0.052)	0.267 (0.021)		
S03_06	S052256	1.150 (0.077)	0.762 (0.035)	0.194 (0.015)		
S03_07Z	S052043Z	0.503 (0.025)	1.201 (0.059)			
S03_08	S052194	1.148 (0.080)	0.774 (0.037)	0.213 (0.015)		
S03_09	S052179	0.904 (0.081)	1.044 (0.050)	0.218 (0.017)		
S03_10	S052233	0.755 (0.035)	1.490 (0.054)			
S03_11	S052159	0.497 (0.068)	0.365 (0.204)	0.385 (0.046)		
S03_12A	S052289A	0.841 (0.052)	-0.911 (0.104)	0.279 (0.040)		
S03_12B	S052289B	0.563 (0.051)	0.736 (0.084)	0.140 (0.028)		
S03_12C	S052289C	0.822 (0.031)	0.746 (0.029)			
S05_01	S042053	1.226 (0.067)	-0.124 (0.046)	0.265 (0.022)		
S05_02	S042408	0.739 (0.028)	0.650 (0.030)			
S05_03	S042015	0.959 (0.078)	0.710 (0.051)	0.279 (0.019)		
S05_04	S042309	0.321 (0.047)	1.084 (0.211)	0.144 (0.048)		
S05_05A	S042049A	0.980 (0.032)	-0.579 (0.026)			
S05_05B	S042049B	1.141 (0.036)	0.280 (0.019)			
S05_06	S042182	0.694 (0.048)	-0.311 (0.100)	0.214 (0.035)		
S05_07	S042402	0.886 (0.035)	1.144 (0.036)			
S05_08A	S042228A	1.449 (0.053)	1.105 (0.024)			
S05_08B	S042228B	1.285 (0.038)	0.033 (0.017)			
S05_08C	S042228C	1.527 (0.047)	0.556 (0.016)			
S05_09	S042126	0.784 (0.075)	0.273 (0.099)	0.415 (0.029)		
S05_10	S042210	1.018 (0.131)	1.504 (0.069)	0.293 (0.014)		
S05_11	S042176	1.038 (0.036)	0.694 (0.023)			

TIMSS 2015 Eighth Grade Science Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
S05_12	S042211	0.878 (0.030)	0.163 (0.023)			
S05_13	S042135	0.795 (0.028)	-0.167 (0.026)			
S05_14	S042257	0.674 (0.089)	1.163 (0.086)	0.312 (0.025)		
S06_01	S052003	1.062 (0.083)	0.230 (0.065)	0.431 (0.022)		
S06_02	S052071	1.326 (0.075)	0.510 (0.030)	0.182 (0.014)		
S06_03	S052246	0.921 (0.077)	0.898 (0.049)	0.232 (0.018)		
S06_04	S052276	0.687 (0.052)	0.094 (0.089)	0.221 (0.031)		
S06_05A	S052303A	0.609 (0.051)	-0.008 (0.120)	0.247 (0.037)		
S06_05B	S052303B	0.738 (0.028)	0.541 (0.028)			
S06_06	S052125	0.898 (0.118)	1.099 (0.074)	0.456 (0.019)		
S06_07	S052145	1.274 (0.039)	0.426 (0.017)			
S06_08	S052049	0.701 (0.022)	0.808 (0.023)		0.455 (0.029)	-0.455 (0.039)
S06_09	S052063	0.673 (0.057)	0.627 (0.073)	0.189 (0.026)		
S06_10	S052192	1.403 (0.061)	0.247 (0.024)	0.092 (0.012)		
S06_11	S052232	0.460 (0.074)	1.557 (0.125)	0.198 (0.034)		
S06_12	S052141	1.221 (0.043)	0.892 (0.023)			
S06_13	S052096	0.901 (0.061)	0.070 (0.067)	0.281 (0.026)		
S06_14	S052116	0.836 (0.022)	0.218 (0.016)		0.129 (0.028)	-0.129 (0.028)
S06_15	S052110	0.906 (0.036)	1.073 (0.033)			
S07_01	S042042	0.761 (0.062)	-0.227 (0.114)	0.389 (0.035)		
S07_02	S042030	0.843 (0.034)	1.147 (0.037)			
S07_03	S042003	0.690 (0.075)	0.978 (0.075)	0.261 (0.025)		
S07_04	S042110	0.573 (0.041)	-0.592 (0.137)	0.181 (0.044)		
S07_05A	S042222A	1.001 (0.040)	1.233 (0.035)			
S07_05B	S042222B	0.990 (0.035)	0.859 (0.026)			
S07_05C	S042222C	0.853 (0.059)	0.100 (0.071)	0.270 (0.026)		
S07_06	S042065	0.838 (0.062)	-0.556 (0.113)	0.411 (0.036)		
S07_07	S042280	1.289 (0.065)	0.251 (0.032)	0.162 (0.016)		
S07_08	S042088	0.653 (0.025)	0.060 (0.029)			
S07_09	S042218	1.474 (0.088)	0.531 (0.030)	0.243 (0.014)		
S07_10	S042104	0.918 (0.035)	1.040 (0.032)			
S07_11	S042064	0.859 (0.032)	0.770 (0.028)			
S07_12	S042273	1.213 (0.037)	0.288 (0.018)			
S07_13	S042301	0.839 (0.028)	0.053 (0.024)			
S07_14	S042312	0.405 (0.049)	-0.200 (0.282)	0.263 (0.063)		
S07_15	S042217	1.711 (0.111)	0.734 (0.027)	0.257 (0.012)		

TIMSS 2015 Eighth Grade Science Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
S07_16	S042406	1.105 (0.037)	0.680 (0.021)			
S09_01	S052076	0.883 (0.066)	0.497 (0.057)	0.247 (0.022)		
S09_02	S052272	1.115 (0.034)	-0.028 (0.019)			
S09_03A	S052085A	1.009 (0.041)	1.277 (0.036)			
S09_03B	S052085B	1.072 (0.033)	0.052 (0.019)			
S09_04	S052094	0.612 (0.027)	1.047 (0.045)			
S09_05	S052248	1.010 (0.143)	1.487 (0.073)	0.356 (0.015)		
S09_06	S052146	0.993 (0.032)	0.389 (0.021)			
S09_07	S052282	0.828 (0.064)	0.772 (0.051)	0.177 (0.019)		
S09_08	S052299	1.174 (0.075)	0.330 (0.044)	0.287 (0.019)		
S09_09	S052144	1.294 (0.093)	0.742 (0.036)	0.278 (0.015)		
S09_10	S052214	0.995 (0.032)	0.326 (0.021)			
S09_12	S052101	0.590 (0.026)	0.779 (0.039)			
S09_13	S052113	1.713 (0.106)	0.535 (0.028)	0.294 (0.013)		
S09_14	S052107	0.985 (0.089)	1.255 (0.047)	0.173 (0.014)		
S11_01A	S052090A	0.418 (0.054)	-0.163 (0.299)	0.325 (0.063)		
S11_01B	S052090B	0.608 (0.032)	1.805 (0.079)			
S11_02	S052262	0.821 (0.072)	0.790 (0.059)	0.249 (0.021)		
S11_03	S052267	1.003 (0.074)	0.762 (0.043)	0.216 (0.017)		
S11_04	S052273	0.584 (0.019)	0.874 (0.027)		0.201 (0.036)	-0.201 (0.046)
S11_05Z	S052015Z	0.883 (0.029)	-0.119 (0.023)			
S11_06	S052051	1.053 (0.035)	0.683 (0.022)			
S11_07	S052026	0.581 (0.063)	0.348 (0.139)	0.331 (0.038)		
S11_08	S052130	1.005 (0.092)	1.165 (0.046)	0.219 (0.015)		
S11_09	S052028	0.896 (0.074)	0.595 (0.061)	0.304 (0.022)		
S11_10	S052189	1.085 (0.035)	0.424 (0.020)			
S11_11	S052217	0.737 (0.079)	1.015 (0.070)	0.273 (0.023)		
S11_12	S052038	1.002 (0.094)	1.024 (0.050)	0.292 (0.017)		
S11_13	S052099	0.860 (0.031)	0.762 (0.027)			
S11_14	S052118	0.870 (0.036)	1.241 (0.039)			
S13_01	S052006	0.649 (0.019)	-0.067 (0.021)		0.587 (0.036)	-0.587 (0.033)
S13_02	S052069	1.181 (0.099)	0.809 (0.044)	0.342 (0.016)		
S13_03	S052012	0.966 (0.060)	0.421 (0.045)	0.185 (0.019)		
S13_04	S052021	0.892 (0.031)	0.636 (0.025)			
S13_05Z	S052095Z	0.537 (0.022)	-0.220 (0.036)			

TIMSS 2015 Eighth Grade Science Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
S13_06	S052134	2.039 (0.227)	1.399 (0.036)	0.304 (0.009)		
S13_07	S052054	0.764 (0.026)	-0.391 (0.028)			
S13_08	S052150	0.829 (0.084)	1.211 (0.057)	0.213 (0.018)		
S13_09A	S052243A	0.624 (0.025)	0.388 (0.031)			
S13_09B	S052243B	0.778 (0.028)	0.406 (0.026)			
S13_09C	S052243C	0.705 (0.072)	1.070 (0.066)	0.203 (0.022)		
S13_10	S052206	1.133 (0.071)	0.510 (0.038)	0.211 (0.017)		
S13_11A	S052112A	0.809 (0.067)	0.354 (0.077)	0.321 (0.026)		
S13_11B	S052112B	1.045 (0.037)	0.836 (0.025)			
S13_12	S052294	1.105 (0.057)	-0.039 (0.044)	0.185 (0.020)		
Items Introduced in 2015:						
S02_01	S062189	0.433 (0.022)	0.066 (0.038)		0.305 (0.071)	-0.305 (0.069)
S02_02	S062094	0.984 (0.087)	0.439 (0.064)	0.181 (0.028)		
S02_03	S062118	0.866 (0.040)	0.044 (0.032)			
S02_04A	S062103A	1.165 (0.114)	0.621 (0.058)	0.271 (0.024)		
S02_04B	S062103B	0.715 (0.032)	1.057 (0.035)		0.176 (0.043)	-0.176 (0.059)
S02_05	S062010	0.524 (0.034)	0.795 (0.061)			
S02_06	S062253	0.862 (0.082)	0.859 (0.058)	0.094 (0.022)		
S02_07	S062051	0.886 (0.045)	0.844 (0.039)			
S02_08	S062044	1.070 (0.123)	1.338 (0.059)	0.119 (0.016)		
S02_09	S062046	0.855 (0.040)	0.176 (0.032)			
S02_10	S062149	0.426 (0.031)	0.865 (0.076)			
S02_11	S062268	1.024 (0.088)	-0.280 (0.097)	0.296 (0.041)		
S02_12	S062170	0.723 (0.098)	0.280 (0.155)	0.358 (0.047)		
S02_13	S062234	0.791 (0.032)	0.637 (0.027)		0.649 (0.037)	-0.649 (0.047)
S02_14	S062271	0.773 (0.117)	0.991 (0.099)	0.290 (0.033)		
S04_01	S062099	0.827 (0.073)	0.268 (0.079)	0.137 (0.033)		
S04_02	S062095	0.459 (0.022)	0.693 (0.041)		-0.087 (0.065)	0.087 (0.076)
S04_03	S062106	0.651 (0.051)	-1.064 (0.161)	0.000 (0.066)		
S04_04	S062064	0.899 (0.041)	-0.375 (0.035)			
S04_05	S062132	0.918 (0.096)	0.360 (0.088)	0.282 (0.034)		
S04_06	S062163	1.161 (0.066)	1.337 (0.047)			
S04_07	S062153	1.203 (0.142)	0.947 (0.058)	0.298 (0.021)		
S04_08	S062018	0.533 (0.023)	1.452 (0.056)		-0.647 (0.069)	0.647 (0.092)
S04_09	S062143	0.845 (0.057)	1.710 (0.083)			

TIMSS 2015 Eighth Grade Science Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
S04_10	S062276	0.693 (0.040)	0.919 (0.052)			
S04_11	S062050	0.979 (0.050)	0.944 (0.039)			
S04_12	S062205	1.070 (0.098)	0.771 (0.050)	0.150 (0.021)		
S04_13	S062190	0.869 (0.072)	0.074 (0.081)	0.144 (0.035)		
S04_14A	S062024A	0.575 (0.099)	0.937 (0.148)	0.237 (0.047)		
S04_14B	S062024B	0.782 (0.050)	1.500 (0.073)			
S08_01	S062055	0.995 (0.118)	0.140 (0.114)	0.463 (0.036)		
S08_02	S062007	1.183 (0.098)	0.464 (0.051)	0.192 (0.023)		
S08_03	S062275	0.916 (0.046)	0.703 (0.035)			
S08_04	S062225	1.201 (0.173)	1.307 (0.065)	0.259 (0.019)		
S08_05	S062111	0.541 (0.024)	0.536 (0.033)		0.013 (0.056)	-0.013 (0.063)
S08_06A	S062116A	1.156 (0.052)	0.580 (0.027)			
S08_06B	S062116B	1.332 (0.064)	0.931 (0.030)			
S08_06C	S062116C	0.910 (0.054)	1.334 (0.056)			
S08_07	S062262	0.900 (0.129)	1.070 (0.079)	0.286 (0.027)		
S08_08	S062035	1.016 (0.116)	0.996 (0.059)	0.198 (0.022)		
S08_09	S062144	0.677 (0.066)	-0.421 (0.161)	0.161 (0.060)		
S08_10	S062162	0.784 (0.042)	0.792 (0.042)			
S08_11	S062233	0.958 (0.126)	0.783 (0.083)	0.349 (0.029)		
S08_13	S062171	0.399 (0.084)	0.558 (0.346)	0.153 (0.092)		
S10_01	S062090	0.988 (0.100)	0.120 (0.095)	0.335 (0.036)		
S10_02	S062274	0.599 (0.024)	0.818 (0.036)		1.097 (0.047)	-1.097 (0.066)
S10_03	S062284	0.399 (0.081)	0.390 (0.372)	0.162 (0.096)		
S10_04A	S062098A	0.616 (0.024)	0.399 (0.028)		-0.070 (0.052)	0.070 (0.055)
S10_04B	S062098B	0.745 (0.033)	1.278 (0.040)		-0.137 (0.047)	0.137 (0.066)
S10_05	S062032	1.779 (0.280)	1.448 (0.057)	0.296 (0.014)		
S10_06	S062043	0.913 (0.047)	0.902 (0.040)			
S10_07	S062158	0.781 (0.117)	0.819 (0.110)	0.349 (0.035)		
S10_08	S062159	0.977 (0.086)	0.336 (0.069)	0.197 (0.029)		
S10_09	S062005	1.309 (0.058)	0.638 (0.026)			
S10_10	S062075	1.073 (0.130)	0.780 (0.071)	0.343 (0.025)		
S10_11	S062004	1.836 (0.150)	0.825 (0.031)	0.171 (0.014)		
S10_12	S062175	0.781 (0.041)	0.641 (0.039)			
S10_13A	S062173A	0.716 (0.037)	0.313 (0.038)			
S10_13B	S062173B	0.881 (0.153)	1.622 (0.104)	0.202 (0.021)		

TIMSS 2015 Eighth Grade Science Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
S12_01	S062279	1.215 (0.091)	0.238 (0.052)	0.187 (0.024)		
S12_02	S062112	0.554 (0.032)	0.069 (0.047)			
S12_03	S062119	1.214 (0.097)	0.221 (0.057)	0.232 (0.026)		
S12_04	S062093	0.641 (0.027)	0.097 (0.028)		0.289 (0.050)	-0.289 (0.048)
S12_05	S062089	1.301 (0.120)	0.958 (0.042)	0.153 (0.016)		
S12_06	S062006	1.016 (0.046)	0.402 (0.029)			
S12_07	S062067	0.829 (0.040)	0.400 (0.034)			
S12_08	S062247	1.082 (0.159)	1.321 (0.071)	0.264 (0.020)		
S12_09	S062177	0.823 (0.111)	1.065 (0.079)	0.223 (0.027)		
S12_10	S062186	1.592 (0.184)	1.133 (0.044)	0.256 (0.015)		
S12_11A	S062211A	0.780 (0.039)	0.401 (0.036)			
S12_11B	S062211B	0.843 (0.068)	2.084 (0.119)			
S12_13	S062033	1.143 (0.053)	0.673 (0.029)			
S12_14	S062037	0.891 (0.113)	0.698 (0.088)	0.326 (0.030)		
S12_15	S062242	0.755 (0.038)	-1.198 (0.061)			
S14_01A	S062091A	1.052 (0.097)	-0.523 (0.118)	0.384 (0.047)		
S14_01B	S062091B	0.570 (0.043)	-1.056 (0.096)	0.250 (0.000)		
S14_02	S062100	0.884 (0.042)	0.337 (0.032)			
S14_03	S062097	0.912 (0.080)	0.363 (0.069)	0.151 (0.030)		
S14_04	S062101	0.664 (0.028)	0.196 (0.027)		0.297 (0.047)	-0.297 (0.048)
S14_06	S062128	0.890 (0.041)	-0.002 (0.032)			
S14_07	S062047	0.488 (0.033)	0.716 (0.063)			
S14_08	S062042	0.718 (0.039)	0.667 (0.043)			
S14_09	S062250	0.552 (0.037)	1.133 (0.073)			
S14_10	S062246	0.940 (0.139)	1.185 (0.077)	0.279 (0.024)		
S14_11	S062056	1.093 (0.049)	0.459 (0.028)			
S14_12	S062235	0.751 (0.089)	0.707 (0.091)	0.186 (0.034)		
S14_13	S062180	1.272 (0.108)	0.386 (0.053)	0.243 (0.025)		
S14_14	S062022	0.596 (0.035)	0.627 (0.050)			
S14_15	S062243	0.625 (0.022)	0.030 (0.027)		-0.322 (0.056)	0.322 (0.054)

Appendix 13E: TIMSS Numeracy 2015 Mathematics Item Parameters from Item Calibration

TIMSS Numeracy 2015 Mathematics Item Parameters from Concurrent Calibration

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
Items Released in 2011:						
N01_01	MN11135	0.808 (0.088)	-1.263 (0.135)	0.228 (0.050)		
N01_02	MN11114	1.266 (0.074)	-0.287 (0.037)			
N01_03	MN11216	1.342 (0.072)	-0.862 (0.032)			
N01_04	MN11255	1.010 (0.104)	-0.848 (0.085)	0.203 (0.035)		
N01_05	MN11027	1.023 (0.057)	-1.115 (0.039)			
N01_06	MN11259	1.624 (0.166)	-0.337 (0.046)	0.180 (0.019)		
N01_07	MN11031	0.813 (0.078)	-1.299 (0.114)	0.163 (0.044)		
N01_08	MN11227	0.549 (0.047)	0.379 (0.111)			
N01_09	MN11267	0.636 (0.047)	-2.646 (0.106)			
N01_10	MN11042	0.624 (0.042)	-1.133 (0.057)			
N01_11	MN11184	0.793 (0.050)	-0.664 (0.048)			
N01_12	MN11190	1.129 (0.069)	-0.220 (0.042)			
N01_13	MN11193	1.745 (0.267)	0.172 (0.059)	0.288 (0.018)		
N02_01	MN11009	0.842 (0.092)	-0.959 (0.112)	0.204 (0.042)		
N02_02	MN11024	1.015 (0.058)	-0.783 (0.039)			
N02_03	MN11134	1.188 (0.139)	-0.477 (0.072)	0.257 (0.028)		
N02_04	MN11212	0.871 (0.051)	-1.142 (0.044)			
N02_05	MN11253	1.028 (0.105)	-0.868 (0.084)	0.201 (0.034)		
N02_06	MN11221	2.020 (0.211)	-0.146 (0.038)	0.147 (0.015)		
N02_07	MN11146	0.740 (0.049)	-0.332 (0.057)			
N02_08	MN11177	1.258 (0.080)	0.005 (0.044)			
N02_09	MN11158	0.598 (0.042)	-0.884 (0.059)			
N02_10	MN11002	1.280 (0.197)	0.297 (0.073)	0.217 (0.019)		
N02_11A	MN11182A	0.953 (0.090)	-2.142 (0.138)	0.218 (0.060)		
N02_11B	MN11182B	0.952 (0.089)	-1.591 (0.113)	0.200 (0.048)		
N02_12	MN11272	0.747 (0.053)	1.001 (0.096)		-0.232 (0.082)	0.232 (0.141)
N03_01	MN11017	0.741 (0.047)	-1.982 (0.067)			
N03_02	MN11125	0.843 (0.052)	-0.515 (0.047)			
N03_03	MN11077	1.111 (0.070)	-0.109 (0.045)			
N03_04A	MN11047A	1.054 (0.093)	-1.920 (0.106)	0.186 (0.049)		
N03_04B	MN11047B	1.130 (0.103)	-1.570 (0.094)	0.212 (0.043)		

TIMSS Numeracy 2015 Mathematics Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
N03_05	MN11223	1.115 (0.068)	-0.243 (0.042)			
N03_06	MN11034	0.907 (0.126)	-0.004 (0.083)	0.174 (0.026)		
N03_07	MN11175	1.031 (0.060)	-0.558 (0.040)			
N03_08	MN11262	0.830 (0.123)	-0.031 (0.095)	0.196 (0.031)		
N03_09	MN11239	0.702 (0.155)	0.618 (0.152)	0.207 (0.031)		
N03_10	MN11202	0.842 (0.050)	-1.200 (0.046)			
N03_11	MN11299	1.193 (0.068)	-0.572 (0.036)			
N04_01 *	M061272	0.910 (0.038)	0.121 (0.028)			
N04_02 *	M061243	0.477 (0.015)	-0.220 (0.031)		-0.923 (0.072)	0.923 (0.068)
N04_03 *	M061029	1.151 (0.072)	-0.226 (0.055)	0.139 (0.027)		
N04_04 *	M061031	1.497 (0.087)	0.563 (0.027)	0.066 (0.012)		
N04_05 *	M061050	1.427 (0.104)	0.596 (0.036)	0.184 (0.017)		
N04_06 *	M061167	0.730 (0.033)	-0.826 (0.047)			
N04_07 *	M061206	0.723 (0.069)	0.755 (0.070)	0.105 (0.027)		
N04_08A	M061265A	0.775 (0.083)	1.308 (0.181)			
N04_08B *	M061265B	0.991 (0.103)	1.125 (0.057)	0.183 (0.019)		
N04_09 *	M061185	0.980 (0.063)	-0.503 (0.076)	0.114 (0.036)		
N04_10 *	M061239	1.408 (0.056)	-0.587 (0.026)			
N05_01	MN11076	0.838 (0.087)	-1.454 (0.135)	0.224 (0.051)		
N05_02	MN11141	1.011 (0.056)	-1.115 (0.040)			
N05_03	MN11142	1.693 (0.156)	-0.420 (0.041)	0.133 (0.017)		
N05_04	MN11005	2.124 (0.240)	-0.223 (0.040)	0.225 (0.017)		
N05_05A	MN11256A	0.983 (0.056)	-1.617 (0.046)			
N05_05B	MN11256B	0.944 (0.054)	-1.104 (0.042)			
N05_06	MN11108	1.113 (0.075)	0.151 (0.054)			
N05_07	MN11062	0.322 (0.035)	-0.295 (0.124)			
N05_08	MN11174	0.695 (0.048)	-0.264 (0.062)			
N05_09	MN11067	0.455 (0.070)	-1.218 (0.299)	0.230 (0.074)		
N05_10	MN11043	0.633 (0.056)	-3.583 (0.175)			
N05_11	MN11268	0.725 (0.081)	-0.621 (0.102)	0.130 (0.035)		
N05_12	MN11270	1.152 (0.069)	-0.319 (0.040)			
N06_01	MN11019	0.959 (0.110)	-0.686 (0.091)	0.222 (0.034)		
N06_02	MN11145	0.973 (0.055)	-1.389 (0.043)			
N06_03	MN11211	1.895 (0.172)	-0.683 (0.041)	0.175 (0.020)		
N06_04	MN11014	0.997 (0.059)	-0.475 (0.042)			

* Items with fixed item parameters estimated in TIMSS 2015 fourth grade item calibration.

TIMSS Numeracy 2015 Mathematics Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
N06_05	MN11300	1.071 (0.065)	-0.307 (0.042)			
N06_06	MN11028	1.265 (0.068)	-0.974 (0.034)			
N06_07	MN11231	1.578 (0.339)	0.783 (0.100)	0.199 (0.015)		
N06_08	MN11061	0.795 (0.077)	-2.067 (0.160)	0.204 (0.062)		
N06_09	MN11045	0.953 (0.104)	-0.755 (0.090)	0.200 (0.035)		
N06_10	MN11265	0.760 (0.081)	-2.244 (0.203)	0.261 (0.075)		
N06_11	MN11154	0.594 (0.028)	-0.521 (0.040)		-0.392 (0.077)	0.392 (0.083)
N06_12	MN11240	1.000 (0.197)	0.454 (0.108)	0.267 (0.024)		
N07_01	MN11023	1.494 (0.146)	-0.743 (0.057)	0.227 (0.026)		
N07_02	MN11056	1.062 (0.107)	-0.655 (0.072)	0.169 (0.029)		
N07_03	MN11057	1.110 (0.061)	-1.239 (0.038)			
N07_04	MN11113	0.899 (0.052)	-1.102 (0.043)			
N07_05	MN11200	0.436 (0.019)	-2.284 (0.067)		-1.923 (0.164)	1.923 (0.145)
N07_06	MN11129	1.269 (0.140)	-0.392 (0.062)	0.209 (0.025)		
N07_07	MN11218	0.726 (0.047)	-1.868 (0.065)			
N07_08	MN11036	1.224 (0.157)	0.143 (0.064)	0.157 (0.019)		
N07_09	MN11225	0.652 (0.048)	-0.063 (0.073)			
N07_10	MN11041	0.862 (0.122)	-0.547 (0.122)	0.305 (0.040)		
N07_11	MN11179	0.855 (0.057)	-0.068 (0.058)			
N07_12	MN11303	1.002 (0.075)	0.439 (0.072)			
N07_13	MN11305	0.910 (0.184)	0.445 (0.116)	0.272 (0.027)		
N08_01 *	M061026	0.920 (0.055)	-0.764 (0.079)	0.043 (0.038)		
N08_02 *	M061273	0.815 (0.065)	0.246 (0.073)	0.119 (0.031)		
N08_03 *	M061034	1.230 (0.051)	0.673 (0.025)			
N08_04 *	M061040	1.711 (0.117)	0.601 (0.030)	0.169 (0.015)		
N08_05 *	M061228	0.780 (0.026)	0.878 (0.026)		-0.309 (0.042)	0.309 (0.050)
N08_06 *	M061166	1.141 (0.045)	-0.158 (0.025)			
N08_07 *	M061171	1.316 (0.086)	-0.240 (0.054)	0.201 (0.028)		
N08_08 *	M061080	0.854 (0.039)	0.598 (0.033)			
N08_09 *	M061222	0.904 (0.094)	0.401 (0.089)	0.326 (0.032)		
N08_10 *	M061076	0.583 (0.030)	-0.477 (0.048)			
N08_11 *	M061084	1.119 (0.050)	0.869 (0.031)			
N09_01	MN11128	0.946 (0.057)	-0.446 (0.044)			
N09_02	MN11022	1.170 (0.065)	-1.466 (0.038)			
N09_03	MN11010	1.120 (0.064)	-0.476 (0.038)			

* Items with fixed item parameters estimated in TIMSS 2015 fourth grade item calibration.

TIMSS Numeracy 2015 Mathematics Item Parameters from Concurrent Calibration (Continued)

Item		Slope (a_j)	Location (b_j)	Guessing (c_j)	Step 1 (d_{j1})	Step 2 (d_{j2})
N09_04A	MN11278A	1.186 (0.103)	-1.633 (0.087)	0.191 (0.043)		
N09_04B	MN11278B	1.565 (0.179)	0.051 (0.049)	0.144 (0.016)		
N09_05	MN11136	0.940 (0.054)	-1.033 (0.041)			
N09_06	MN11261	0.975 (0.064)	0.037 (0.055)			
N09_07	MN11033	0.359 (0.035)	-1.269 (0.095)			
N09_08	MN11039	0.615 (0.063)	-1.913 (0.190)	0.176 (0.063)		
N09_09	MN11040	0.381 (0.064)	-0.592 (0.279)	0.172 (0.064)		
N09_10	MN11195	0.644 (0.052)	0.452 (0.103)			
N09_11	MN11188	0.521 (0.043)	-0.087 (0.088)			
N09_12	MN11252	1.793 (0.208)	-0.041 (0.046)	0.183 (0.017)		
N10_01	MN11055	0.939 (0.056)	-1.740 (0.050)			
N10_02	MN11214	1.234 (0.127)	-0.693 (0.068)	0.222 (0.029)		
N10_03A	MN11116A	1.003 (0.059)	-1.807 (0.049)			
N10_03B	MN11116B	1.049 (0.062)	-0.362 (0.042)			
N10_04A	MN11066A	1.105 (0.066)	-0.256 (0.042)			
N10_04B	MN11066B	1.162 (0.075)	0.063 (0.049)			
N10_05	MN11260	1.546 (0.140)	-0.819 (0.052)	0.188 (0.025)		
N10_06	MN11032	0.874 (0.077)	-1.340 (0.097)	0.137 (0.039)		
N10_07	MN11170	0.503 (0.075)	-0.643 (0.200)	0.177 (0.056)		
N10_08	MN11068	0.527 (0.039)	-1.109 (0.066)			
N10_09	MN11269	0.968 (0.056)	-1.415 (0.043)			
N10_10	MN11001	1.049 (0.137)	-0.071 (0.074)	0.196 (0.025)		
N10_11	MN11235	0.501 (0.029)	0.697 (0.088)		-0.796 (0.106)	0.796 (0.144)

CHAPTER 14

Using Scale Anchoring to Interpret the TIMSS 2015 Achievement Scales

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Introduction

As described in Chapter 13: Scaling the TIMSS 2015 Achievement Data, the TIMSS 2015 achievement results are summarized using item response theory (IRT) scaling and reported on 0 to 1,000 achievement scales, with most achievement scores ranging from 300 to 700. Countries' average scores provide users of the data with information about how achievement compares among countries and whether scores are improving or declining over time.

To provide as much information as possible for policy and curriculum reform, however, it is important to understand the mathematics and science competencies associated with different locations within the range of scores on the achievement scales. For example, in terms of levels of student understanding, what does it mean for a country to have average achievement of 513 or 426, and how are these scores different?

The TIMSS 2015 International Benchmarks provide information about what students know and can do at different points along the achievement scales. More specifically, TIMSS has identified four points along the achievement scales to use as international benchmarks of achievement—Advanced International Benchmark (625), High International Benchmark (550), Intermediate International Benchmark (475), and Low International Benchmark (400). For each assessment, the TIMSS & PIRLS International Study Center works with the expert international committee, Science and Mathematics Item Review Committee (SMIRC), to conduct a scale anchoring analysis to describe student competencies at the benchmarks.

This chapter describes the scale anchoring procedures that were applied to describe student performance at the international benchmarks for TIMSS 2015. The analysis was conducted separately for mathematics and for science at fourth and eighth grades. In brief, scale anchoring

involved identifying items that students scoring at the international benchmarks answered correctly, and then having experts examine the content of each item to determine the kind of knowledge, skill, or reasoning demonstrated by students who responded correctly to the item. The experts then summarized the detailed list of item competencies in a brief description of achievement at each international benchmark. Thus, the scale anchoring procedure yielded a content-referenced interpretation of the achievement results that can be considered in light of the TIMSS 2015 frameworks for assessing mathematics and science.

Classifying the Items

As the first step, students scoring within 5 scale-score points of each benchmark (i.e., the benchmark point plus or minus 5) were identified for the benchmark analysis. This 10-point range provided an adequate sample of students scoring at the benchmark, and yet was small enough so that performance at one international benchmark was still distinguishable from the next. The score ranges around each international benchmark and the number of students scoring in each range are shown in Exhibit 14.1.

Exhibit 14.1: Range Around Each International Benchmark and Number of Students Within Each Range

	Low (400)	Intermediate (475)	High (550)	Advanced (625)
Range of Scale Scores	*395–405*	*470–480*	*545–555*	*620–630*
TIMSS Grade 4 Mathematics (Includes Numeracy)	6,209	10,218	11,078	5,546
TIMSS Grade 4 Science	4,021	8,717	11,554	5,421
TIMSS Grade 8 Mathematics	6,999	8,525	7,756	4,041
TIMSS Grade 8 Science	5,860	8,462	8,878	4,627

The second step involved computing the percentage of those students scoring in the range around each international benchmark that answered each item correctly. To compute these percentages, students in each country were weighted proportionally to the size of the student population in the country. For multiple-choice items and constructed response items worth 1 point, it was a straightforward matter of computing the percentage of students at each benchmark who answered each item correctly. For constructed response items scored for partial and full credit, percentages were computed for students receiving partial credit (1-point) as well as for students receiving full credit (2-points).

Third, the criteria described below were applied to identify the items that anchored at each benchmark. An important feature of the scale anchoring method is that it yields descriptions of the performance demonstrated by students reaching each of the international benchmarks on

the scales, and that the descriptions reflect demonstrably different accomplishments by students reaching each successively higher benchmark. Because the process entails the delineation of sets of items that students at each international benchmark are likely to answer correctly and that discriminate between one benchmark and the next, the criteria for identifying the items that anchor considers performance at more than one benchmark.

For multiple-choice items, 65 percent was used as the criterion for anchoring at each benchmark being analyzed, since students would be likely (about two thirds of the time) to answer the item correctly. A somewhat less strict criterion was used for the constructed response items, because students had much less scope for guessing. For constructed response items, the criterion of 50 percent was used for the benchmark without any discrimination criterion for the next lower benchmark. In addition, a criterion of less than 50 percent was used for the next lower benchmark, because with this response probability, students were more likely to have answered the item incorrectly than correctly.

Using a multiple-choice items as an example, the criteria for each benchmark are outlined below.

- A multiple-choice item anchored at the Low International Benchmark (400) if at least 65 percent of students scoring in the range answered the item correctly. Because this was the lowest benchmark described, there were no further criteria.
- A multiple-choice item anchored at the Intermediate International Benchmark (475) if at least 65 percent of students scoring in the range answered the item correctly, and less than 50 percent of students at the Low International Benchmark answered the item correctly.
- A multiple-choice item anchored at the High International Benchmark (550) if at least 65 percent of students scoring in the range answered the item correctly, and less than 50 percent of students at the Intermediate International Benchmark answered the item correctly.
- A multiple-choice item anchored at the Advanced International Benchmark (625) if at least 65 percent of students scoring in the range answered the item correctly, and less than 50 percent of students at the High International Benchmark answered the item correctly.

To include all of the multiple-choice items in the anchoring process and provide information about content domains and cognitive processes that might not otherwise have had many anchor items, the concept of items that "almost anchored" was introduced. These were items that met slightly less stringent criteria for being answered correctly. The criteria to identify multiple-choice items that "almost anchored" were that 60 to 65 percent of students scoring in the range answered the item correctly and less than 50 percent of students at the next lowest benchmark answered the

item correctly. To be completely inclusive for all items, items that met only the criterion that 60 to 65 percent of the students answered correctly (regardless of the performance of students at the next lower point) were also identified. The categories of items were mutually exclusive, and ensured that all of the items were available to inform the descriptions of student achievement at the anchor levels. A multiple-choice item was considered to be "too difficult" to anchor if less than 60 percent of students at the advanced benchmark answered the item correctly. A constructed response item was considered to be "too difficult" to anchor if less than 50 percent of students at the advanced benchmark answered the item correctly.

Exhibit 14.2 presents the number of TIMSS 2015 mathematics and science items that anchored at each international benchmark. A description of the items for mathematics at the fourth grade, science at the fourth grade, mathematics at the eighth grade, and science the eighth grade can be found in Appendix 14A, 14B, 14C, and 14D, respectively. It should be noted that a partial credit item can anchor twice, typically at a higher benchmark for full credit, and a lower benchmark for partial credit (but sometimes both anchored at the same level). Scale anchoring for the science items considered partial credit and full credit responses separately. Scale anchoring for mathematics used only the full credit anchoring results. For the mathematics scale anchoring at the fourth grade, TIMSS took advantage of data from the Numeracy assessment items in developing the descriptions for the Low and Intermediate Benchmarks.

Exhibit 14.2: Number of Items Anchoring and Almost Anchoring at Each International Benchmark

	Low (400)	Intermediate (475)	High (550)	Advanced (625)	Above Advanced	Total
TIMSS Grade 4 Mathematics						
Number	24	35	40	33	2	134
Geometric Shapes and Measures	10	17	21	23	3	74
Data Display	9	4	13	4	0	30
Mathematics Total*	**43**	**56**	**74**	**60**	**5**	**238**
*Includes Numeracy items at the Low and Intermediate Benchmarks						
TIMSS Grade 4 Science						
Life Science	8	15	28	23	8	82
Physical Science	4	6	21	26	5	62
Earth Science	0	5	16	10	5	36
Science Total	**12**	**26**	**65**	**59**	**18**	**180**

	Low (400)	Intermediate (475)	High (550)	Advanced (625)	Above Advanced	Total
TIMSS Grade 8 Mathematics						
Number	2	13	28	20	1	64
Algebra	0	3	24	28	6	61
Geometry	0	5	14	15	9	43
Data and Chance	2	10	14	12	3	41
Mathematics Total	**4**	**31**	**80**	**75**	**19**	**209**
TIMSS Grade 8 Science						
Biology	3	19	29	25	11	87
Chemistry	1	4	16	18	6	45
Physics	1	6	16	21	9	53
Earth Science	1	9	16	16	6	48
Science Total	**6**	**38**	**77**	**80**	**32**	**233**

Writing the Scale Anchoring Descriptions

The scale anchoring for TIMSS 2015 was conducted in the spring of 2016 at a four-day meeting in Seoul, South Korea. In preparation for review by SMIRC, staff at the TIMSS & PIRLS International Study Center used examples from previous assessments to draft short descriptions of the student competencies demonstrated by a correct (or partially correct) response to each mathematics and science item. Then, the mathematics and science items were organized separately by grade, grouped by international benchmark, and within each benchmark the items were sorted by content area. The final categorization was by the anchoring criteria the items met—items that anchored, followed by items that almost anchored, then by items that met only the 60 to 65 percent criteria. Also, in addition to the short draft descriptions, the following information was included for each item: framework classification, answer key or scoring guide, secure status, percent correct at each benchmark, and overall international percent correct.

At the scale anchoring meetings, the expert committees 1) worked through each item to finalize the description of the student competencies demonstrated by a correct (or a partially correct) response, 2) summarized the proficiency demonstrated by students reaching each international benchmark for publication in reports, and 3) selected example items that supported and illustrated the benchmark descriptions to publish together with the descriptions.

Following the scale anchoring meeting, the descriptions and example items published in the TIMSS 2015 reports were reviewed by National Research Coordinators at their 8th meeting in Quebec City, Canada.

Appendix 14A: TIMSS 2015 Fourth Grade Mathematics Item Descriptions Developed During the TIMSS 2015 Benchmarking

Items at Low International Benchmark (400)	
Number	
M01_01	Identifies a four-digit number given in words
M04_01	Adds a four-digit, three-digit, and two-digit number
M05_01	Subtracts a three-digit number from another three-digit number
M07_01	Identifies the rectangular representation for a unit fraction
N01_01	Adds three three-digit numbers
N01_04	Divides a two-digit number by a one-digit number
N01_05	Generates the next value in a well-defined number pattern
N01_07	Recognizes a unit fraction represented pictorially
N02_04	Multiplies a three-digit number by a one-digit number
N02_05	Identifies an expression that represents a situation
N03_01	Adds two two-digit numbers
N05_01	Identifies a four-digit number represented in words
N05_02	Solves a two-step word problem involving subtraction of one- and two-digit numbers
N06_02	Solves a word problem involving addition of two two-digit numbers
N06_08	Recognizes a non-unit fraction represented pictorially
N07_01	Solves a word problem involving multiplication of one- and two-digit numbers
N07_03	Solves a word problem involving subtraction of a one-digit number from a three-digit number
N07_07	Finds the missing value in an addition number sentence
N09_02	Solves a word problem involving subtraction of a one-digit number from a two-digit number
N09_05	Multiplies a one-digit number by a two-digit number
N10_01	Orders four three-digit numbers

N10_03A	Identifies the largest of four three-digit numbers in context
N10_06	Recognizes a unit fraction represented pictorially
N10_09	Solves a word problem involving addition of three one-digit numbers
Geometric Shapes and Measures	
M13_06B	Identifies a street perpendicular to a given street
N01_09	Reads a ruler to find the length of an object
N01_10	Identifies triangles
N02_11A	Identifies the tallest of four rectangular prisms represented pictorially
N02_11B	Identifies the greatest volume of four rectangular prisms represented pictorially
N03_10	Determines the distance around a triangle given the side lengths
N05_09	Identifies a shape with equal angles
N05_10	Completes a rectangle on a square grid
N06_10	Identifies a cube
N09_08	Identifies a cylinder
Data Display	
M01_12	Identifies the largest increase shown in a bar graph
M05_12	Completes a table from given information by counting
M06_11A	Reads data from a bar graph
N03_04A	Reads data from a bar graph
N03_04B	Compares data presented on a bar graph
N05_05A	Reads data from a table
N05_05B	Compares data presented in a table
N07_05	Uses data from a table to complete a bar graph (2 of 2 points)
N09_04A	Reads data from a bar graph

Items at Intermediate International Benchmark (475)	
Number	
M01_02	Solves a word problem involving multiplication of one-digit numbers
M02_06	Generates the next term in a well-defined number pattern
M04_02	Determines a four-digit number given the place values of the digits
M08_01	Identifies a four-digit number given in expanded form
M08_07	Identifies an expression that represents a situation
M09_01	Adds a four-digit and a three-digit number
M10_02	Divides a three-digit number by a one-digit number
M12_03	Multiplies a one-digit number by a three-digit number
M12_06	Determines the operation to complete a number sentence
M13_02	Identifies the representation of a non-unit fraction
N01_03	Solves a word problem involving multiplication of a one-digit number by 10
N01_06	Solves a two-step word problem involving subtraction and division
N01_12	Solves a word problem involving addition of money
N02_01	Identifies a four-digit number given the digits in two places
N02_02	Solves a word problem involving addition of two- and three-digit numbers
N02_03	Divides a two-digit number by a one-digit number with a remainder
N03_02	Divides a two-digit number by a one-digit number
N03_07	Solves a word problem involving addition of decimals
N03_11	Solves a word problem involving addition of hours and minutes
N05_03	Solves a word problem involving division of a two-digit number by a one-digit number
N05_04	Identifies an expression that represents a situation
N05_12	Solves a word problem involving addition of hours and minutes
N06_01	Subtracts a two-digit number from a three-digit number

N06_03	Solves a word problem involving multiplication of one- and two-digit numbers
N06_06	Determines the missing number in a well-defined number pattern
N07_02	Multiplies a one-digit number by a two-digit number
N07_04	Writes a number between two two-digit numbers
N07_06	Finds the missing term in an addition word problem
N09_01	Subtracts a two-digit number from a three-digit number
N09_03	Writes a four-digit number given the digits in two places
N09_06	Solves a multi-step word problem involving multiplication and division with a remainder
N09_07	Writes a fraction larger than a given unit fraction
N10_02	Solves a word problem involving division of a two-digit number by a one-digit number
N10_03B	Justifies the greatest number if one of four numbers is increased by 100
N10_05	Solves a word problem involving subtraction of one- and two-digit numbers
Geometric Shapes and Measures	
M01_06A	Identifies the shape made by connecting specified dots on a circle
M02_09	Identifies a time when the hands of a clock form a right angle
M03_09	Draws the reflection of a simple shape across a line
M04_08	Finds the halfway point between two positions on a number line
M05_07	Identifies a pair of parallel lines
M05_10	Identifies a net of a cube
M09_08	Identifies a shape with a right angle
M13_07	Identifies the number of triangular faces in a given three-dimensional shape
N01_11	Draws a rectangle with given dimensions on a square grid
N02_09	Draws a right angle on a square grid given one side
N05_11	Determines the number of unit cubes to fill a rectangular prism
N06_09	Identifies the appropriate metric unit of measurement for an object

N06_11	Determines the number of faces on a rectangular prism
N07_10	Identifies a common shape inside another common shape
N09_09	Identifies a triangle with given properties
N09_11	Justifies which figure made of unit cubes has the larger volume
N10_08	Writes the names of four common two-dimensional shapes
Data Display	
M01_11	Interprets information in a table to solve a problem
M02_10	Reads data from a table
M07_12	Recognizes which set of labels on a bar graph could show given information
M14_10A	Reads data from a graph

Items at High International Benchmark (550)

Number	
M01_03	Identifies multiples of a given number
M01_04	Adds two two-place decimals
M01_05	Follows a rule to complete a table
M02_01	Divides a two-digit number by a one-digit number with a remainder
M02_02	Provides numbers that round to specified conditions (2 of 2 points)
M02_03	Analyzes place value conditions to identify a four-digit number
M03_01	Subtracts a three-digit number from a four-digit number
M03_02	Solves a word problem involving division of two-digit numbers with a remainder
M04_05	Solves a word problem involving subtracting one-place decimals
M04_06	Identifies an expression that represents a situation
M05_02	Identifies the whole number closest to a given multiple of a hundred
M06_01	Identifies an expression that represents a situation
M06_05	Solves a multi-step problem involving two-place decimals and whole numbers

M07_02	Uses knowledge of place value to solve a problem involving a five-digit number
M07_04	Writes a fraction that represents a subset of a set of objects
M07_05	Identifies the largest of a set of unit fractions
M08_02	Multiplies a two-digit number by a two-digit number
M08_06	Solves for a repeated missing number in a subtraction sentence
M09_02	Identifies the number closest in size to a given four-digit number
M09_03	Solves a word problem involving division
M09_04	Solves a word problem involving addition of time
M10_01	Classifies two- and three-digit numbers as even or odd
M10_04	Solves a word problem involving non-unit fractions
M10_06	Determines the operation to complete a number sentence with operations on both sides
M10_07	Identifies an expression that represents a situation
M11_03	Solves a word problem involving multiplication of two-digit numbers
M11_04	Identifies a set of objects with a given fraction shaded
M11_05	Solves a number sentence involving multiplication facts
M11_06	Adds a whole number and a two-place decimal
M12_01	Rounds a four-digit number to the thousands place
M12_02	Identifies a number that satisfies two conditions of multiples
M12_04	Solves a problem set in a novel situation involving addition and comparison of whole numbers and justifies the solution
M13_01	Identifies the set of numbers having a given number as a factor
M13_04A	Solves a word problem involving rectangular representations of fractions
M13_04B	Solves a word problem involving rectangular representations of fractions
M13_05	Follows a two-step rule to extend a number pattern
M14_02	Determines whether three pairs of numbers follow a two-step rule
M14_03	Identifies a true statement about two- and three-digit numbers

M14_05	Solves for the missing number in a subtraction sentence
M14_07	Follows a two-step rule to generate the next number in a pattern
Geometric Shapes and Measures	
M01_06B	Draws a specified geometric shape by connecting dots on a circle
M01_06C	Draws a specified geometric shape by connecting dots on a circle
M01_07	Identifies the number of edges of a solid shown in a picture
M01_08	Determines the perimeter of a figure made of squares
M03_07	Identifies a shape that can be made by combining two given shapes
M03_08	Identifies a property common to two triangles
M04_09	Identifies a solid given two faces
M05_08	Uses knowledge about properties of rectangles to classify statements as true or false
M06_07	Identifies a shape that has a line of symmetry
M06_09	Identifies the stack of cubes with the largest volume
M06_10	Given a starting position on a map, follows specified moves and provides final coordinates
M07_07	Identifies a pair of shapes which are not mirror images of each other
M08_09	Finds the distance between two positions on a number line
M08_10	Relates a specified face of a cube to its net
M09_11	Solves a problem by filling a three-dimensional shape with rectangular solids
M10_09	Recognizes acute angles in an irregular quadrilateral
M11_08	Given a line, draws another line to form an angle less than a right angle
M11_09	Identifies the two-dimensional view of a three-dimensional object
M12_08	Classifies angle types in a figure
M14_08	Draws an obtuse angle on a square grid given one side
M14_09	Identifies a two-dimensional view of an irregular three-dimensional figure

Data Display	
M03_11	Compares information in a table and a bar graph to solve a problem
M03_12	Interprets data from a pie chart to solve a problem
M05_13	Completes a bar graph from information given in a tally chart (2 of 2 points)
M06_11B	Uses information from a bar graph to solve a problem
M07_11	Interprets a bar graph to solve a problem
M07_13A	Finds totals and decides which one is the least
M09_12	Completes a bar graph using information from a pictograph
M10_11	Identifies a pie chart that represents given data
M11_11	Uses information from a bar graph to solve a problem
M11_12	Identifies a pie chart that has the same information as a bar graph
M12_11A	Uses a key to retrieve data from a pictograph
M13_09A	Identifies the greatest value in a bar graph
M14_10B	Extrapolates from a graph to solve a problem

Items at Advanced International Benchmark (625)

Number	
M02_04	Solves a multi-step reasoning problem involving division
M02_05	Identifies the missing number in a number sentence with addition on both sides
M03_03	Solves a word problem involving subtraction of time
M03_05	Solves a multi-step problem involving two-place decimals and whole numbers
M03_06	Identifies a term in a repeating pictorial pattern using division with a remainder
M04_03	Devises two ways to allocate money in a given context (2 of 2 points)
M04_04	Determines the missing digit for a two-digit number that satisfies two conditions
M04_07	Identifies the missing number in a number sentence with operations on both sides
M05_03	Identifies the smallest number from a set of one- and two-place decimals

M05_04A	Identifies the circular representation of a non-unit fraction
M05_04B	Explains why a chosen circular representation shows a given non-unit fraction
M05_05	Identifies the missing first number in a number sentence involving subtraction
M05_06	Identifies the two-step rule that relates the numbers in two columns of a table
M06_02	Identifies the closest estimate to the result of a subtraction involving a five-digit number
M06_03	Given four different digits, writes two two-digit numbers with the largest sum
M06_04	Identifies a two-place decimal on a number line marked with one-place decimals
M06_06	Solves a multi-step reasoning problem involving place value of whole numbers
M07_03	Estimates the quotient of a four-digit number divided by a two-digit number
M07_06	Solves a word problem involving proportional reasoning
M08_03	Solves a multi-step word problem involving addition and subtraction of two- and three-digit numbers
M08_04	Solves a problem to identify a fraction that represents the shaded portion of a figure
M08_05	Solves a word problem involving division with a remainder and justifies the solution (2 of 2 points)
M09_05	Identifies a fraction equivalent to a given fraction
M10_03	Devises two ways of grouping objects that satisfy two conditions (2 of 2 points)
M10_05	Draws a complete shape on a grid given a picture of a fraction of the shape
M11_01	Solves a multi-step word problem involving multiplication and addition of whole numbers
M11_02	Identifies a fraction equivalent to a one place decimal
M12_05	Solves a word problem involving adding fractions with different denominators
M12_07	Identifies a number sentence that represents a situation
M13_03	Solves a multi-step problem involving division and gives a reason for their answer
M14_01	Recognizes equivalent three-digit numbers written in expanded form
M14_04	Identifies a number between a one-place decimal and two-place decimal
M14_06	Identifies an expression that represents a situation

Geometric Shapes and Measures	
M01_10	Draws all four lines of symmetry on a non-standard shape (2 of 2 points)
M02_07	Estimates the total length of a curved path given the length of a part of it
M02_08A	Given a description of a movement on a number line, determines another possible ending position
M02_08B	Given a starting point and two movements on a number line, identifies a possible ending position
M03_10	Finds the perimeter of a given figure made of a square and a rectangle
M04_10A	Draws a parallel line on a square grid given conditions
M04_10B	Draws a perpendicular line on a square grid given conditions
M05_09	Solves a multi-step word problem involving perimeter
M05_11	Identifies the area of a right triangle drawn on a grid
M06_08	Selects an appropriate unit of length to use in three different contexts
M07_08	Determines the number of cubes in a given rectangular box
M07_10	Draws a line through a given point perpendicular to a given line
M08_08	Identifies parallel lines on a geometric shape
M09_07	Identifies a rule to sort shapes into two sets
M09_09	Identifies a shape that has both line and rotational symmetry
M09_10	Determines the length of one side of an equilateral triangle and finds its perimeter
M10_08	Reads a ruler to find the length of a line segment beginning and ending at half-units
M10_10	Determines the number of square and triangular faces of three-dimensional shapes (2 of 2 points)
M11_07	Reads a ruler to find the length of an object beginning at a half-unit
M11_10	Finds the area of a rectangle given its dimensions
M12_09	Given two positions on a curved path, follows specified moves and labels another position (2 of 2 points)
M12_10	Identifies a net of a hexagonal prism
M13_06A	Identifies a street parallel to a given street

Data Display	
M07_13B	Draws and justifies a conclusion from data given in a table
M08_11	Represents data from a table in a pie chart
M12_11B	Uses information in a pictograph to solve a problem
M13_09B	Interprets a bar graph to solve a two-step problem

Items Above the Advanced International Benchmark (625)

Number	
M03_04	Solves a non-routine problem presented pictorially (2 of 2 points)
M09_06	Solves a multi-step problem involving fractions
Geometric Shapes and Measures	
M01_09	Estimates the length of a curved line in non-standard units
M07_09	Identifies the area of an isosceles triangle drawn on a grid
M13_08	Identifies a net of a given object

Appendix 14B: TIMSS 2015 Fourth Grade Science Item Descriptions Developed During the TIMSS 2015 Benchmarking

Items at Low International Benchmark (400)

Life Science	
S02_01	Identifies examples of animals that lay eggs
S03_01	Recognizes the mammal from among four pictures of animals
S05_05	States one thing necessary to maintain good physical health (1 of 2 points)
S07_01	Completes a table by matching diagrams of animals to their ecosystems
S08_03	Recognizes a living thing that produces its own food (1 of 2 points)
S10_01	Recognizes an animal that has a backbone
S14_02	States one way to avoid catching illness in a crowded space (1 of 2 points)
S14_03	Analyzes a diagram to explain which flower will grow better
Physical Science	
S04_08	Classifies materials as solids, liquids, or gases
S07_06	Recognizes ice as the solid form of water
S08_06	Identifies a way to sort objects containing metals
S10_06	Recognizes the states of matter of three different materials

Items at Intermediate International Benchmark (475)

Life Science	
S01_01	Recognizes the function of seeds
S01_02	Recognizes that the body needs more oxygen during exercise
S01_06	For four out of five human activities, identifies which have positive and which have negative effects on the environment (1 of 2 points)
S01_11	States one effect the Sun can have on unprotected skin
S02_04	Recognizes a transportation method that produces the least air pollution
S04_01	Recognizes why milk is important in a balanced diet

S04_02	States two things that plants need from their environment to make their own food
S06_04	Uses a list of living things in a desert ecosystem to complete a food chain
S06_05	Identifies a benefit of washing hands before eating
S07_02	Describes one way people can protect their teeth from decay, in addition to brushing
S08_05	Describes how human heart rate changes during exercise
S10_04	States two reasons why a plant will not survive by analyzing given conditions
S12_03	Completes a diagram describing the stages in the life cycle of a flowering plant
S12_06	Describes one way a polar bear's fur helps it survive (1 of 2 points)
S14_04	Evaluates two diagrams to explain which environment is better for sharks
Physical Science	
S01_07	Identifies the direction of the force of Earth's gravity in a diagram
S02_08	Identifies the source of heat that causes ice cubes to melt
S04_09	Explains why one object requires more force to start its motion than another
S06_07	Identifies a property of steel that makes it a better building material than wood
S12_10	Identifies why a bulb will not light in a model of an electric circuit
S14_08	Identifies the best material to complete a circuit
Earth Science	
S03_10	Recognizes what happens to water on a sidewalk when it disappears
S05_11	States one planet other than Earth that orbits the Sun (1 of 2 points)
S05_11	States two planets other than Earth that orbit the Sun (2 of 2 points)
S06_12	Provides evidence for the existence of air inside a balloon
S09_10	Matches each item in a list of Earth's landscape features to its description

Items at High International Benchmark (550)

Life Science	
S01_06	For five human activities, identifies which have positive and which have negative effects on the environment (2 of 2 points)
S02_02	States two things that both plants and animals need to live
S03_02	States two changes which occur in the body during running in addition to feeling hot
S03_04	Identifies how having coloring similar to their surroundings helps birds stay alive
S04_04	Identifies a difference in the life cycles of a grasshopper and a butterfly
S04_06	Recognizes a way to avoid spreading the flu
S05_01	Recognizes the organ where digestion takes place
S05_03	Recognizes the body covering the protects a reptile
S05_04	From a list of plants and animals, identifies some of those that make their own food (1 of 2 points)
S06_01	Recognizes why standing water provides an environment beneficial for mosquitos
S06_02	Describes one way pollen is spread from flower to flower (1 of 2 points)
S06_06	Explains one reason why it is important to have spiders in a garden
S07_05	States one characteristic that a plant and an animal share, other than a need for water (1 of 2 points)
S08_01	Recognizes the plant part that produces seeds
S08_02	Uses a list of living things in an Arctic ecosystem to complete a food chain
S08_04	Recognizes a feature of how snakes eat
S09_01	States one difference between living things and nonliving things
S09_03	Recognizes an advantage of thin, pointed leaves compared to broad, flat leaves
S09_04	States one reason why plastic objects in the ocean are dangerous for sea animals
S09_05	Provides a possible reason why some trees in a group do not grow as well as others
S10_02	Describes two ways that a mammal helps its young survive
S10_03A	Uses a food web to identify what a predator eats
S11_03	Recognizes whether labeled features of a bird are inherited

S12_04A	Interprets data from an investigation to recognize the best condition for growing plants
S12_05	Relates factory pollution to its effect on farm fields
S13_01	Recognizes that in mammals, a male and female of the same kind are needed to reproduce
S13_02	Explains that germs can be transmitted even when people do not appear to be sick
S13_05	Identifies a function of a plant's stalk by interpreting an observation from an investigation
Physical Science	
S01_12	Names a source of energy other than coal, oil, or natural gas that is used to produce electricity
S02_07	Explains the function of a battery in an electric circuit
S02_10A	Recognizes which direction to apply a force to reverse the direction of a moving object
S03_08	Given a list of five everyday objects, recognizes which ones conduct electricity
S05_09B	Evaluates between two methods which would dissolve a piece of candy faster
S06_08	Recognizes from a list which are sources of energy and which are not
S06_10	Explains how a sweater can keep a bottle of water cold
S07_04	Identifies the cause of a shadow forming
S07_11	From a diagram, identifies the orientation of the poles on two repelling magnets
S08_08	Recognizes what happens to the water when a puddle of water on a metal tray becomes smaller
S08_10	Explains why pressing a guitar string stops the sound
S09_07	Describes a difference between ice and water in addition to their physical states
S09_09A	Identifies from a diagram how a shadow is formed
S11_06	States a reason for the color change and surface roughening of a metal object over time
S11_08	Gives a reason why two objects of the same shape and size travel different distances after a push
S11_09	Using a model of a flashlight, identifies an object that can be used to complete an electrical connection
S12_09A	Explains why boiling decreases the amount of water in a container
S12_09B	Predicts the effect on a cold window glass of boiling water nearby
S13_07	Observes that two metal bars repel and determines whether they are magnets

S13_08	Explains that heat in a metal object reaches the nearest point soonest
S13_09	Using a diagram, identifies which hidden object could complete an electric circuit
Earth Science	
S01_08	Recognizes evidence that there were many kinds of animals on Earth that no longer exist today
S03_11	Identifies a conclusion scientists draw from fossils of shellfish found on land
S03_12	Identifies a pictorial representation of a shadow at midday
S04_11	Recognizes a diagram showing the correct relative positions of the Earth, Moon, and Sun
S04_12	From pictures of rock formations, identifies how a given rock may have looked long ago
S05_12	From a diagram showing a shadow at different times of the day, explains why the shadow changed
S06_11	Recognizes that water flows from mountains to oceans via rivers
S07_13	States one thing that makes up Earth's crust (1 of 2 points)
S07_14	From a table showing temperature and cloud cover at different locations, identifies the place where is it most likely to snow
S08_11	Using two pictures of the same location, explains that the Moon can look different at different times
S08_12	Recognizes which step in a diagram of a water cycle shows evaporation
S10_10A	Interprets information from a graph to recognize which crops will grow best in an area with given precipitation
S11_11	Recognizes a feature of the Moon from observations over a month
S12_02	Recognizes seasons north and south of the Equator
S13_11	Recognizes that the solar system is made up of the Sun and its planets
S14_12	Interprets information from temperature graphs to identify which of two places has certain climate properties

Items at Advanced International Benchmark (625)

Life Science	
S01_03	Identifies examples of animals that take care of their young
S01_04	Identifies how being poisonous to birds is an advantage for monarch butterflies
S02_03	Recognizes a food with a high protein content

S02_05	Explains how a flu-like disease can be transmitted through the air
S03_05	Analyzes statements to identify possible characteristics of predators and prey
S04_03	Identifies a reason that some mammals pant on hot days
S04_05	Predicts the consequences of removing a predator from an animal's habitat
S05_02	Recognizes the function of the flowering part of a plant
S05_06	Recognizes an animal that is classified as a mammal
S06_02	Describes two ways pollen is spread from flower to flower (2 of 2 points)
S07_07	Explains why people should drink a lot of liquid every day
S07_09	Identifies one physical change that can take place in a mammal as the weather gets colder
S10_03B	Uses a food web to determine which animals are competitors
S11_01	Recognizes the function of muscles attached to bones
S11_04	Evaluates three experimental designs and explains which is best to test if plants need light to grow
S11_05	Draws a conclusion by relating one function of feathers to keeping a body warm in the case of dinosaurs
S12_04B	Identifies a conclusion about plant growth using data from an investigation
S12_06	Describes two ways a polar bear's fur helps it survive (2 of 2 points)
S13_03A	Explains that to test the survival of plants, they should be compared under different conditions
S13_03B	Identifies a desert plant and describes one feature that helps it survive in the desert
S13_04	States two things in addition to water that animals need to survive
S14_02	States two ways to avoid catching an illness in a crowded space (2 of 2 points)
S14_05	Describes how boiling water makes it safe to drink
Physical Science	
S01_13	Recognizes that burning results in new substances
S02_06	Explains how the poles of two magnets should be oriented to cause repulsion
S02_09	Recognizes a property of metals that makes them good electrical wires
S02_10B	Recognizes which direction to apply a force to change the direction of a moving object

S03_07	Recognizes a property used to classify everyday objects into two groups
S03_09	Names the force that moves an object down a sloping track
S04_07	Predicts which of two objects is a better conductor of heat with supporting explanation
S04_10	States one form of energy present in a model of an electric circuit (1 of 2 points)
S05_09A	Evaluates between two methods which would dissolve a piece of candy faster
S05_09C	Evaluates a list of methods and predicts which method produces a less sweet drink
S05_10	Recognizes the best conductor of heat in a list of materials
S07_03	Using information in a table, identifies another item whose physical properties match those of one of the items in the table
S08_07	Analyzes a diagram to identify one way to make a shadow bigger
S09_08	Identifies that the temperature at which an object melts depends on the material from which it is made
S09_09B	Recognizes that a shadow produced in colored light is black
S10_07	Explains the process by which wet objects become dry
S10_08	Explains how to separate a mixture of two types of solids of different sizes
S10_09A	Recognizes set-ups that will more quickly dissolve a solid in water
S10_09B	Explains the importance of controlling a variable in an experiment
S12_07	Identifies a physical property of metal pot that makes it good for boiling water
S12_08A	Evaluates the best way to separate a mixture of solids of similar size
S12_08B	Evaluates the best way to separate a mixture of things that dissolve and things that do not dissolve
S13_06	Identifies that two objects of the same size and shape have the same volume and, from a diagram, that they have different masses
S14_06	Recognizes one property of a liquid
S14_07	Evaluates the best set-up to investigate whether temperature affects the rate at which a solid dissolves in water
S14_09	Recognizes a diagram that demonstrates motion due to gravity
Earth Science	
S01_10	Draws a conclusion from an investigation to explain why water does not fill a glass inverted in water, (referring to air in the glass) OR to explain why water does fill a glass when it is tilted (referring to air escaping) (1 of 2 points)

S07_12	Recognizes how long it takes for Earth to orbit the Sun
S07_13	States two things that make up Earth's crust (2 of 2 points)
S09_11	Identifies how fish fossils are formed
S10_10B	Synthesizes precipitation information from a graph and diagram to recognize the best area to plant a crop in a given climate
S11_10	Identifies that clouds are made of water droplets
S11_12	Interprets a diagram of the Earth and the Sun to describe how Earth turning on its axis causes day and night in a particular location
S12_01	Recognizes which place is likely to have weather that is hot and wet
S13_10	Identifies the diagram that shows relative amounts of water and land on the Earth's surface
S14_10	Relates two different environments and weathering effects on rocks

Items Above the Advanced International Benchmark (625)

Life Science	
S03_03	Explains that the same type of plants should be compared when investigating plant growth with or without fertilizer
S05_04	From a list of plants and animals, identifies all of those that make their own food (2 of 2 points)
S05_05	States one thing necessary to maintain good physical health with a supporting explanation (2 of 2 points)
S06_03	Explains why laying a large number of eggs helps frogs survive in their environment
S07_05	States two characteristics that a plant and an animal share, other than a need for water (2 of 2 points)
S08_03	Recognizes a living thing that produces its own food and describes the process (2 of 2 points)
S09_06	Identifies that more use of public transportation will decrease air pollution in a large city
S11_02	Recognizes the main function of leaves on a plant
Physical Science	
S01_05	Labels the freezing point of water on a diagram of a thermometer
S03_06	Explains that cooking causes a change that cannot be reversed
S04_10	States two forms of energy present in a model of an electric circuit (2 of 2 points)
S05_08	Explains which orientation of two batteries in series, depicted in two circuit diagrams, allows a bulb to light
S11_07	Explains why a metal spoon in hot soup feels hotter than a wooden spoon in hot soup

Earth Science	
S01_10	In the context of an investigation, explains why water does not fill a glass inverted in water, (referring to air in the glass) AND explains why water does fill a glass when it is tilted (referring to air escaping) (2 of 2 points)
S02_11	Recognizes how wind can cause weathering of rocks
S02_12	Explains why stars are not visible during the day
S08_09	States one source of energy other than sunlight that can be changed into electricity
S14_11	Recognizes four true statements about recycling metals

Appendix 14C: TIMSS 2015 Eighth Grade Mathematics Item Descriptions Developed During the TIMSS 2015 Benchmarking

Items at Low International Benchmark (400)	
Number	
M04_01	Recognizes a 7-digit number given in words
M07_01	Evaluates the power of a whole number
Data and Chance	
M01_13	Uses information in a table to complete a bar graph
M06_13	Identifies the table that matches the information shown in a pictograph

Items at Intermediate International Benchmark (475)	
Number	
M01_04	Identifies equivalent ratios
M02_01	Recognizes the commutative property
M03_01	Identifies the decimal number closest in size to a given fraction
M05_01	Identifies the divisor by moving the decimal point
M07_03	Uses knowledge of the whole being 100 percent to solve a simple word problem
M07_04A	Completes a table of equivalent proportions
M08_04	Shades a percent of a figure
M09_01	Evaluates an expression involving negative whole numbers and parentheses
M09_02	Solves a word problem involving subtraction of negative numbers
M10_01	Solves a word problem involving subtraction of negative numbers
M11_03	Solves a two-step word problem involving whole numbers
M11_04	Determines what fraction of a 10×10 grid is shaded
M13_02A	Solves a word problem involving addition of time

Algebra	
M11_06	Evaluates the power of an expression given its value
M12_08	Uses values for a linear function to determine an extrapolated value
M14_05	Solves a linear equation in two-variables given the value of one variable
Geometry	
M02_08	Identifies opposite faces of a cube given its net
M04_09	Recognizes congruent quadrilaterals
M05_12	Identifies a true statement based on the properties of parallel and perpendicular lines
M12_09	Identifies the reflection of a partly shaded shape
M12_11	Determines the total number of stacked unit cubes
Data and Chance	
M05_15	Given a table of percentages, selects the pie chart that could represent the given data
M06_12A	Compares the chances of two outcomes shown pictorially
M07_12	Reads values from two line graphs to solve a problem
M07_14	Given a situation, judges the chance of an outcome as unlikely
M08_14A	Estimates an expected value given an observed sample
M09_12	Finds and compares the unit prices of four objects
M09_14	Identifies the bar graph that matches the information shown in a table
M11_12A	Reads data from a line graph
M11_12B	Compares data from two line graphs to solve a problem
M13_12	Solves a problem given the chance of an outcome

Items at High International Benchmark (550)

Number	
M01_01	Solves a word problem involving multiplication of a fraction and a decimal
M01_06B	Selects and combines information from two sources to solve a multi-step word problem (2 of 2 points)
M02_02	Solves a two-step word problem involving subtraction of whole numbers and multiplication of a fraction

M02_03A	Determines the percentage for a section of a pie chart
M03_04	Orders decimals with different numbers of decimal places
M03_05	Solves a proportion problem involving decimals
M05_02	Recognizes the fraction equivalent to a percentage
M05_03	Approximates the sum of five three-digit numbers to the nearest hundred
M05_04	Identifies the larger of two fractions with different numerators and different denominators and explains why it is larger
M06_01	Uses the distributive law to identify an expression equivalent to a given one
M06_04	Determines fractions equivalent to a given fraction
M07_04B	Finds the unknown term in a proportion in a given situation
M08_01	Identifies an expression equivalent to a given division expression
M08_03	Finds the missing value in an addition problem with both fractions and decimals
M09_04	Given the two parts of a whole in a word problem, identifies the fraction which represents one part
M09_05A	Solves a word problem involving multiplication and addition of whole numbers
M10_02	Identifies equivalent ratios
M10_04	Uses four different digits to write two two-digit numbers with the smallest product
M11_01	Solves a word problem involving ratios
M11_02	Identifies a prime number
M12_01	Solves a word problem involving a fraction of a whole
M12_02	Solves a word problem involving division of whole numbers with a remainder
M13_01	Identifies the representation of a fraction equivalent to a given representation of a fraction
M13_03	Understands a property of adding multiples
M13_04	Writes a decimal with three places as a fraction
M14_01	Identifies an expression equivalent to a given multiplicative expression
M14_02	Solves a two-step word problem involving subtraction of whole numbers and multiplication of a fraction
M14_04	Solves a word problem involving ratios and decimals

Algebra	
M01_03	Recognizes the distributive property in evaluating an algebraic expression
M01_05	Identifies the algebraic expression that represents a fraction of a variable
M01_07	Identifies the ordered pair of numbers that satisfies a given linear equation
M01_08	Identifies the equation that models a situation given in a word problem
M01_09	Identifies values of two variables, each satisfying a simple inequality
M03_06	Evaluates an algebraic expression involving a fraction
M03_08	Identifies the solution to an equation involving a square root
M03_09	Identifies the formula that represents a situation involving area
M05_06	Solves a simple linear equation in one variable with a mixed number solution
M05_07	Finds a missing term in a non-arithmetic and non-geometric number sequence
M05_08	Identifies the linear equation satisfied by two given values
M05_11A	Adds two algebraic expressions and simplifies
M06_08A	Extends a pattern to find the area of a square
M07_07	Finds the value of an algebraic expression involving parentheses and negative terms
M08_07	Identifies an algebraic expression that represents the perimeter of an irregular shape
M08_08	Determines a missing coordinate for a linear relationship given in a table
M09_07	Evaluates an algebraic expression involving fractions and integers
M09_08	Uses a given formula involving fractions to solve a word problem
M10_05	Identifies an expression that represents a situation
M12_06	Identifies an equation that models a situation
M12_07	Identifies an expression for the area of part of a geometric figure
M13_06	Identifies the equivalent algebraic expression involving exponents and multiplication
M13_07A	Extends a given geometric pattern to find the value of the 10th term
M14_07	Identifies the true statement about a linear relationship given in a graph

Geometry	
M01_11	Identifies the number of remaining unit cubes
M02_07	Draws the reflection of a shape over a diagonal line on a grid
M03_11	Identifies a net of a rectangular solid
M03_12	Solves a problem involving angles of a triangle and parallel lines
M05_13	Uses the angle properties of triangles and rectangles to find a missing angle
M06_09	Uses the Pythagorean theorem to solve a word problem
M06_10	Solves a problem involving angles of a triangle
M07_09	Draws a symmetrical shape given half of it and its line of symmetry
M08_10	Finds the coordinates of a midpoint given two points in the Cartesian plane
M09_10	Identifies the value of an angle involving properties of corresponding and supplementary angles
M09_11	Draws an angle of a given measure on a square grid
M11_10	Solves a problem involving similar triangles
M13_11	Solves a problem involving angles of a triangle
M14_08A	Solves a word problem involving the length around a hexagonal prism
Data and Chance	
M01_14	Explains why a conclusion drawn from a given bar graph is incorrect
M02_13	Identifies the probability of an event
M05_16	Interpolates from a line graph to provide an estimated value
M06_12B	Compares the chances of two outcomes
M07_02	Reads the value indicated by an unlabeled mark on a speedometer
M07_13	Identifies a possible description of a part of a time-speed graph
M10_13A	Computes the mean of four given values
M11_13	Interprets data in a pictograph to solve a multi-step problem
M11_14	Justifies a conclusion resulting from comparing two distributions

M12_13	Interprets a histogram to identify a proportion
M12_14	Draws a spinner that has given probabilities
M13_13B	Uses and interprets data sets in pie charts to solve a problem involving percentages
M14_11	Evaluates information given by a time/distance graph
M14_13	Identifies the probability of an event

Items at Advanced International Benchmark (625)

Number	
M01_02	Uses knowledge of place value to express a sum as a decimal
M01_06A	Selects and combines information from two sources to solve a multi-step word problem (2 of 2 points)
M02_03B	Determines the whole given the amount of a percentage
M03_02	Solves a non-routine problem involving whole numbers
M03_03	Reasons about divisibility in an algebraic expression
M04_02	Given the volume of a fraction of a container, determines the total volume for multiple containers of the same size
M04_03	Solves a word problem involving price per unit and explains reasoning
M04_04	Given four different containers, identifies the container with the greatest fraction filled
M06_02	Solves a word problem involving comparison of fractions and percentages and explains answer
M06_03	Solves a non-routine word problem involving reasoning with whole numbers (2 of 2 points)
M06_05	Reasons about fractional parts of a whole in a word problem and explains answer
M08_02	Solves a two-step word problem involving whole numbers
M09_03	Solves a two-step word problem involving percentages
M09_05B	Solves a non-routine word problem involving whole numbers
M10_03	Determines the dimensions of a rectangle that is similar to a given rectangle
M11_05	Identifies a true statements about percentages of given numbers
M12_03	Completes a table of equivalent proportions and percentages (2 of 2 points)
M12_04	Solves a word problem involving ratios

M13_02B	Solves a word problem involving percentages and elapsed time
M14_03	Identifies a percentage using a given ratio
Algebra	
M01_10	Uses a given formula to solve a word problem
M02_04	Solves a pair of simultaneous linear equations in two variables
M02_05	Computes values of a function given values of the variable
M02_06	Identifies a linear equation given the y-intercept
M04_05	Simplifies an algebraic expression
M04_06	Retrieves coordinate points from a graph of a function
M04_08	Constructs a linear equation for the perimeter of a triangle and solves for the length of one side
M05_05	Writes a rule for a multiplicative number pattern involving negative numbers
M05_09	Solves a proportion expressed algebraically
M05_10	Constructs and uses the solution of a linear equation to solve a word problem (2 of 2 points)
M05_11B	Subtracts one algebraic expression from another and simplifies
M06_06	Identifies an equivalent equation
M06_07	Identifies a pair of simultaneous linear equations that model a given situation
M07_05	Identifies the equation of a line that passes through points shown on a graph
M07_06	Identifies the equation that models a situation involving distance, speed, and time
M07_08A	Finds a specific term in a pattern presented numerically and geometrically
M07_08B	Explains how to find a specific term in a pattern presented numerically and geometrically
M07_08C	Expresses the general term algebraically in a pattern presented numerically and geometrically
M08_06	Identifies a line with positive slope
M09_06	Identifies an equivalent algebraic expression
M09_09	Demonstrates an understanding of slope by relating graphs and their equations
M10_06	Constructs a linear equation to represent a situation

M10_08	Constructs a linear equation for the perimeter of a rectangle and finds the area (2 of 2 points)
M11_08	Solves a pair of simultaneous linear equations
M13_05	Identifies an algebraic expression that represents the area of a given rectangle
M13_07B	Gives a rule for the nth term of a geometric pattern
M13_08	Identifies the graph of a linear equation
M14_06	Identifies the slope of a line given its equation
Geometry	
M01_12	Uses the Pythagorean theorem in finding the area of a triangle
M02_09	Identifies two different arrangements of trapezoids with the same perimeter
M04_10	Finds the coordinates of a vertex of a rectangle given the other three vertices
M05_14	Uses properties of similar triangles to identify equal angles
M06_11	Identifies the point equidistant from two given points in the Cartesian plane
M07_10	Uses the Pythagorean theorem in finding the perimeter of a trapezoid
M07_11	Identifies two shapes that make a square
M08_09	Uses properties of triangles and quadrilaterals to solve for an angle
M08_12	Draws a rectangle on square grid given area and perimeter (2 of 2 points)
M10_09	Estimates area of an irregular shape on a square grid
M10_10	Finds vertices of triangles created from trapezoids in the Cartesian plane (2 of 2 points)
M10_11	Uses properties of supplementary angles to solve for an angle
M12_10	Determines the number of faces of a regular solid with unit cubes removed
M13_10	Determines the surface area of a prism given its net
M14_08B	Solves a word problem involving the lateral surface area of a hexagonal prism
Data and Chance	
M01_15	Uses understanding of average to solve a problem
M02_11	Identifies the statement that best describes a data set given in a table

M02_12	Estimates probability given an observed sample
M03_13	Explains why a data representation could be misleading
M03_14	Interprets data in a pie chart to solve a word problem
M03_15	Uses understanding of mean and range to solve a problem
M04_12A	Calculates mean and median for two ordered lists of data (2 of 2 points)
M08_14B	Compares observed and expected values
M10_12	Estimates the number of objects in a given probability sample
M10_13B	Determines the change in a mean given changes in individual scores
M12_12	Solves a word problem involving averages
M13_13A	Uses and interprets data sets in pie charts to solve a problem involving percentages

Items Above the Advanced International Benchmark (625)

Number	
M01_06C	Compares results derived from two sources and provides a justification for the conclusion (2 of 2 points)
Algebra	
M03_07	Writes an expression for the area of part of a geometric figure
M04_07	Determines a collinear point given another point on the line and the slope
M06_08B	Writes the algebraic expression for the nth term in a series
M08_05	Identifies the equivalent form of a linear inequality in one variable
M11_07	Identifies an algebraic expression involving parentheses and negative terms
M12_05	Identifies equivalent rational expressions
Geometry	
M02_10	Explains how to find the area of an irregular shape on a grid (2 of 2 points)
M03_10	Solves a word problem using properties of similar triangles
M04_11	Explains why two shaded areas of overlapping congruent triangles are equal
M08_11	Solves for a missing side length given two similar triangles
M11_09	Draws all lines of symmetry on a regular polygon

M11_11	Solves a multi-step word problem involving ratios between volumes
M13_09	Identifies the image of a shape after rotation and reflection
M14_09	Determines the number of exposed faces for unit-cubes that make up a larger cube (2 of 2 points)
M14_10	Solves a word problem involving the Pythagorean theorem
Data and Chance	
M04_13	Solves a multi-step problem involving probability
M08_13	Compares characteristics of two dot plots to justify a conclusion
M09_13	Explains why a data representation could be misleading

Appendix 14D: TIMSS 2015 Eighth Grade Science Item Descriptions Developed During the TIMSS 2015 Benchmarking

Items at Low International Benchmark (400)

Biology	
S13_01	States one reason why male penguins' incubation behavior helps their eggs survive (1 of 2 points)
S14_01A	Uses a food web to identify which organisms are producers
S14_01B	Uses a food web to identify which organisms eat only plants
Chemistry	
S07_06	Recognizes a material that best conducts both heat and electricity
Physics	
S12_15	Recognizes whether an electromagnet would attract objects made of various materials (1 of 2 points)
Earth Science	
S03_12A	Using a diagram, identifies what moves water from an artesian basin to the surface

Items at Intermediate International Benchmark (475)

Biology	
S02_03	Explains the advantage for a species of mice to have color matching its environment
S03_02	Matches 2 of 4 animal groups to their characteristic features (1 of 2 points)
S04_03	Recognizes characteristics inherited by rabbits in a given context
S04_04	Justifies an advantage of hollow bones for birds
S05_01	Identifies how vaccination helps prevent illnesses
S05_05A	Interprets information in a table to describe how the populations of two organisms changed over time
S06_01	Recognizes a living thing that has growth rings
S06_04	Recognizes from a list of foods which is the best source of calcium
S06_05A	Identifies why fish eat mosquito larvae but not adult mosquitos
S07_01	Recognizes an organism that is a producer

S07_05C	Identifies an advantage for a species of butterfly to resemble another species that is toxic to birds
S09_02	Analyzes information about an ecosystem and explains the effect of introducing a new population
S09_03B	Reasons how a crocodile's angle of vision helps it to survive in the environment
S10_01	Recognizes the process in the water cycle indicated in a diagram of an ecosystem
S10_02	States one substance plants obtain from their environment and use in photosynthesis (1 of 2 points)
S11_01A	Recognizes the agent that causes influenza
S12_04	Describes one characteristic of mammals that is advantageous for survival in cold weather (1 of 2 points)
S13_05	For pairs of animals, distinguishes between predatory and competitive relationships
S14_04	Recognizes the functions of 2 of 4 tissues found in the human stomach (1 of 2 points)
Chemistry	
S07_04	Uses information from an investigation to recognize the condition under which nails would rust most
S08_01	Recognizes a chemical process that involves the absorption of light
S11_07	Recognizes an everyday occurrence that is an example of a chemical change
S13_07	Applies knowledge of concentration to explain why one solution is paler than another solution
Physics	
S01_10A	Given a diagram showing a ball being thrown upwards, states the force that causes the ball to fall
S02_11	Uses information in a graph to recognize the motion of an object at five time points
S03_11	Recognizes the placement of a fulcrum that requires the least amount of force to move an object
S05_06	Recognizes the form of energy in a compressed spring
S08_09	Recognizes the type of energy change that occurs as a child slides down a slide
S14_06	Relates knowledge of density to indicate the order in which three liquids will settle after being poured in a beaker
Earth Science	
S02_01	Recognizes whether 4 of 5 effects are a benefits of recycling paper (1 of 2 points)
S02_12	Recognizes a possible result of Earth's continents moving
S02_13	Describes one thing being done by car-makers to reduce air pollution (1 of 2 points)

S05_09	Recognizes a gas that is increasing in Earth's atmosphere
S06_14	Uses a diagram to state one advantage of a plant having roots that reach the subsoil (1 of 2 points)
S07_14	Recognizes an effect of Earth rotating on its axis
S13_11A	Uses information in a table with characteristics of planets to identify the planet with the shortest day length
S13_12	Recognizes the reason for cold temperatures outside an airplane in flight
S14_15	Synthesizes information in rainfall and temperature graphs to match 2 of 4 animals with the climate where they live (1 of 2 points)

Items at High International Benchmark (550)

Biology	
S01_02	Classifies 6 of 7 animals into two groups, based on a stated physical or behavioral characteristic (1 of 2 points)
S01_04A	Indicates in a table which gas is released into the air and which gas is removed from the air during animal respiration
S01_04C	Indicates in a table which gas is released into the air and which gas is removed from the air during photosynthesis
S02_02	Recognizes the group to which an animal belongs given some of its features
S02_04A	Predicts the change in the amounts of two gases in the air as a result of an experiment on photosynthesis
S02_04B	Identifies 1 of 2 factors other than light intensity that could affect the rate of photosynthesis in an investigation (1 of 2 points)
S04_01	Recognizes what happens to an animal's cells as it grows
S04_02	Recognizes 2 of 3 major organs in a diagram (1 of 2 points)
S05_02	Explains why birds of prey cannot survive in an environment without plants
S05_05B	Draws a conclusion from population data in a table and gives a possible explanation for a change in population
S06_02	Identifies why birds puff up their feathers in cold weather
S06_06	Identifies parts of the human body as organ systems
S08_05	Selects and classifies 3 of 4 foods from a list that comprise a balanced diet (1 of 2 points)
S08_06A	Evaluates data from a table to draw a conclusion about the reason for a change in population of a species
S09_01	Recognizes which food is the best source of carbohydrates
S10_03	Recognizes why rabbits inherit traits that their parents do not have

S10_04A	Identifies one way that plant and animal cells are similar (1 of 2 points)
S11_02	Interprets a diagram to identify what happens to biceps and triceps when an elbow bends
S11_03	Recognizes a human characteristic that is acquired
S11_04	Explains how flooding leads to a shortage of drinking water or the spread of disease (1 of 2 points)
S12_01	Recognizes a list of food that comprises a healthy, balanced meal
S12_02	Explains why it is unlikely for someone to get sick with the measles a second time
S12_03	Identifies the conclusion best supported by a diagram of rock layers with embedded fossils
S12_04	Describes two characteristics of mammals that are advantageous for survival in cold weather (2 of 2 points)
S13_02	Recognizes an organism that is made up of cells with cell walls
S13_03	Recognizes how decomposers get their energy
S13_04	Given a food chain, explains which organism competes most with humans in a farming community
S14_02	Explains how a fossil can be classified as plant or animal, based on its cellular structure
S14_03	Predicts how heart rate changes in response to exercise, based on a set of given conditions
Chemistry	
S03_05	Recognizes a property of most nonmetals
S05_08B	In the context of an investigation about the gold content of jewelry, selects information from a table of properties of gold alloys to complete a table relating the density of alloys to number of carats and percentage of gold in each piece of jewelry
S05_08C	In the context of an investigation about the gold content of jewelry, uses previously selected information and follows an example to calculate the mass of gold in jewelry
S06_07	From a table of melting and boiling points of three substances, identifies the state of each substance at a given temperature
S06_08	Given two proposed methods for separating a mixture of small pieces of two metals, identifies which method will work or why the other method will not work (1 of 2 points)
S06_09	Recognizes an everyday activity that is a chemical process that releases energy
S07_08	Identifies and explains which solution is more dilute than another in a given context
S08_02	Recognizes a model of a carbon dioxide molecule
S09_06	Recognizes and explains which substance will float on water using a table of densities
S09_08	Recognizes which process makes bronze dark and dull over time

S10_10	Recognizes which model best illustrates the results of a chemical reaction
S11_05	From a list of symbols and formulas, recognizes which are elements and which are compounds
S11_10	Explains the effect of temperature on diffusion in the context of an investigation
S12_06	Identifies the number of atoms of each element in nitric acid
S12_07	Use data in a table to order set-ups according to the rate at which a solute will dissolve in water
S14_11	Explains whether a reaction between two solutions in a given context can occur a second time
Physics	
S01_07	Recognizes the pathway of light required for an object to be seen
S01_08	Recognizes an everyday object most likely to be used as a lever
S02_09	Explains whether a conclusion can be made about the relative strengths of two magnets in a given context
S04_05	Relates knowledge of heat transfer to recognize a graph that shows how two substances eventually reach temperature equilibrium
S05_12	Explains that there are forces acting on students sitting on a wall
S06_10	Recognizes the orientation of a hidden mirror given rays of light reflecting
S07_07	Uses a table showing the speed of sound through different media and knowledge of the state of each medium to recognize a conclusion that may be drawn about the relative speed of sound
S07_09	Recognizes why a helium balloon rises into the air
S07_12	Explains why lightning is seen before thunder is heard during an electrical storm
S09_10	Given the densities of two objects and three liquids, and diagrams showing the objects floating or sinking in the liquids, identifies each liquid
S10_07	Recognizes which graph represents a musical note with given specifications for volume and pitch
S10_08	Recognizes a free-body diagram that has a total force acting towards the right
S11_09	Recognizes how to increase the strength of an electromagnet
S12_14	Recognizes the type of energy transformation that occurs when a car begins to move from rest
S13_09B	Explains that in a parallel arrangement of two bulbs, one bulb failing does not affect the other bulb
S13_10	Recognizes the best explanation of why two bar magnets repel each other
Earth Science	
S01_14	Recognizes a consequence of the gravitational pull of the Moon on Earth

S04_13	Identifies a disadvantage of using solar energy
S04_14A	Recognizes the process that forms rock layers
S05_13	Matches each of four processes that take place in the water cycle with the description of the process
S06_13	Recognizes a non-renewable energy source
S07_13	Describes a cause of earthquakes
S08_11	Recognizes a major source of water for desalinization plants
S08_13	Uses a diagram of a mountain range on the ocean and a given wind direction to recognize which location will have the greatest rainfall
S09_13	Uses a graph of average monthly temperature to identify the city most likely to be located at the equator
S10_12	Describes one geographic factor to consider when selecting a safe location for a nuclear power plant
S10_13A	Relates information in temperature graphs and maps to recognize climatic attributes of two cities
S11_12	Recognizes the source of energy for the water cycle
S12_11A	Interprets information in a climate graph to determine the warmest and driest month of the year
S14_13	Identifies how the melting of permafrost can affect the Earth's climate
S14_14	Recognizes sources of fresh and salt water in a diagram
S14_15	Synthesizes information in rainfall and temperature graphs to match 4 of 4 animals with the climates where they live (2 of 2 points)

Items at Advanced International Benchmark (625)

Biology	
S01_01	Identifies a function shared by lungs, skin, and kidneys
S01_02	Classifies 7 of 7 animals into two groups based on a stated physical or behavioral characteristics (2 of 2 points)
S01_03	Recognizes which organelle produces energy for the cell
S01_05	Designs an investigation to find out how fertilizer affects plant growth using equipment shown in a diagram
S03_01	Recognizes the function of shivering
S03_03B	In the context of an investigation about cellular respiration, identifies the gas produced and its source
S03_04	Explains why offspring are unlikely to have traits dissimilar to their parents

S05_03	Recognizes a function of the cell membrane
S05_04	Recognizes an explanation for a change over time in a physical characteristic of an organism
S06_03	Identifies the best conclusion supported by a diagram of limbs from different animals
S06_05B	Predicts the consequence for a prey population of increasing a predator population in a pond ecosystem
S07_02	Recognizes an example of asexual reproduction and describes the characteristics of asexual reproduction
S07_03	Identifies an organism in which gases are exchanged through the skin
S07_05B	Identifies and explains the stage of the life cycle during which a butterfly develops
S08_04	Applies knowledge about the theory of evolution to identify the best conclusion supported by a diagram of limbs from different animals
S08_05	Selects and classifies 4 of 4 foods from a list that comprise a balanced diet (2 of 2 points)
S08_06B	Selects and evaluates data from a table to draw a conclusion about the likely reason for a change in population of a species
S09_03A	Justifies a statement about crocodiles' adaptation to their environment, based on given facts
S09_04	States one similarity between the life cycles of a bird and a frog
S09_05	Identifies an explanation for disappearance of a trait over generations
S10_04A	Identifies two ways that plant and animal cells are similar (2 of 2 points)
S10_04B	States one way that plant and animal cells are different (1 of 2 points)
S12_05	Recognizes an example of a symbiotic relationship between two organisms
S13_01	States two reasons why male penguins' incubation behavior helps their eggs survive (2 of 2 points)
S14_04	Recognizes the functions of 4 of 4 tissues found in the human stomach (2 of 2 points)
Chemistry	
S01_06	Recognizes a mixture
S02_05	Recognizes whether characteristics of substances are physical or chemical properties
S02_06	Recognizes a statement that best describes chemical reactions
S02_07	Determines the color that results after a pH indicator is added to four solutions based on information provided about the indicator
S03_06	Recognizes the reason for the difference in taste between distilled and drinking water
S04_08	Recognizes whether 4 of 5 substances are elements, compounds, or mixtures (1 of 2 points)

S04_10	Identifies and explains whether a described change is physical or chemical
S04_11	Explains whether a reaction took place after a pH indicator is added to a solution based on information provided about the indicator
S05_08A	In the context of an investigation about the gold content of jewelry, describes the measurements to be taken using a graduated cylinder and water to find the volume of the jewelry
S07_10	Applies knowledge of conservation of mass during a neutralization reaction to explain what happens to mass when new substances are formed
S07_11	Applies knowledge of density to explain why oil floats on water
S08_03	Applies knowledge of density to identify and explain which liquid will leave a dropper first after a mixture separates
S09_07	Recognizes a property that is common to both acids and bases
S10_09	Explains the difference between a solid and air in terms of particle spacing in context
S10_11	Recognizes what happens to the atoms in an object pounded flat
S11_06	Identifies an element as a metal or a nonmetal, based on a list of physical properties and predicts one additional property
S13_06	Given their chemical formulas, recognizes a compound with the same number of atoms as another compound
S13_08	Recognizes an everyday process that is an example of a physical change
Physics	
S01_09	Applies knowledge of expansion of water during freezing to explain why a bottle full of water cracked when it was left in a freezer
S01_12	Applies knowledge of thermal conductivity to explain why ice will stay frozen in a wooden container longer than in a metal container
S02_10	Explains whether one person can see another person in a practical problem involving reflection of light from plane mirrors
S03_08	Given two unknown samples and using knowledge that only gases fill the available space, recognizes a statement about the spacing of particles in the samples
S03_09	Recognizes the relative temperatures of the outside surfaces of containers made of materials with different thermal properties
S04_06	Explains why a vehicle with tires is more likely to sink in the mud than a vehicle with treads
S04_07	Recognizes an explanation for why a ball appears a certain color in a given context
S05_07	Interprets a diagram to describe the direction of heat flow in metals
S05_11	Describes a way to distinguish between fresh water and salt water, using two hot plates and without using a thermometer
S06_12	Explains why one orientation of a rectangular block exerts the greatest pressure on the ground
S08_07	Recognizes which property of sound allows animals to navigate and find food

S08_10	Identifies and explains which of three methods will require the smallest force to move a heavy box onto a truck
S09_09	Recognizes why gases are easier to compress than solids and liquids
S10_06	Uses a diagram to explain one way to increase the strength of an electromagnet
S11_08	Recognizes the property of a gas in a dented ping pong ball that stays constant if the ball is heated
S11_11	Applies knowledge about the relationship between depth and water pressure to recognize a conclusion about the pressure at different depths
S12_13	Draws a conclusion about the states of substances in two pistons, based on the different amounts of compression that occurred
S13_09A	States one reason why a bulb in a diagram of an electrical circuit does not light
S13_09C	Recognizes a correct statement about battery life and bulb brightness in two given electrical circuits
S14_07	Recognizes whether a red object will absorb or reflect different colors of light
S14_08	Indicates whether parts of a light bulb are electrical conductors or insulators
Earth Science	
S02_01	Recognizes whether each of five effects is a benefit of recycling paper (2 of 2 points)
S02_14	From diagrams involving the Earth, Moon, and Sun, identifies the one that explains the changing seasons
S03_12B	Identifies the cause of decreasing water flow in an artesian well over time
S03_12C	Explains why water from an artesian well can be hot
S05_14	Recognizes what causes the moon to appear to change shape
S06_14	Uses a diagram to state two advantages of a plant having roots that reach into the subsoil (2 of 2 points)
S06_15	Explains whether an object's weight is less on the Moon than on the Earth
S07_15	Recognizes how a shadow changes throughout the day
S07_16	Draws an arrow on a map to show the direction a river flows and explains why it flows in this direction
S09_12	States one condition below Earth's crust that can be inferred from volcanic eruptions
S09_14	Identifies an explanation for why a constellation visible one night is no longer visible six months later
S11_13	Explains one way trees protect soil from erosion
S11_14	Justifies a claim that the Moon travels around the Sun
S12_09	Recognizes how oil is formed on Earth

S13_11B	Synthesizes information from tables about revolution times around and distances from the Sun to infer relative distances of planets from the Sun
S14_12	Recognizes a negative effect that fertilizer can have on the environment

Items Above the Advanced International Benchmark (625)

Biology	
S01_04B	Indicates in a table which gas is released into the air and which gas is removed from the air during plant respiration
S02_04B	Identifies two factors other than light intensity that could affect the rate of photosynthesis in an investigation (2 of 2 points)
S03_02	Matches 4 of 4 animal groups to their characteristic features (2 of 2 points)
S03_03A	In the context of an investigation about cellular respiration, interprets the role of parts of an experimental set-up to provide a controlled condition
S04_02	Recognizes 3 of 3 major organs in a diagram (2 of 2 points)
S07_05A	Identifies and explains the stage of the life cycle in which a butterfly grows
S08_06C	Predicts which species would best survive in a given environment, using information in a table, and provides a supporting explanation
S10_02	States two substances plants obtain from their environment and use in photosynthesis (2 of 2 points)
S10_04B	States two ways that plant and animal cells are different (2 of 2 points)
S11_01B	Explains how influenza can be spread rapidly around the world
S11_04	Explains how flooding leads to a shortage of drinking water and the spread of disease (2 of 2 points)
Chemistry	
S03_07	Recognizes whether everyday liquids will neutralize a base
S04_08	Recognizes whether each of five substances is an element, a compound, or a mixture (2 of 2 points)
S06_08	Given two proposed methods for separating a mixture of small pieces of two metals, identifies which method will work and explains why it will work and why the other method will not work (2 of 2 points)
S12_08	Recognizes a property of a basic solution
S14_09	Explains how painting a metal prevents rust from forming
S14_10	Recognizes a true statement about neutral atoms
Physics	
S01_10B	Recognizes that a falling ball will not bounce as high as the point from which it fell and explains why

S01_11	Calculates resistance from current and voltage
S02_08	Interprets a diagram showing heat transfer to recognize the relative temperatures of two blocks in water
S03_10	From a diagram of an object floating in different liquids, explains that the portion of the object which is submerged depends on the density of the liquid
S04_09	Explains how a substance can be in two different states in a container at one time in a given context
S05_10	Recognizes what happens to the mass and volume of water when it freezes
S06_11	Recognizes the correct statement about the relative motion of an object seen from two frames of reference
S08_08	Recognizes how the temperature of water changes over time when heated
S10_05	Recognizes how the mass of a metal ball will change as it cools down
Earth Science	
S02_13	Describes two things being done by car-makers to reduce air pollution (2 of 2 points)
S04_12	Recognizes the gas that makes up most of Earth's atmosphere
S04_14B	Given a diagram, explains a process that shaped a rock formation in the ocean
S10_13B	Synthesizes information in temperature graphs and maps to recognize an explanation for the difference in seasonal climates of two cities at similar latitudes
S12_10	Recognizes the relative composition of gases in Earth's atmosphere
S12_11B	Evaluates a conclusion about climate data, based on one week of weather observations

CHAPTER 15:

Creating and Interpreting the TIMSS 2015 Context Questionnaire Scales

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Overview

As described in Chapter 2: Developing the TIMSS 2015 Context Questionnaires, many of the TIMSS 2015 context questionnaire items were developed to be combined into scales measuring a single underlying latent construct. For reporting, the scales were constructed using item response theory (IRT) scaling methods, specifically the Rasch partial credit model (Masters and Wright, 1997). As a parallel to the TIMSS International Benchmarks of achievement, each context scale allowed students to be classified into regions corresponding to high, middle, and low values on the construct. To facilitate interpretation of the regions, the cutpoints delimiting the regions were defined in terms of combinations of response categories. For certain scales that maintained many of the same items across TIMSS 2011 and TIMSS 2015, the scales were linked to allow for trend measurement on the background construct.

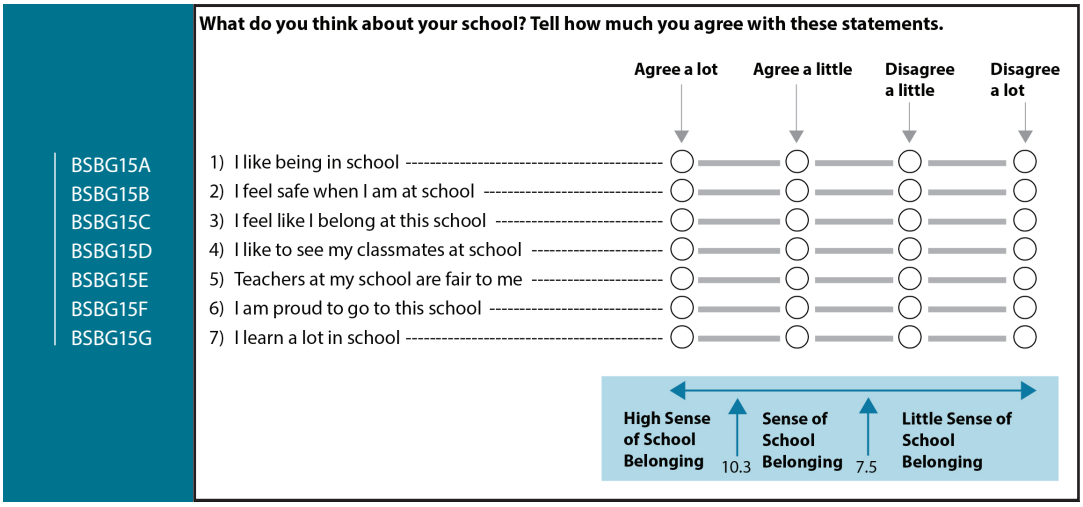
This chapter describes the procedures for constructing, interpreting, and validating scales based on responses to student, teacher, school, and home questionnaires, and then details the process for linking and reporting trend scales.

Reporting TIMSS 2015 Context Questionnaire Scales

As an example illustrating the TIMSS approach to reporting context questionnaire data, Exhibit 15.1 presents the TIMSS 2015 *Students' Sense of School Belonging* scale at the eighth grade, a scale that was reported for the first time for the 2015 assessment. As the name suggests, this scale seeks

to measure students' feelings towards their school and connectedness with the school community. For each of the seven statements, students were asked to indicate the degree of their agreement with the statement: agree a lot, agree a little, disagree a little, or disagree a lot. Using IRT partial credit scaling, the data from student responses were placed on a scale constructed so that the scale centerpoint of 10 was located at the mean score across all TIMSS countries. The units of the scale were chosen so that 2 scale score points corresponded to the standard deviation across all countries. Students with a High Sense of School Belonging had a scale score greater than or equal to the point on the scale, 10.3 in this case, corresponding to agreeing a lot, on average, with four of the seven statements and agreeing a little with three of the statements. Students with Little Sense of School Belonging had a score no higher than the point (7.5) on the scale corresponding to disagreeing a little with four of the statements, on average, and agreeing a little with three of them.

Exhibit 15.1: Items in the TIMSS 2015 *Students' Sense of School Belonging* Scale, Eighth Grade



Scaling Procedure

Partial credit IRT scaling is based on a statistical model that relates the probability that a person will choose a particular response to an item to that person's location on the underlying construct. In the TIMSS 2015 *Students' Sense of School Belonging* scale, the underlying construct is students' feelings about their school, and students who agree in general with the seven statements are assumed to have a greater sense of belonging and students who disagree with the statements are assumed to feel less belonging.

The partial credit model is shown below:

$$P_{x_i}(\theta_n) = \frac{e^{\sum_{j=0}^{x_i}(\theta_n - \delta_i + \tau_{ij})}}{\sum_{h=0}^{m_i} e^{\sum_{j=0}^{x_i}(\theta_n - \delta_i + \tau_{ij})}} \quad x_i = 0, 1, \ldots, m_i$$

where $P_{x_i}(\theta_n)$ denotes the probability that person n with location θ_n on the latent construct would choose response level x_i to item i out of the m_i possible response levels for the item. The item parameter δ_i gives the location of the item on the latent construct and τ_{ij} denotes step parameters for the response levels. For each scale, the scaling procedure involves first estimating the δ_i and τ_{ij} item parameters, and then using the model with these parameters to estimate θ_n, the score on the latent construct, for each on the n respondents. Depending on the scale, respondents may be students, parents, teachers, or school principals.

The TIMSS 2015 context questionnaire scaling was conducted using the ConQuest 2.0 software (Wu, Adams, Wilson, & Haldane, 2007).

In preparation for the context questionnaire scaling effort, the TIMSS & PIRLS International Study Center developed a system of production programs that could effectively calibrate the items on each scale using ConQuest and produce scale scores for each scale respondent. Each assessment population (TIMSS fourth grade, TIMSS eighth grade) consisted of approximately 300,000 students, as well as their parents, teachers, and school principals. The estimation of the item parameters, a procedure also known as item calibration, was conducted on the combined data from all countries, with each country contributing equally to the calibration. This was achieved by assigning weights that sum to 500 for each country's student data. Exhibit 15.2 shows the international item parameters for the *Students' Sense of School Belonging* scale. For each item, the delta parameter δ_i shows the estimated overall location of the item on the scale, and the tau parameters τ_{ij} show the location of the steps, expressed as deviations from delta. Also, included in the right column is the Rasch infit item statistic, which is a measure of how well the data matches the model, with values above 1.3 indicating unexpected response patterns. As can be seen in this exhibit, the data seemed to match the model well for the seven items of the *Belonging* scale.

Exhibit 15.2: Item Parameters for the TIMSS 2015 *Students' Sense of School Belonging* Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBG15A	0.38218	–0.95870	–0.74432	1.70302	1.01
BSBG15B	0.07288	–0.94599	–0.58632	1.53231	0.99
BSBG15C	0.21160	–0.83609	–0.55012	1.38621	0.94
BSBG15D	–0.73119	–0.52286	–0.46686	0.98972	1.17
BSBG15E	0.20067	–0.98123	–0.56256	1.54379	1.12
BSBG15F	0.26647	–0.76246	–0.50391	1.26637	0.91
BSBG15G	–0.40261	–0.89880	–0.61886	1.51766	0.98

Once the calibration was completed and international item parameters were estimated, individual scores for each respondent (students, teachers, principals, or parents) were generated using weighted maximum likelihood estimation (Warm, 1989). All cases with valid responses to at least two items on a scale were included in the calibration and scoring processes.

The scale scores produced by the weighted likelihood estimation are in the logit metric with measured values ranging from approximately –5 to +5. To convert to a more convenient reporting metric, a linear transformation was applied to the international distribution of logit scores for each scale, so that the resulting distribution across all countries had a mean of 10 and a standard deviation of 2. Exhibit 15.3 presents the scale transformation constants applied to the international distribution of logit scores for the *Students' Sense of School Belonging* scale to transform them to the (10, 2) reporting metric.

Exhibit 15.3: Scale Transformation Constants for the TIMSS 2015 *Students' Sense of School Belonging* Scale, Eighth Grade

Scale Transformation Constants	
A = 7.847376	Transformed Scale Score = 7.847376 + 1.363355 • Logit Scale Score
B = 1.363355	

To provide an approach to reporting the context questionnaire scales analogous to the TIMSS International Benchmarks for the TIMSS achievement scales, a method was developed to divide each scale into high, middle, and low regions and provide a content-referenced interpretation for these regions. For the TIMSS achievement scales, the Low, Intermediate, High, and Advanced International Benchmarks are specific reference points on the scale that can be used to monitor progress in student achievement. Using a scale anchoring procedure, student performance at each Benchmark is described in terms of the mathematics and science (depending on the subject) that students reaching that Benchmark know and can do. The percentage of students reaching each of these International Benchmarks can serve as a profile of student achievement in a country.

For the high, middle, and low regions of the context questionnaire scales, the interpretation is content-referenced to the extent that the boundaries of the regions were defined in terms of identifiable combinations of response categories. The particular response combinations that defined the regions boundaries, or cutpoints, were based on a judgment of what constituted a high or low region on each individual scale. For example, based on a consideration of the questions making up the *Students' Sense of School Belonging* scale, it was determined that in order to be in the high region of the scale and labeled "High Sense of School Belonging," a student would have to agree a lot, on average, to at least four of the seven statements and agree a little to the other three. Similarly, it was determined that a student who, on average, at most agreed a little with three of the statements and disagreed a little with the other four would be labeled to have "Little Sense of School Belonging."

The scale region cutpoints were quantified by assigning a numeric value to each response category, such that each respondent's responses to the scale's questions could be expressed as a "raw score." Assigning 0 to "Disagree a lot," 1 to "Disagree a little," 2 to "Agree a little," and 3 to "Agree a lot," results in raw scores on the *Students' Sense of School Belonging* scale ranging from 0 (disagree a lot with all seven statements) to 21 (agree a lot to all seven). A student who agreed a lot with four statements and agreed a little with the other three would have a raw score of 18 (4×3 + 3×2). Following this approach, a student with a raw score of 18 or more would be in the "High Sense of School Belonging" region of the scale. Similarly, agreeing a little with three statements and disagreeing a little with four statements would result in a raw score of 10 (3×2 + 4×1), so that a student with a raw score less than or equal to 10 would be in the "Little Sense of School Belonging" region.

A property of a Rasch scale is that each raw score has a unique scale score associated with it. Exhibit 15.4 presents a raw score-scale score equivalence table for the *Students' Sense of School Belonging* scale. From this table, it can be seen that a raw score of 10 corresponds to a scale score of 7.5 (rounding up) and a raw score of 18 corresponds to a scale score of 10.3 (rounding down).[1] These scale scores were the cutpoints used to divide the scale into the three regions.

1 The reason for rounding was to facilitate reporting, and it was decided that the highest cutpoint would be rounded down to ensure that those with an unrounded scale score (e.g., 10.39858 for the *Belonging* scale) at the cutpoint were included within the highest region. For a similar reason, the lower cutpoint was rounded up.

Exhibit 15.4: Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 *Students' Sense of School Belonging Scale*, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.04846	
1	4.43161	
2	5.08351	
3	5.53680	
4	5.89159	
5	6.19976	
6	6.47840	
7	6.73927	
8	6.99036	
9	7.23785	
10	7.48892	7.5
11	7.74446	
12	8.01437	
13	8.30564	
14	8.62531	
15	8.98361	
16	9.39043	
17	9.85678	
18	10.39858	10.3
19	11.05536	
20	11.94384	
21	13.62245	

Linking Procedures for Trend Context Questionnaire Scales

As a new initiative, trend results in the form of changes from 2011 to 2015 were reported for 12 fourth grade and 20 eighth grade context questionnaire scales. For these trend scales, linking procedures were implemented to place the data from the two cycles on a common metric. This section describes the procedures for measuring trends—placing data for the TIMSS 2015 context questionnaire scales onto the TIMSS 2011 metric and validating this process.

As described in Chapter 2, with each cycle of TIMSS, the questionnaires are revised to keep up with the times and to improve the measurement of the constructs. Using context questionnaire IRT scales to measure background constructs began with TIMSS 2011, and during the development phase of the TIMSS 2015 questionnaires, a conscious effort was made to increase the number of items contributing to each scale in order to enhance scale reliability. The context scales used to

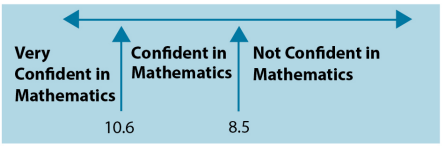
measure trends in TIMSS 2015 have items common to both TIMSS 2011 and TIMSS 2015—also called trend items—and new items unique to TIMSS 2015. Generally, a context questionnaire scale was considered for trend reporting in 2015 if it had a sufficient number of items in common with 2011: a minimum of 5 common items and more than half of the TIMSS 2015 items being common items.

As an example, Exhibit 15.5 shows the TIMSS 2015 *Students Confident in Mathematics* scale for fourth grade students—one of the scales where trend measurement was reported. This scale measures how confident students feel about their ability in mathematics, in terms of their level of agreement with nine statements about mathematics. Statements expressing negative sentiment were reverse coded during the scaling. Seven of the nine statements were common to the TIMSS 2011 and TIMSS 2015 versions of this scale, with 'T' for trend identifying these items to the left of their variable name. Two new statements were added to the seven common items to improve the measure of *Students Confident in Mathematics* for TIMSS 2015.

Exhibit 15.5: Items in the TIMSS 2015 *Students Confident in Mathematics* Trend Scale, Fourth Grade

		How much do you agree with these statements about mathematics?	Agree a lot	Agree a little	Disagree a little	Disagree a lot
T	ASBM03A	1) I usually do well in mathematics	○	○	○	○
T	ASBM03B*	2) Mathematics is harder for me than for many of my classmates*	○	○	○	○
T	ASBM03C*	3) I am just not good at mathematics*	○	○	○	○
T	ASBM03D	4) I learn things quickly in mathematics	○	○	○	○
	ASBM03E*	5) Mathematics makes me nervous*	○	○	○	○
T	ASBM03F	6) I am good at working out difficult mathematics problems	○	○	○	○
T	ASBM03G	7) My teacher tells me I am good at mathematics	○	○	○	○
T	ASBM03H*	8) Mathematics is harder for me than any other subject*	○	○	○	○
	ASBM03I*	9) Mathematics makes me confused*	○	○	○	○

* Reverse coded



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

The IRT calibration and scoring methods for trend scales were the same as those used for the new context scales. The data for these nine items were calibrated across all TIMSS 2015 countries using the Rasch partial credit model, and, through this calibration, item parameters were estimated on a logit scale that was unique to the 2015 cycle. Following calibration, weighted maximum likelihood estimation was used to derive Rasch logit scale scores based on these estimated item

parameters for all countries and benchmarking participants, and as such student scores were placed on this 2015 logit metric. Although similar, the TIMSS 2015 logit metric is not identical to the TIMSS 2011 logit metric, and thus the TIMSS 2015 scores needed to be transformed to the 2011 metric to allow for trend reporting.

This linking was achieved through a two-step transformation process. The first transformation—with linear constants A_1 and B_1—placed the TIMSS 2015 logit scale scores on the TIMSS 2011 logit metric, and the second transformation—with linear constants A_2 and B_2—transformed the TIMSS 2011 logit metric to the TIMSS scale metric, which uses the (10, 2) metric described earlier. To increase the efficiency of this transformation process and reduce rounding errors, both transformations were combined into one calculation using the equations below to create a set of final scale transformation constants, A and B:

$$B = B_2 \cdot B_1$$

$$A = A_2 + B_2 \cdot A_1$$

The first set of transformation parameters, A_1 and B_1, were obtained by applying the mean/sigma method (Kolen & Brennan, 2004) to the two sets of common item parameters: one from the current calibration of TIMSS 2015 data and the other from the previous calibration of TIMSS 2011 data. The mean and standard deviation of the estimates of the difference between item location and item step parameter, $(\delta_i - \tau_{ij})$, were first found over all common items and all categories for each calibration. The transformation parameters A_1 and B_1 were calculated based on these two sets of means and standard deviations:

$$B_1 = \frac{SD_{c11}}{SD_{c15}}$$

$$A_1 = MN_{c11} - \frac{SD_{c11}}{SD_{c15}} \cdot MN_{c15}$$

where MN_{c15} and SD_{c15} are the mean and standard deviation of the estimates of $(\delta_i - \tau_{ij})$ of all common items and categories from the current calibration on TIMSS 2015 data; MN_{c11} and SD_{c11} are the mean and standard deviation of the estimates of $(\delta_i - \tau_{ij})$ of all common items and categories from the previous calibration on TIMSS 2011 data.

The second set of transformation parameters, A_2 and B_2, were retrieved from the scale transformations which were established in 2011 for reporting. This transformation aimed to place the resulting Rasch scores on the TIMSS (10, 2) trend reporting metric.

Exhibit 15.6 presents the final trend scale transformation constants applied to the TIMSS 2015 international distribution of logit scale scores for the *Students Confident in Mathematics* trend scale to transform them to the (10, 2) trend reporting metric.

Exhibit 15.6: Scale Transformation Constants for the TIMSS 2015 *Students Confident in Mathematics* Scale, Fourth Grade

Scale Transformation Constants	
A = 8.5562	Transformed Scale Score = 8.5562 + 1.599041 • Logit Scale Score
B = 1.599041	

To assess the accuracy of the linking, item parameter estimates for the trend items were compared across the two cycles by examining the differences between the TIMSS 2015 item parameter estimates after being transformed to the TIMSS 2011 logit metric, and the TIMSS 2011 item parameter estimates on the 2011 logit scale. Exhibit 15.7 presents the differences between these estimates for the *Students Confident in Mathematics* trend scale. As can be seen in the exhibit, the differences were at an acceptable level for both location and step parameters, with most deviations being less than 0.1.

Exhibit 15.7: Differences in Parameter Estimates for Common Items on the TIMSS 2011 Logit Metric, *Students Confident in Mathematics* Scale, Fourth Grade

TIMSS 2015 Variable	TIMSS 2011 Variable	Difference in delta	Difference in tau_1	Difference in tau_2	Difference in tau_3
ASBM03A	ASBM03A	0.01907	–0.01847	–0.08334	0.10181
ASBM03B*	ASBM03B*	0.07164	0.00355	–0.07789	0.07434
ASBM03C*	ASBM03C*	–0.05559	–0.00555	–0.03665	0.04220
ASBM03D	ASBM03D	0.02644	0.07476	–0.07052	–0.00424
ASBM03F	ASBM03E	0.05700	0.08382	–0.02372	–0.06010
ASBM03G	ASBM03F	–0.08982	0.04175	–0.03405	–0.00770
ASBM03H*	ASBM03G*	–0.02875	–0.01985	–0.03125	0.05110

* Reverse coded

Validating the TIMSS 2015 Context Questionnaire Scales

As evidence that the context questionnaire scales provide comparable measurement across countries, reliability coefficients were computed for each scale for every country and benchmarking participant, and a principal components analysis of the scale items was conducted. Exhibit 15.8 presents the results of this analysis for the *Students Confident in Mathematics* scale. The Cronbach's Alpha reliability coefficients generally were at an acceptable level, with almost all above 0.7 and many above 0.8. The exhibit also shows the percentage of variance among the scale items accounted for by the first principal component in each country. In most cases this was acceptably high, indicating that the items could be adequately represented by a single scale. The component loadings of each questionnaire item from the principal components analysis are positive and substantial, indicating a strong correlation between each item and the scale in every country.

Exhibit 15.8: Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the TIMSS 2015 *Students Confident in Mathematics* Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item								
			ASBM03A	ASBM03B*	ASBM03C*	ASBM03D	ASBM03E*	ASBM03F	ASBM03G	ASBM03H*	ASBM03I*
Australia	0.87	50	0.74	0.71	0.78	0.71	0.65	0.74	0.42	0.78	0.74
Bahrain	0.76	35	0.18	0.72	0.74	0.38	0.73	0.34	0.33	0.79	0.74
Belgium (Flemish)	0.88	52	0.81	0.76	0.82	0.70	0.50	0.71	0.60	0.80	0.72
Bulgaria	0.87	49	0.73	0.70	0.73	0.71	0.62	0.70	0.66	0.74	0.73
Canada	0.86	48	0.73	0.75	0.77	0.70	0.63	0.69	0.38	0.78	0.74
Chile	0.82	41	0.65	0.60	0.70	0.64	0.64	0.61	0.44	0.72	0.75
Chinese Taipei	0.86	48	0.74	0.68	0.65	0.74	0.57	0.70	0.62	0.75	0.76
Croatia	0.89	53	0.75	0.73	0.71	0.76	0.69	0.70	0.67	0.77	0.78
Cyprus	0.86	47	0.71	0.68	0.71	0.68	0.61	0.70	0.59	0.73	0.74
Czech Republic	0.88	51	0.74	0.74	0.80	0.75	0.64	0.59	0.61	0.78	0.73
Denmark	0.87	50	0.78	0.75	0.80	0.74	0.58	0.63	0.54	0.75	0.74
England	0.87	49	0.73	0.70	0.78	0.71	0.64	0.72	0.36	0.79	0.76
Finland	0.86	49	0.78	0.73	0.81	0.74	0.64	0.70	0.52	0.77	0.53
France	0.87	50	0.75	0.72	0.77	0.74	0.64	0.61	0.54	0.76	0.77
Georgia	0.76	35	0.38	0.71	0.73	0.44	0.65	0.32	0.39	0.75	0.70
Germany	0.89	53	0.76	0.76	0.80	0.74	0.66	0.70	0.63	0.77	0.73
Hong Kong SAR	0.86	48	0.72	0.68	0.81	0.71	0.56	0.71	0.60	0.77	0.63
Hungary	0.88	52	0.78	0.72	0.78	0.76	0.56	0.74	0.72	0.74	0.68
Indonesia	0.75	34	0.37	0.70	0.73	0.41	0.70	0.16	0.32	0.75	0.76
Iran, Islamic Rep. of	0.76	34	0.50	0.56	0.50	0.52	0.68	0.52	0.49	0.72	0.72
Ireland	0.85	48	0.73	0.75	0.77	0.70	0.63	0.69	0.29	0.78	0.74
Italy	0.85	45	0.69	0.70	0.64	0.71	0.66	0.59	0.60	0.75	0.71
Japan	0.88	50	0.71	0.67	0.83	0.72	0.66	0.77	0.46	0.75	0.75
Jordan	0.75	35	0.09	0.73	0.76	0.26	0.78	0.17	0.25	0.80	0.77
Kazakhstan	0.85	45	0.68	0.69	0.72	0.66	0.62	0.66	0.65	0.72	0.64
Korea, Rep. of	0.88	53	0.82	0.78	0.78	0.73	0.43	0.79	0.56	0.80	0.76
Kuwait	0.75	33	0.22	0.68	0.70	0.40	0.71	0.36	0.39	0.75	0.70
Lithuania	0.84	45	0.75	0.70	0.75	0.66	0.48	0.69	0.62	0.72	0.59
Morocco	0.74	32	0.39	0.66	0.71	0.35	0.71	0.27	0.32	0.72	0.70
Netherlands	0.89	54	0.80	0.77	0.82	0.74	0.46	0.77	0.53	0.80	0.82
New Zealand	0.83	42	0.70	0.66	0.74	0.66	0.54	0.67	0.42	0.72	0.67
Northern Ireland	0.87	49	0.77	0.74	0.79	0.70	0.66	0.71	0.31	0.76	0.76

* Reverse coded

Exhibit 15.8: Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the TIMSS 2015 *Students Confident in Mathematics Scale*, Fourth Grade (Continued)

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item								
			ASBM03A	ASBM03B*	ASBM03C*	ASBM03D	ASBM03E*	ASBM03F	ASBM03G	ASBM03H*	ASBM03I*
Norway (5)	0.87	49	0.76	0.72	0.75	0.75	0.57	0.75	0.50	0.76	0.70
Oman	0.69	30	0.07	0.73	0.62	0.21	0.74	0.08	0.15	0.78	0.76
Poland	0.88	52	0.75	0.74	0.73	0.76	0.60	0.74	0.65	0.79	0.74
Portugal	0.86	49	0.72	0.64	0.77	0.67	0.65	0.72	0.66	0.69	0.75
Qatar	0.80	38	0.34	0.75	0.76	0.43	0.72	0.40	0.39	0.79	0.73
Russian Federation	0.89	54	0.75	0.75	0.78	0.77	0.69	0.71	0.62	0.76	0.76
Saudi Arabia	0.75	35	0.04	0.74	0.74	0.24	0.79	0.18	0.24	0.81	0.77
Serbia	0.88	51	0.71	0.72	0.75	0.68	0.68	0.68	0.66	0.76	0.75
Singapore	0.87	49	0.77	0.73	0.76	0.69	0.61	0.69	0.52	0.78	0.75
Slovak Republic	0.87	48	0.72	0.68	0.75	0.70	0.67	0.67	0.58	0.74	0.74
Slovenia	0.88	52	0.76	0.70	0.72	0.69	0.66	0.74	0.66	0.78	0.75
South Africa (5)	0.69	29	0.12	0.72	0.73	0.11	0.68	0.05	0.06	0.76	0.71
Spain	0.85	45	0.68	0.71	0.74	0.61	0.65	0.61	0.58	0.73	0.73
Sweden	0.87	49	0.75	0.73	0.74	0.74	0.60	0.71	0.47	0.79	0.72
Turkey	0.82	42	0.63	0.70	0.74	0.55	0.61	0.58	0.59	0.70	0.70
United Arab Emirates	0.79	37	0.46	0.67	0.71	0.51	0.65	0.48	0.44	0.73	0.70
United States	0.86	48	0.70	0.75	0.77	0.68	0.64	0.68	0.39	0.79	0.75
Benchmarking Participants											
Buenos Aires, Argentina	0.81	40	0.64	0.62	0.69	0.55	0.66	0.55	0.41	0.74	0.75
Ontario, Canada	0.86	49	0.73	0.76	0.78	0.69	0.61	0.70	0.39	0.78	0.74
Quebec, Canada	0.87	50	0.77	0.75	0.76	0.77	0.66	0.69	0.39	0.75	0.72
Norway (4)	0.84	45	0.71	0.67	0.72	0.73	0.49	0.74	0.47	0.72	0.68
Abu Dhabi, UAE	0.77	35	0.37	0.67	0.71	0.45	0.69	0.40	0.37	0.72	0.73
Dubai, UAE	0.83	42	0.62	0.69	0.70	0.60	0.63	0.60	0.54	0.73	0.69
Florida, US	0.87	50	0.71	0.78	0.76	0.68	0.68	0.67	0.47	0.81	0.75

* Reverse coded

As indicators of effective environments for learning, a positive relationship with achievement is an important aspect of validity for the TIMSS context questionnaire scales. For the *Students*

Confident in Mathematics scale, Exhibit 15.9 presents the Pearson correlation with mathematics achievement in TIMSS 2015 for each country, together with *r*-squared—the proportion of variance in mathematics and science achievement attributable to the *Students Confident* scale. These figures show a moderate relationship with achievement across participating countries. Also shown is the proportion of variance in achievement attributable to differences between the regions of the *Students Confident* scale. This is very similar to the proportion of variance explained by the scale as a whole, indicating that dividing the scale into regions loses little of its power to account for achievement differences.

Exhibit 15.9: Relationship Between the TIMSS 2015 *Students Confident in Mathematics* Scale, Fourth Grade, and TIMSS 2015 Mathematics Achievement

Country	Pearson's Correlation with Mathematics Achievement		Variance in Mathematics Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.44	0.19	0.18
Bahrain	0.37	0.14	0.13
Belgium (Flemish)	0.39	0.15	0.14
Bulgaria	0.40	0.16	0.16
Canada	0.44	0.19	0.19
Chile	0.41	0.17	0.17
Chinese Taipei	0.44	0.19	0.20
Croatia	0.45	0.20	0.19
Cyprus	0.44	0.19	0.18
Czech Republic	0.42	0.18	0.18
Denmark	0.42	0.17	0.17
England	0.32	0.10	0.12
Finland	0.43	0.19	0.17
France	0.40	0.16	0.16
Georgia	0.36	0.13	0.15
Germany	0.42	0.18	0.18
Hong Kong SAR	0.41	0.17	0.18
Hungary	0.49	0.24	0.25
Indonesia	0.29	0.09	0.09
Iran, Islamic Rep. of	0.30	0.09	0.10
Ireland	0.43	0.18	0.18
Italy	0.32	0.10	0.10
Japan	0.44	0.19	0.19
Jordan	0.38	0.14	0.15
Kazakhstan	0.22	0.05	0.05
Korea, Rep. of	0.54	0.29	0.27
Kuwait	0.26	0.07	0.07
Lithuania	0.46	0.21	0.21
Morocco	0.32	0.10	0.10

Exhibit 15.9: Relationship Between the TIMSS 2015 *Students Confident in Mathematics* Scale, Fourth Grade, and TIMSS 2015 Mathematics Achievement (Continued)

Country	Pearson's Correlation with Mathematics Achievement		Variance in Mathematics Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Netherlands	0.52	0.27	0.28
New Zealand	0.37	0.14	0.13
Northern Ireland	0.40	0.16	0.17
Norway (5)	0.42	0.18	0.16
Oman	0.31	0.10	0.10
Poland	0.47	0.22	0.22
Portugal	0.49	0.24	0.25
Qatar	0.28	0.08	0.10
Russian Federation	0.39	0.15	0.16
Saudi Arabia	0.28	0.08	0.09
Serbia	0.44	0.19	0.19
Singapore	0.47	0.22	0.22
Slovak Republic	0.40	0.16	0.15
Slovenia	0.46	0.21	0.21
South Africa (5)	0.38	0.15	0.15
Spain	0.44	0.19	0.21
Sweden	0.38	0.14	0.13
Turkey	0.47	0.22	0.20
United Arab Emirates	0.32	0.11	0.11
United States	0.43	0.18	0.19
International Median	**0.41**	**0.17**	**0.17**
Benchmarking Participants			
Buenos Aires, Argentina	0.33	0.11	0.12
Ontario, Canada	0.45	0.20	0.20
Quebec, Canada	0.43	0.19	0.17
Norway (4)	0.39	0.15	0.14
Abu Dhabi, UAE	0.37	0.14	0.14
Dubai, UAE	0.30	0.09	0.10
Florida, US	0.43	0.18	0.20

Item parameter estimates and item and scale statistics similar to those above are available in Appendix 15A for each of the fourth grade TIMSS 2015 context questionnaire scales and in Appendix 15B for each of the eighth grade context questionnaire scales.

Reporting the TIMSS 2015 Trend Context Questionnaire Scales

Exhibit 15.10 shows an excerpt from the *Students Confident in Mathematics* exhibit at the fourth grade. To represent trends from 2011, the two columns to the right of the exhibit present the average scale score in 2015 for each country and the difference from the average in 2011, respectively. Up and down arrows indicate whether the trend difference is significantly higher or lower in 2015, with a 99% level of confidence.

Trend results were not reported for the percentage of students in each region. To facilitate interpretation of the region boundaries in terms of combinations of response categories, trend scales followed the same procedure as non-trend scales in setting cutpoints for classification into regions. As such, the procedure was primarily dependent on similarities in response patterns without taking into account variations in difficulty across the items that were unique to 2011 or 2015. Consequently, although the cutpoints generally are quite close across the two cycles, they are not identical and therefore it was considered most appropriate to use differences in scale score means rather than changes in the percentages in scale regions as indicators of trend.

Exhibit 15.10: Excerpt from *Students Confident in Mathematics* Exhibit, Fourth Grade

Reported by Students

Students were scored according to their degree of agreement with nine statements on the *Students Confident in Mathematics* scale. Students **Very Confident in Mathematics** had a score on the scale of at least 10.6, which corresponds to their "agreeing a lot" with five of the nine statements and "agreeing a little" with the other four, on average. Students who were **Not Confident in Mathematics** had a score no higher than 8.5, which corresponds to their "disagreeing a little" with five of the nine statements and "agreeing a little" with the other four, on average. All other students were **Confident in Mathematics**.

Country	Very Confident in Mathematics		Confident in Mathematics		Not Confident in Mathematics		Average Scale Score	Difference in Average Scale Score from 2011
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement		
Serbia	45 (1.2)	556 (5.2)	36 (1.0)	507 (4.1)	19 (0.8)	458 (4.7)	10.5 (0.05)	0.4 (0.07) ▲
Cyprus	44 (1.1)	560 (2.9)	38 (0.9)	511 (2.8)	17 (0.8)	469 (3.9)	10.5 (0.05)	◊ ◊
Norway (5)	44 (1.0)	578 (3.0)	44 (0.9)	536 (2.6)	12 (0.6)	493 (4.5)	10.5 (0.05)	◊ ◊
Bulgaria	42 (1.2)	561 (4.0)	37 (0.9)	513 (5.0)	20 (1.1)	478 (8.3)	10.5 (0.06)	◊ ◊
Jordan	42 (1.2)	434 (3.6)	39 (0.9)	376 (3.6)	19 (1.0)	328 (7.5)	10.5 (0.06)	◊ ◊
Turkey	41 (1.0)	532 (3.0)	40 (0.9)	464 (3.6)	19 (0.8)	423 (4.4)	10.4 (0.05)	0.1 (0.06)
Netherlands	40 (1.0)	562 (1.8)	39 (1.0)	522 (2.1)	21 (0.8)	484 (2.1)	10.3 (0.04)	0.2 (0.06) ▲
Kazakhstan	40 (1.5)	566 (4.9)	48 (1.2)	535 (5.3)	12 (0.9)	515 (6.3)	10.6 (0.06)	0.1 (0.09)
England	37 (1.1)	578 (4.7)	43 (1.0)	541 (3.4)	20 (0.9)	499 (3.3)	10.1 (0.05)	0.1 (0.06)
Kuwait	37 (1.1)	387 (5.2)	45 (0.9)	342 (4.9)	18 (0.7)	317 (6.5)	10.3 (0.05)	◊ ◊
Georgia	37 (1.6)	501 (4.2)	50 (1.3)	458 (3.6)	13 (0.8)	400 (6.2)	10.3 (0.06)	-0.2 (0.07) ▼
Ireland	37 (0.9)	583 (2.6)	45 (0.8)	539 (2.4)	18 (0.8)	498 (3.7)	10.2 (0.04)	-0.2 (0.07) ▼

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Source: The full Students Confident in Mathematics exhibit at the fourth grade can be found within the TIMSS 2015 International Results in Mathematics report.

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Appendix 15A: TIMSS 2015 Context Questionnaire Scales, Fourth Grade

Challenges Facing Teachers Scale, Fourth Grade

The Challenges Facing Teachers (CFT) scale was created based on teachers' degree of agreement with the eight statements described below.

Items in the TIMSS 2015 Challenges Facing Teachers Scale, Fourth Grade

Indicate the extent to which you agree or disagree with each of the following statements.

		Disagree a lot	Disagree a little	Agree a little	Agree a lot
ATBG11A	1) There are too many students in the classes	○	○	○	○
ATBG11B	2) I have too much material to cover in class	○	○	○	○
ATBG11C	3) I have too many teaching hours	○	○	○	○
ATBG11D	4) I need more time to prepare for class	○	○	○	○
ATBG11E	5) I need more time to assist individual students	○	○	○	○
ATBG11F	6) I feel too much pressure from parents	○	○	○	○
ATBG11G	7) I have difficulty keeping up with all the changes to the curriculum	○	○	○	○
ATBG11H	8) I have too many administrative tasks	○	○	○	○

Few Challenges — Some Challenges (10.4) — Many Challenges (7.1)

Item Parameters for the TIMSS 2015 Challenges Facing Teachers Scale, Fourth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
ATBG11A	0.07889	-0.76467	0.14939	0.61528	1.15
ATBG11B	0.47864	-1.35276	0.09232	1.26044	0.93
ATBG11C	-0.52363	-0.93560	-0.19692	1.13252	0.97
ATBG11D	0.33075	-1.28469	0.21303	1.07166	0.92
ATBG11E	1.28961	-1.28077	0.54728	0.73349	0.89
ATBG11F	-0.86698	-1.40866	-0.06337	1.47203	1.04
ATBG11G	-0.76404	-1.47618	0.14792	1.32826	1.00
ATBG11H	-0.02324	-0.71014	0.16389	0.54625	1.09

Scale Transformation Constants for the TIMSS 2015 Challenges Facing Teachers Scale, Fourth Grade

Scale Transformation Constants	
A = 10.434525	Transformed Scale Score = 10.434525 + 2.004701 • Logit Scale Score
B = 2.004701	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Challenges Facing Teachers Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	1.92363	
1	4.32702	
2	5.54237	
3	6.39547	
4	7.07364	7.1
5	7.64510	
6	8.14648	
7	8.59908	
8	9.01602	
9	9.40854	
10	9.78201	
11	10.14266	
12	10.49619	10.4
13	10.84813	
14	11.20423	
15	11.57049	
16	11.95345	
17	12.36030	
18	12.79709	
19	13.27735	
20	13.81571	
21	14.43884	
22	15.19930	
23	16.26129	
24	18.41488	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Challenges Facing Teachers Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item							
			ATBG11A	ATBG11B	ATBG11C	ATBG11D	ATBG11E	ATBG11F	ATBG11G	ATBG11H
Australia	0.74	38	0.61	0.70	0.53	0.75	0.68	0.49	0.49	0.61
Bahrain	0.81	43	0.63	0.66	0.73	0.72	0.68	0.60	0.64	0.60
Belgium (Flemish)	0.73	35	0.54	0.68	0.59	0.67	0.63	0.48	0.45	0.67
Bulgaria	0.71	34	0.61	0.62	0.74	0.65	0.55	0.37	0.44	0.58
Canada	0.77	39	0.62	0.65	0.56	0.66	0.60	0.61	0.59	0.68
Chile	0.72	38	0.58	0.68	0.67	0.74	0.76	0.47	0.31	0.60
Chinese Taipei	0.80	43	0.70	0.73	0.72	0.72	0.67	0.64	0.48	0.52
Croatia	0.78	40	0.56	0.65	0.62	0.69	0.70	0.67	0.52	0.64
Cyprus	0.66	30	0.49	0.55	0.63	0.72	0.50	0.49	0.51	0.42
Czech Republic	0.78	40	0.51	0.68	0.72	0.75	0.71	0.55	0.56	0.54
Denmark	0.78	41	0.57	0.58	0.78	0.76	0.67	0.55	0.52	0.62
England	0.86	51	0.65	0.79	0.69	0.72	0.78	0.62	0.71	0.77
Finland	0.67	31	0.49	0.59	0.61	0.70	0.60	0.46	0.55	0.41
France	0.61	28	0.42	0.62	0.56	0.62	0.46	0.41	0.57	0.50
Georgia	0.66	31	0.54	0.70	0.52	0.65	0.59	0.48	0.55	0.34
Germany	0.74	36	0.49	0.55	0.69	0.70	0.58	0.55	0.59	0.63
Hong Kong SAR	0.76	39	0.69	0.65	0.41	0.71	0.63	0.56	0.68	0.60
Hungary	0.78	41	0.48	0.67	0.69	0.78	0.75	0.58	0.54	0.56
Indonesia	0.70	33	0.49	0.71	0.63	0.55	0.44	0.57	0.52	0.61
Iran, Islamic Rep. of	0.73	35	0.53	0.52	0.55	0.67	0.68	0.56	0.61	0.61
Ireland	0.81	44	0.54	0.74	0.52	0.75	0.64	0.62	0.73	0.74
Italy	0.76	39	0.45	0.74	0.48	0.78	0.64	0.54	0.72	0.52
Japan	0.73	38	0.35	0.76	0.77	0.76	0.66	0.36	0.35	0.69
Jordan	0.76	39	0.65	0.58	0.73	0.82	0.60	0.61	0.42	0.52
Kazakhstan	0.66	32	0.26	0.35	0.68	0.57	0.46	0.70	0.65	0.69
Korea, Rep. of	0.84	48	0.55	0.75	0.79	0.72	0.75	0.67	0.67	0.62
Kuwait	0.76	38	0.52	0.66	0.75	0.66	0.60	0.59	0.62	0.50
Lithuania	0.67	31	0.43	0.59	0.48	0.65	0.57	0.58	0.66	0.47
Morocco	0.70	34	0.62	0.72	0.72	0.58	0.50	0.41	0.51	0.49
Netherlands	0.73	36	0.53	0.54	0.54	0.72	0.73	0.52	0.53	0.66
New Zealand	0.82	46	0.53	0.72	0.61	0.78	0.73	0.59	0.70	0.72
Northern Ireland	0.80	45	0.65	0.64	0.67	0.73	0.70	0.46	0.67	0.78
Norway (5)	0.79	42	0.53	0.68	0.72	0.74	0.61	0.66	0.60	0.65
Oman	0.75	38	0.58	0.70	0.67	0.73	0.63	0.60	0.51	0.43
Poland	0.74	36	0.46	0.48	0.58	0.74	0.71	0.59	0.60	0.59
Portugal	0.74	40	0.58	0.76	0.64	0.71	0.73	0.56	0.49	0.52
Qatar	0.79	41	0.52	0.66	0.64	0.71	0.58	0.72	0.67	0.58
Russian Federation	0.68	33	0.37	0.59	0.53	0.74	0.63	0.63	0.61	0.38
Saudi Arabia	0.75	38	0.73	0.73	0.69	0.66	0.65	0.45	0.46	0.46
Serbia	0.76	38	0.64	0.61	0.71	0.69	0.63	0.55	0.58	0.50
Singapore	-	-	-	-	-	-	-	-	-	-
Slovak Republic	0.79	42	0.60	0.77	0.73	0.69	0.66	0.59	0.54	0.53
Slovenia	0.68	31	0.65	0.62	0.64	0.55	0.53	0.50	0.50	0.45
South Africa (5)	0.66	31	0.51	0.50	0.70	0.70	0.56	0.25	0.56	0.53
Spain	0.72	34	0.56	0.50	0.60	0.71	0.54	0.54	0.61	0.57
Sweden	0.73	37	0.36	0.65	0.69	0.81	0.66	0.51	0.41	0.64
Turkey	0.76	38	0.57	0.77	0.75	0.72	0.65	0.42	0.39	0.48
United Arab Emirates	0.84	47	0.62	0.79	0.74	0.77	0.72	0.61	0.63	0.60
United States	0.79	41	0.49	0.76	0.55	0.73	0.65	0.57	0.70	0.65
Benchmarking Participants										
Buenos Aires, Argentina	0.78	40	0.63	0.61	0.77	0.66	0.72	0.52	0.54	0.59
Ontario, Canada	0.77	39	0.63	0.72	0.52	0.65	0.56	0.61	0.64	0.63
Quebec, Canada	0.79	41	0.65	0.59	0.59	0.61	0.62	0.67	0.66	0.71
Norway (4)	0.74	37	0.58	0.63	0.64	0.65	0.58	0.64	0.53	0.59
Abu Dhabi, UAE	0.79	41	0.59	0.74	0.68	0.75	0.71	0.35	0.64	0.59
Dubai, UAE	0.84	49	0.56	0.82	0.74	0.73	0.73	0.72	0.63	0.64
Florida, US	0.73	37	0.49	0.67	0.29	0.73	0.81	0.49	0.60	0.65

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Challenges Facing Teachers Scale, Fourth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	-0.01	0.02	0.00	0.00	0.00	0.00
Bahrain	0.01	-0.02	0.00	0.00	0.00	0.00
Belgium (Flemish)	-0.11	-0.11	0.01	0.01	0.01	0.01
Bulgaria	0.06	0.04	0.00	0.00	0.00	0.00
Canada	-0.07	-0.06	0.01	0.00	0.00	0.00
Chile	0.04	0.05	0.00	0.00	0.01	0.01
Chinese Taipei	0.06	-0.04	0.00	0.00	0.01	0.00
Croatia	-0.06	-0.05	0.00	0.00	0.00	0.00
Cyprus	0.01	0.03	0.00	0.00	0.00	0.00
Czech Republic	0.00	-0.01	0.00	0.00	0.00	0.00
Denmark	-0.03	0.02	0.00	0.00	0.00	0.00
England	0.04	0.02	0.00	0.00	0.00	0.00
Finland	-0.01	-0.01	0.00	0.00	0.00	0.00
France	0.05	0.05	0.00	0.00	0.01	0.00
Georgia	0.07	0.11	0.00	0.01	0.01	0.01
Germany	0.02	-0.01	0.00	0.00	0.00	0.00
Hong Kong SAR	-0.04	0.10	0.00	0.01	0.01	0.01
Hungary	-0.10	-0.11	0.01	0.01	0.01	0.01
Indonesia	0.07	0.06	0.00	0.00	0.01	0.01
Iran, Islamic Rep. of	0.02	0.02	0.00	0.00	0.00	0.00
Ireland	-0.05	-0.02	0.00	0.00	0.00	0.00
Italy	-0.02	-0.06	0.00	0.00	0.00	0.00
Japan	-0.03	-0.05	0.00	0.00	0.00	0.00
Jordan	0.09	-	0.01	-	0.00	-
Kazakhstan	0.15	0.16	0.02	0.03	0.00	0.00
Korea, Rep. of	0.01	0.01	0.00	0.00	0.00	0.00
Kuwait	0.12	0.09	0.01	0.01	0.01	0.00
Lithuania	-0.08	-0.08	0.01	0.01	0.01	0.01
Morocco	0.14	0.16	0.02	0.03	0.01	0.01
Netherlands	-0.05	-0.07	0.00	0.00	0.01	0.01
New Zealand	-0.01	-0.03	0.00	0.00	0.00	0.00
Northern Ireland	0.02	0.01	0.00	0.00	0.00	0.00
Norway (5)	0.02	0.04	0.00	0.00	0.00	0.00
Oman	-0.01	0.00	0.00	0.00	0.01	0.00
Poland	-0.02	-0.05	0.00	0.00	0.00	0.00
Portugal	0.08	0.06	0.01	0.00	0.02	0.01
Qatar	0.08	0.08	0.01	0.01	0.02	0.01
Russian Federation	0.06	0.06	0.00	0.00	0.01	0.01
Saudi Arabia	0.08	0.15	0.01	0.02	0.01	0.01
Serbia	-0.04	-0.03	0.00	0.00	0.01	0.01
Singapore	-	-	-	-	-	-
Slovak Republic	0.02	0.03	0.00	0.00	0.00	0.00
Slovenia	-0.01	0.01	0.00	0.00	0.00	0.00
South Africa (5)	0.10	-	0.01	-	0.03	-
Spain	-0.01	-0.01	0.00	0.00	0.00	0.00
Sweden	-0.01	0.05	0.00	0.00	0.00	0.00
Turkey	0.02	0.03	0.00	0.00	0.00	0.00
United Arab Emirates	0.13	0.16	0.02	0.03	0.01	0.02
United States	-0.06	-0.06	0.00	0.00	0.00	0.00
International Median	0.01	0.02	0.00	0.00	0.00	0.00
Benchmarking Participants						
Buenos Aires, Argentina	0.13	0.14	0.02	0.02	0.01	0.01
Ontario, Canada	-0.06	-0.08	0.00	0.01	0.00	0.01
Quebec, Canada	-0.01	0.01	0.00	0.00	0.01	0.00
Norway (4)	-0.04	-0.01	0.00	0.00	0.00	0.00
Abu Dhabi, UAE	0.18	0.15	0.03	0.02	0.03	0.02
Dubai, UAE	0.05	0.08	0.00	0.01	0.00	0.00
Florida, US	0.02	-0.02	0.00	0.00	0.00	0.00

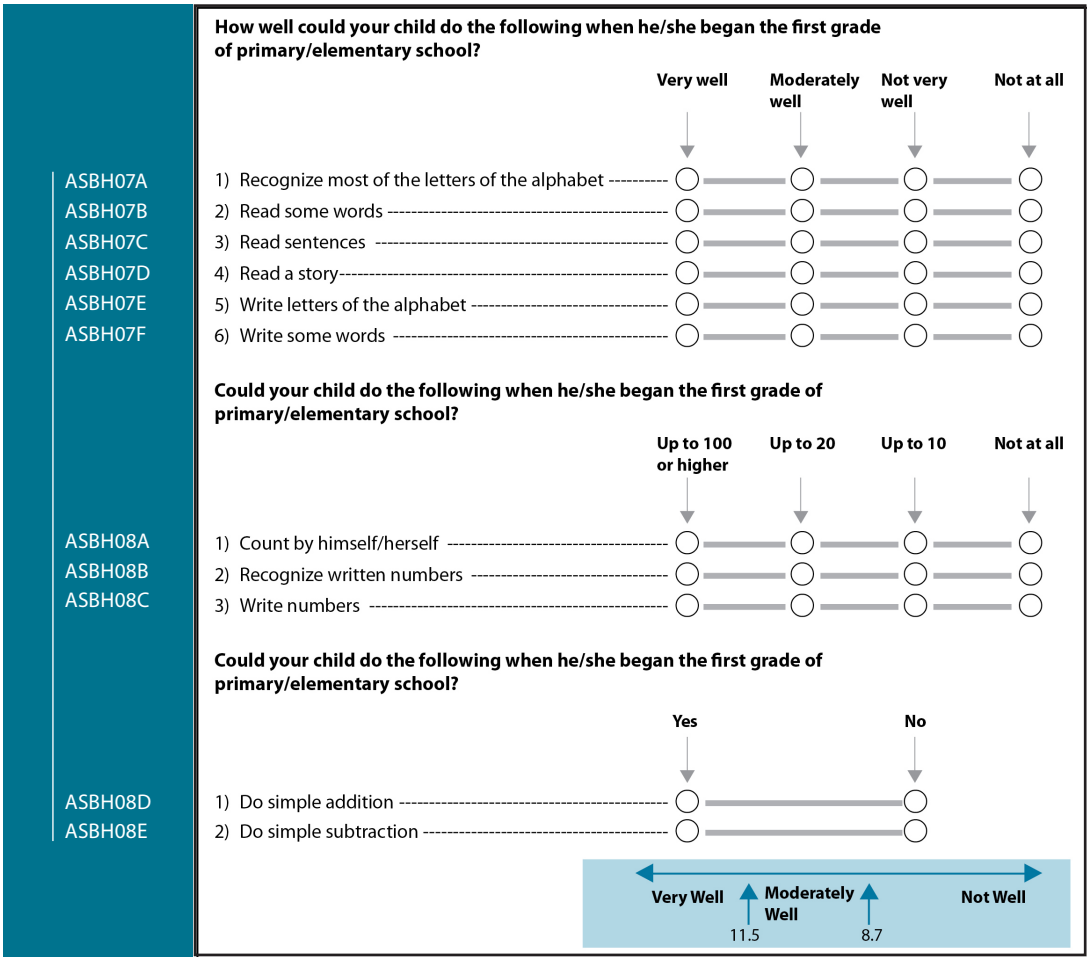
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Could Do Literacy and Numeracy Tasks When Began Primary School Scale, Fourth Grade

The Could Do Literacy and Numeracy Tasks When Began Primary School (LNT) scale was created based on parents' responses to how well their children could do the tasks described below when they began primary school.

Items in the TIMSS 2015 Could Do Literacy and Numeracy Tasks When Began Primary School, Fourth Grade



Item Parameters for the TIMSS 2015 Could Do Literacy and Numeracy Tasks When Began Primary School Scale, Fourth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
ASBH07A	-1.03450	-1.59845	-0.12765	1.72610	0.95
ASBH07B	0.00558	-1.49311	-0.20363	1.69674	0.80
ASBH07C	0.95109	-1.27650	-0.19632	1.47282	0.84
ASBH07D	1.46628	-1.16350	-0.27247	1.43597	1.06
ASBH07E	-0.54696	-1.61915	-0.16181	1.78096	0.91
ASBH07F	0.16992	-1.52300	-0.23087	1.75387	0.87
ASBH08A	-0.41760	-2.17966	0.18999	1.98967	1.43
ASBH08B	0.05264	-2.24322	0.38476	1.85846	1.14
ASBH08C	0.30953	-2.07283	0.40542	1.66741	1.10
ASBH08D	-0.97181				1.01
ASBH08E	0.01583				1.06

Scale Transformation Constants for the TIMSS 2015 Could Do Literacy and Numeracy Tasks When Began Primary School Scale, Fourth Grade

Scale Transformation Constants	
A = 8.878367	Transformed Scale Score = 8.878367 + 1.114077 • Logit Scale Score
B = 1.114077	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Could Do Literacy and Numeracy Tasks When Began Primary School Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.40776	
1	4.74405	
2	5.42885	
3	5.92038	
4	6.31822	
5	6.66220	
6	6.96984	
7	7.25206	
8	7.51564	
9	7.76514	
10	8.00345	
11	8.23377	
12	8.45736	
13	8.67576	8.7
14	8.89052	
15	9.10234	
16	9.31314	
17	9.52414	
18	9.73701	
19	9.95373	
20	10.17669	
21	10.40891	
22	10.65416	
23	10.91566	
24	11.20323	
25	11.52771	11.5
26	11.90919	
27	12.38473	
28	13.05784	
29	14.38775	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Could Do Literacy and Numeracy Tasks When Began Primary School Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item										
			ASBH07A	ASBH07B	ASBH07C	ASBH07D	ASBH07E	ASBH07F	ASBH08A	ASBH08B	ASBH08C	ASBH08D	ASBH08E
Australia	0.91	53	0.72	0.82	0.82	0.79	0.78	0.81	0.64	0.72	0.76	0.58	0.56
Bahrain	0.87	45	0.65	0.80	0.81	0.73	0.72	0.80	0.57	0.62	0.63	0.46	0.48
Belgium (Flemish)	0.89	48	0.73	0.82	0.80	0.75	0.78	0.80	0.44	0.63	0.68	0.50	0.53
Bulgaria	0.93	61	0.83	0.86	0.82	0.76	0.83	0.85	0.73	0.77	0.78	0.65	0.67
Canada	0.90	50	0.69	0.80	0.80	0.76	0.75	0.80	0.62	0.67	0.71	0.59	0.57
Chile	0.90	50	0.73	0.80	0.83	0.77	0.77	0.81	0.57	0.63	0.64	0.58	0.58
Chinese Taipei	0.83	40	0.78	0.85	0.85	0.79	0.80	0.76	0.21	0.26	0.26	0.39	0.42
Croatia	0.90	52	0.76	0.84	0.83	0.77	0.78	0.82	0.59	0.68	0.70	0.55	0.56
Cyprus	0.90	49	0.73	0.84	0.81	0.74	0.78	0.82	0.55	0.63	0.65	0.54	0.57
Czech Republic	0.89	49	0.78	0.85	0.83	0.77	0.79	0.82	0.50	0.60	0.62	0.45	0.50
Denmark	0.87	44	0.73	0.79	0.73	0.61	0.72	0.78	0.54	0.66	0.70	0.49	0.48
England	-	-	-	-	-	-	-	-	-	-	-	-	-
Finland	0.91	53	0.75	0.83	0.82	0.78	0.78	0.83	0.66	0.72	0.72	0.49	0.52
France	0.88	46	0.65	0.77	0.76	0.68	0.71	0.76	0.60	0.69	0.69	0.56	0.52
Georgia	0.88	46	0.74	0.83	0.82	0.71	0.78	0.80	0.42	0.57	0.62	0.46	0.50
Germany	0.88	46	0.75	0.79	0.76	0.67	0.75	0.75	0.52	0.65	0.71	0.50	0.51
Hong Kong SAR	0.82	38	0.74	0.82	0.83	0.71	0.79	0.78	0.31	0.32	0.33	0.32	0.35
Hungary	0.90	50	0.80	0.86	0.82	0.72	0.81	0.80	0.49	0.67	0.72	0.43	0.44
Indonesia	0.91	53	0.76	0.83	0.82	0.76	0.76	0.80	0.66	0.71	0.71	0.58	0.57
Iran, Islamic Rep. of	0.90	51	0.77	0.82	0.81	0.74	0.81	0.82	0.43	0.62	0.64	0.63	0.62
Ireland	0.89	51	0.75	0.83	0.85	0.80	0.80	0.83	0.56	0.60	0.63	0.55	0.54
Italy	0.90	49	0.73	0.80	0.79	0.70	0.75	0.79	0.58	0.71	0.73	0.55	0.54
Japan	0.86	46	0.82	0.84	0.86	0.82	0.84	0.85	0.27	0.36	0.40	0.52	0.48
Jordan	0.89	50	0.78	0.85	0.81	0.69	0.81	0.84	0.54	0.59	0.61	0.58	0.60
Kazakhstan	0.88	46	0.69	0.79	0.80	0.76	0.73	0.78	0.57	0.64	0.67	0.46	0.48
Korea, Rep. of	0.84	47	0.85	0.89	0.92	0.90	0.90	0.89	0.21	0.19	0.22	0.38	0.41
Kuwait	0.89	48	0.74	0.82	0.82	0.74	0.77	0.82	0.56	0.63	0.63	0.48	0.48
Lithuania	0.89	48	0.75	0.81	0.80	0.75	0.73	0.75	0.60	0.65	0.65	0.53	0.54
Morocco	0.93	59	0.78	0.88	0.86	0.74	0.83	0.86	0.66	0.76	0.78	0.70	0.57
Netherlands	0.91	52	0.79	0.84	0.82	0.78	0.77	0.79	0.58	0.70	0.72	0.49	0.54
New Zealand	0.90	51	0.73	0.81	0.80	0.74	0.78	0.80	0.57	0.70	0.74	0.58	0.57
Northern Ireland	-	-	-	-	-	-	-	-	-	-	-	-	-
Norway (5)	0.90	50	0.78	0.83	0.81	0.69	0.80	0.82	0.52	0.70	0.72	0.53	0.50
Oman	0.88	47	0.69	0.79	0.79	0.71	0.73	0.80	0.61	0.65	0.65	0.52	0.54
Poland	0.90	51	0.75	0.83	0.83	0.76	0.80	0.83	0.59	0.70	0.71	0.47	0.51
Portugal	0.89	48	0.73	0.80	0.77	0.71	0.77	0.79	0.54	0.65	0.67	0.55	0.56
Qatar	0.89	48	0.68	0.81	0.80	0.73	0.76	0.82	0.59	0.65	0.66	0.50	0.52
Russian Federation	0.90	51	0.75	0.83	0.83	0.77	0.74	0.77	0.65	0.71	0.72	0.50	0.52
Saudi Arabia	0.89	49	0.70	0.83	0.82	0.73	0.78	0.83	0.53	0.61	0.62	0.55	0.57
Serbia	0.89	49	0.77	0.81	0.77	0.51	0.78	0.82	0.61	0.67	0.70	0.59	0.61
Singapore	0.88	47	0.73	0.82	0.83	0.78	0.76	0.80	0.59	0.60	0.60	0.44	0.47
Slovak Republic	0.89	48	0.75	0.82	0.76	0.67	0.78	0.79	0.52	0.66	0.72	0.54	0.55
Slovenia	0.92	54	0.80	0.84	0.82	0.74	0.81	0.84	0.60	0.72	0.76	0.55	0.56
South Africa (5)	0.86	42	0.65	0.74	0.77	0.72	0.72	0.74	0.52	0.58	0.61	0.47	0.49
Spain	0.91	53	0.76	0.80	0.83	0.78	0.78	0.82	0.64	0.67	0.70	0.59	0.55
Sweden	0.90	52	0.76	0.84	0.83	0.76	0.78	0.81	0.61	0.68	0.70	0.52	0.57
Turkey	0.92	58	0.81	0.84	0.83	0.80	0.85	0.86	0.57	0.69	0.73	0.66	0.67
United Arab Emirates	0.88	47	0.68	0.80	0.80	0.74	0.73	0.80	0.61	0.65	0.66	0.47	0.48
United States	-	-	-	-	-	-	-	-	-	-	-	-	-
Benchmarking Participants													
Buenos Aires, Argentina	0.91	52	0.76	0.81	0.80	0.73	0.77	0.77	0.65	0.73	0.73	0.54	0.54
Ontario, Canada	0.90	50	0.68	0.79	0.82	0.77	0.75	0.80	0.62	0.67	0.71	0.56	0.56
Quebec, Canada	0.89	48	0.68	0.79	0.76	0.69	0.73	0.77	0.65	0.68	0.72	0.59	0.55
Norway (4)	0.91	52	0.77	0.84	0.80	0.69	0.78	0.82	0.58	0.73	0.76	0.54	0.55
Abu Dhabi, UAE	0.89	47	0.70	0.82	0.81	0.75	0.74	0.81	0.61	0.64	0.65	0.45	0.45
Dubai, UAE	0.88	47	0.67	0.78	0.80	0.73	0.72	0.79	0.61	0.64	0.67	0.52	0.51
Florida, US	-	-	-	-	-	-	-	-	-	-	-	-	-

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Could Do Literacy and Numeracy Tasks When Began Primary School Scale, Fourth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.27	0.22	0.07	0.05	0.06	0.04
Bahrain	0.27	0.27	0.08	0.07	0.06	0.06
Belgium (Flemish)	0.03	-0.05	0.00	0.00	0.00	0.00
Bulgaria	0.30	0.35	0.09	0.12	0.07	0.09
Canada	0.32	0.31	0.10	0.09	0.08	0.07
Chile	0.35	0.28	0.12	0.08	0.10	0.07
Chinese Taipei	0.30	0.26	0.09	0.07	0.07	0.05
Croatia	0.35	0.31	0.12	0.09	0.10	0.08
Cyprus	0.25	0.21	0.06	0.05	0.05	0.04
Czech Republic	0.24	0.15	0.06	0.02	0.05	0.03
Denmark	0.21	0.14	0.05	0.02	0.03	0.01
England	-	-	-	-	-	-
Finland	0.45	0.35	0.20	0.12	0.18	0.11
France	0.22	0.14	0.05	0.02	0.04	0.02
Georgia	0.20	0.19	0.04	0.04	0.03	0.03
Germany	0.15	0.07	0.02	0.00	0.01	0.00
Hong Kong SAR	0.32	0.33	0.10	0.11	0.07	0.08
Hungary	0.19	0.14	0.04	0.02	0.03	0.02
Indonesia	0.35	0.33	0.12	0.11	0.11	0.11
Iran, Islamic Rep. of	0.26	0.23	0.07	0.05	0.04	0.03
Ireland	0.41	0.36	0.16	0.13	0.14	0.11
Italy	0.18	0.09	0.03	0.01	0.02	0.01
Japan	0.35	0.29	0.13	0.08	0.11	0.08
Jordan	0.43	-	0.19	-	0.15	-
Kazakhstan	0.16	0.16	0.03	0.02	0.03	0.02
Korea, Rep. of	0.34	0.32	0.12	0.10	0.10	0.09
Kuwait	0.30	0.27	0.09	0.07	0.07	0.05
Lithuania	0.44	0.35	0.19	0.12	0.15	0.10
Morocco	0.22	0.27	0.05	0.07	0.06	0.07
Netherlands	0.25	0.23	0.06	0.05	0.04	0.04
New Zealand	0.26	0.19	0.07	0.03	0.06	0.03
Northern Ireland	-	-	-	-	-	-
Norway (5)	0.30	0.23	0.09	0.05	0.06	0.03
Oman	0.26	0.29	0.07	0.08	0.05	0.06
Poland	0.31	0.26	0.10	0.07	0.08	0.06
Portugal	0.21	0.17	0.04	0.03	0.03	0.02
Qatar	0.28	0.31	0.08	0.10	0.06	0.08
Russian Federation	0.32	0.32	0.10	0.10	0.09	0.09
Saudi Arabia	0.15	0.19	0.02	0.04	0.02	0.03
Serbia	0.39	0.33	0.15	0.11	0.13	0.10
Singapore	0.46	0.45	0.21	0.20	0.17	0.17
Slovak Republic	0.22	0.18	0.05	0.03	0.03	0.02
Slovenia	0.29	0.23	0.08	0.05	0.07	0.04
South Africa (5)	0.27	-	0.07	-	0.06	-
Spain	0.35	0.29	0.12	0.08	0.09	0.06
Sweden	0.34	0.25	0.11	0.06	0.10	0.05
Turkey	0.25	0.24	0.06	0.06	0.03	0.03
United Arab Emirates	0.29	0.32	0.09	0.10	0.07	0.09
United States	-	-	-	-	-	-
International Median	0.28	0.26	0.08	0.07	0.06	0.05
Benchmarking Participants						
Buenos Aires, Argentina	0.35	0.22	0.12	0.05	0.10	0.05
Ontario, Canada	0.41	0.34	0.17	0.12	0.13	0.09
Quebec, Canada	0.27	0.21	0.07	0.04	0.06	0.04
Norway (4)	0.31	0.21	0.09	0.04	0.08	0.03
Abu Dhabi, UAE	0.35	0.37	0.12	0.14	0.10	0.11
Dubai, UAE	0.25	0.27	0.06	0.07	0.05	0.06
Florida, US	-	-	-	-	-	-

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Early Literacy and Numeracy Activities Before Beginning Primary School Scale, Fourth Grade

The Early Literacy and Numeracy Activities Before Beginning Primary School (ELN) scale was created based on parents' frequency of doing the sixteen activities described below.

Items in the TIMSS 2015 Early Literacy and Numeracy Activities Before Beginning Primary School Scale, Fourth Grade

Before your child began primary/elementary school, how often did you or someone else in your home do the following activities with him or her?

			Often	Sometimes	Never or almost never
T	ASBH02A	1) Read books	○	○	○
T	ASBH02B	2) Tell stories	○	○	○
T	ASBH02C	3) Sing songs	○	○	○
T	ASBH02D	4) Play with alphabet toys (e.g., blocks with letters of the alphabet)	○	○	○
T	ASBH02E	5) Talk about things you had done	○	○	○
T	ASBH02F	6) Talk about what you had read	○	○	○
T	ASBH02G	7) Play word games	○	○	○
T	ASBH02H	8) Write letters or words	○	○	○
T	ASBH02I	9) Read aloud signs and labels	○	○	○
T	ASBH02J	10) Say counting rhymes or sing counting songs	○	○	○
T	ASBH02K	11) Play with number toys (e.g., blocks with numbers)	○	○	○
T	ASBH02L	12) Count different things	○	○	○
T	ASBH02M	13) Play games involving shapes (e.g., shape sorting toys, puzzles)	○	○	○
T	ASBH02N	14) Play with building blocks or construction toys	○	○	○
T	ASBH02O	15) Play board or card games	○	○	○
	ASBH02P	16) Write numbers	○	○	○

Often 10.4 | Sometimes | Never or Almost Never 6.5

T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Early Literacy and Numeracy Activities Before Beginning Primary School Scale, Fourth Grade

Item	delta	tau_1	tau_2	Infit
ASBH02A	-0.32169	-1.40660	1.40660	1.01
ASBH02B	-0.20513	-1.37557	1.37557	1.00
ASBH02C	0.10661	-1.03171	1.03171	1.17
ASBH02D	0.25379	-1.05591	1.05591	0.94
ASBH02E	-0.76183	-1.25727	1.25727	1.09
ASBH02F	0.35496	-1.37009	1.37009	1.03
ASBH02G	0.47225	-1.25920	1.25920	0.93
ASBH02H	0.01255	-1.16783	1.16783	0.99
ASBH02I	0.19765	-1.01939	1.01939	1.00
ASBH02J	0.48348	-1.02734	1.02734	1.01
ASBH02K	0.39214	-1.07179	1.07179	0.89
ASBH02L	-0.60000	-1.25574	1.25574	0.90
ASBH02M	-0.28391	-1.03163	1.03163	0.95
ASBH02N	-0.32170	-0.85306	0.85306	1.02
ASBH02O	0.30628	-1.16501	1.16501	1.08
ASBH02P	-0.08545	-1.21120	1.21120	1.02

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Early Literacy and Numeracy Activities Before Beginning Primary School Scale, Fourth Grade

Scale Transformation Constants	
A = 8.435922	Transformed Scale Score = 8.435922 + 1.454568 • Logit Scale Score
B = 1.454568	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 for the TIMSS 2015 Early Literacy and Numeracy Activities Before Beginning Primary School Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	1.52118	
1	3.21261	
2	4.05217	
3	4.63893	
4	5.10326	
5	5.49791	
6	5.84602	
7	6.16205	
8	6.45508	6.5
9	6.73118	
10	6.99414	
11	7.24849	
12	7.49560	
13	7.73744	
14	7.97558	
15	8.21137	
16	8.44607	
17	8.68032	
18	8.91562	
19	9.15294	
20	9.39354	
21	9.63897	
22	9.89110	
23	10.15236	
24	10.42416	10.4
25	10.71309	
26	11.02427	
27	11.36672	
28	11.75490	
29	12.21205	
30	12.79071	
31	13.62125	
32	15.30297	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Early Literacy and Numeracy Activities Before Beginning Primary School Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item															
			ASBH02A	ASBH02B	ASBH02C	ASBH02D	ASBH02E	ASBH02F	ASBH02G	ASBH02H	ASBH02I	ASBH02J	ASBH02K	ASBH02L	ASBH02M	ASBH02N	ASBH02O	ASBH02P
Australia	0.90	40	0.59	0.60	0.54	0.70	0.48	0.61	0.70	0.66	0.65	0.68	0.73	0.68	0.66	0.55	0.57	0.64
Bahrain	0.84	30	0.47	0.48	0.36	0.62	0.43	0.44	0.61	0.60	0.56	0.56	0.69	0.60	0.59	0.57	0.56	0.57
Belgium (Flemish)	0.84	29	0.45	0.44	0.45	0.60	0.35	0.43	0.65	0.59	0.59	0.62	0.66	0.64	0.53	0.46	0.51	0.57
Bulgaria	0.93	47	0.69	0.67	0.45	0.75	0.61	0.71	0.70	0.76	0.68	0.63	0.75	0.74	0.75	0.69	0.63	0.73
Canada	0.89	38	0.57	0.57	0.47	0.69	0.46	0.59	0.68	0.66	0.62	0.65	0.72	0.68	0.66	0.55	0.51	0.63
Chile	0.88	35	0.51	0.55	0.45	0.66	0.44	0.56	0.67	0.65	0.56	0.67	0.72	0.58	0.63	0.60	0.49	0.61
Chinese Taipei	0.90	40	0.61	0.61	0.52	0.65	0.52	0.54	0.64	0.56	0.65	0.73	0.74	0.74	0.72	0.70	0.48	0.64
Croatia	0.84	30	0.51	0.53	0.38	0.63	0.42	0.59	0.58	0.59	0.59	0.55	0.68	0.59	0.58	0.47	0.43	0.59
Cyprus	0.89	37	0.56	0.54	0.48	0.70	0.46	0.59	0.68	0.64	0.57	0.61	0.74	0.65	0.65	0.58	0.66	0.61
Czech Republic	0.82	27	0.38	0.45	0.40	0.61	0.43	0.54	0.54	0.58	0.52	0.53	0.67	0.61	0.51	0.45	0.44	0.60
Denmark	0.84	30	0.49	0.52	0.44	0.61	0.44	0.61	0.65	0.61	0.55	0.61	0.61	0.60	0.49	0.41	0.44	0.58
England	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Finland	0.84	29	0.45	0.50	0.39	0.59	0.41	0.57	0.59	0.62	0.59	0.52	0.62	0.62	0.54	0.43	0.50	0.63
France	0.83	29	0.50	0.49	0.43	0.63	0.38	0.50	0.61	0.61	0.52	0.58	0.65	0.62	0.54	0.45	0.41	0.58
Georgia	0.81	27	0.55	0.44	0.33	0.61	0.34	0.46	0.57	0.56	0.55	0.55	0.69	0.53	0.56	0.59	0.36	0.53
Germany	0.83	28	0.41	0.50	0.42	0.59	0.34	0.48	0.62	0.57	0.59	0.61	0.67	0.59	0.53	0.42	0.45	0.56
Hong Kong SAR	0.88	37	0.58	0.59	0.51	0.68	0.42	0.49	0.67	0.54	0.60	0.69	0.73	0.69	0.70	0.65	0.48	0.59
Hungary	0.82	28	0.44	0.46	0.38	0.64	0.37	0.47	0.63	0.57	0.57	0.60	0.68	0.57	0.52	0.41	0.44	0.57
Indonesia	0.88	36	0.51	0.49	0.51	0.63	0.56	0.61	0.65	0.63	0.59	0.64	0.64	0.63	0.65	0.63	0.59	0.59
Iran, Islamic Rep. of	0.88	35	0.58	0.52	0.50	0.64	0.47	0.55	0.66	0.63	0.62	0.58	0.67	0.60	0.63	0.58	0.62	0.59
Ireland	0.88	36	0.53	0.55	0.47	0.67	0.43	0.55	0.66	0.64	0.63	0.65	0.72	0.67	0.68	0.58	0.51	0.64
Italy	0.83	29	0.39	0.46	0.36	0.68	0.34	0.47	0.57	0.64	0.56	0.59	0.67	0.60	0.56	0.50	0.40	0.60
Japan	0.87	33	0.49	0.52	0.50	0.58	0.49	0.55	0.65	0.65	0.61	0.61	0.64	0.67	0.58	0.50	0.50	0.66
Jordan	0.86	33	0.44	0.52	0.45	0.64	0.50	0.46	0.62	0.63	0.56	0.61	0.69	0.59	0.59	0.58	0.59	0.61
Kazakhstan	0.85	31	0.53	0.45	0.43	0.62	0.47	0.53	0.57	0.55	0.53	0.56	0.68	0.56	0.62	0.59	0.62	0.56
Korea, Rep. of	0.90	40	0.55	0.48	0.48	0.65	0.50	0.59	0.72	0.69	0.70	0.72	0.75	0.75	0.66	0.59	0.48	0.68
Kuwait	0.85	31	0.46	0.45	0.34	0.63	0.40	0.44	0.60	0.61	0.56	0.57	0.69	0.59	0.63	0.56	0.56	0.62
Lithuania	0.84	30	0.54	0.48	0.39	0.66	0.48	0.60	0.63	0.59	0.42	0.56	0.70	0.59	0.55	0.53	0.41	0.56
Morocco	0.92	45	0.67	0.63	0.57	0.71	0.62	0.67	0.70	0.74	0.70	0.65	0.74	0.60	0.69	0.66	0.67	0.72
Netherlands	0.86	32	0.44	0.51	0.45	0.70	0.39	0.48	0.71	0.65	0.52	0.65	0.69	0.65	0.55	0.40	0.49	0.61
New Zealand	0.90	39	0.54	0.59	0.53	0.68	0.49	0.61	0.69	0.65	0.65	0.69	0.71	0.69	0.66	0.57	0.58	0.63
Northern Ireland	0.89	38	0.54	0.56	0.51	0.67	0.48	0.63	0.70	0.65	0.64	0.63	0.70	0.62	0.66	0.60	0.59	0.61
Norway (5)	0.87	34	0.52	0.54	0.44	0.67	0.45	0.61	0.70	0.63	0.59	0.64	0.69	0.63	0.55	0.42	0.51	0.60
Oman	0.83	29	0.49	0.47	0.21	0.61	0.38	0.51	0.59	0.58	0.59	0.50	0.65	0.52	0.57	0.58	0.60	0.57
Poland	0.85	32	0.48	0.49	0.46	0.65	0.50	0.59	0.62	0.58	0.58	0.59	0.71	0.61	0.51	0.47	0.48	0.62
Portugal	0.86	32	0.57	0.57	0.45	0.64	0.41	0.54	0.65	0.59	0.49	0.57	0.71	0.65	0.62	0.56	0.47	0.55
Qatar	0.87	33	0.50	0.52	0.38	0.63	0.47	0.49	0.61	0.60	0.58	0.60	0.70	0.65	0.65	0.59	0.55	0.62
Russian Federation	0.88	36	0.60	0.50	0.46	0.66	0.57	0.60	0.63	0.63	0.52	0.59	0.70	0.61	0.61	0.60	0.58	0.64
Saudi Arabia	0.85	31	0.43	0.47	0.22	0.62	0.49	0.45	0.65	0.62	0.57	0.55	0.71	0.53	0.60	0.59	0.62	0.61
Serbia	0.87	33	0.53	0.55	0.51	0.63	0.48	0.55	0.62	0.60	0.58	0.59	0.67	0.62	0.59	0.56	0.55	0.58
Singapore	0.91	43	0.62	0.62	0.55	0.69	0.53	0.58	0.66	0.68	0.69	0.69	0.74	0.74	0.74	0.66	0.56	0.66
Slovak Republic	0.86	33	0.51	0.52	0.36	0.65	0.52	0.61	0.60	0.59	0.60	0.61	0.69	0.62	0.62	0.55	0.46	0.61
Slovenia	0.86	32	0.47	0.55	0.51	0.65	0.46	0.60	0.64	0.61	0.58	0.63	0.65	0.60	0.54	0.37	0.44	0.64
South Africa (5)	0.89	36	0.61	0.50	0.44	0.63	0.52	0.61	0.63	0.64	0.65	0.60	0.68	0.61	0.67	0.60	0.56	0.60
Spain	0.84	30	0.50	0.53	0.46	0.65	0.35	0.44	0.61	0.61	0.55	0.57	0.69	0.54	0.63	0.57	0.42	0.58
Sweden	0.85	32	0.46	0.49	0.43	0.65	0.43	0.57	0.67	0.63	0.61	0.63	0.70	0.60	0.56	0.44	0.45	0.60
Turkey	0.90	40	0.64	0.64	0.47	0.61	0.60	0.67	0.67	0.65	0.69	0.65	0.68	0.65	0.70	0.56	0.54	0.65
United Arab Emirates	0.86	33	0.46	0.48	0.38	0.64	0.46	0.48	0.60	0.60	0.56	0.62	0.70	0.65	0.66	0.62	0.54	0.61
United States	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benchmarking Participants																		
Buenos Aires, Argentina	0.85	31	0.48	0.48	0.44	0.69	0.41	0.51	0.69	0.63	0.46	0.53	0.67	0.49	0.63	0.57	0.52	0.54
Ontario, Canada	0.89	38	0.57	0.59	0.47	0.69	0.48	0.60	0.69	0.65	0.64	0.65	0.73	0.68	0.68	0.59	0.55	0.61
Quebec, Canada	0.87	34	0.54	0.55	0.43	0.67	0.43	0.53	0.66	0.64	0.58	0.64	0.69	0.66	0.63	0.48	0.48	0.62
Norway (4)	0.86	33	0.50	0.47	0.46	0.68	0.41	0.62	0.68	0.65	0.56	0.64	0.72	0.62	0.52	0.42	0.47	0.62
Abu Dhabi, UAE	0.86	33	0.46	0.48	0.35	0.63	0.47	0.48	0.62	0.60	0.55	0.62	0.70	0.66	0.66	0.64	0.57	0.64
Dubai, UAE	0.87	34	0.52	0.51	0.42	0.65	0.46	0.49	0.61	0.59	0.60	0.63	0.71	0.66	0.67	0.60	0.49	0.58
Florida, US	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Early Literacy and Numeracy Activities Before Beginning Primary School Scale, Fourth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.15	0.19	0.02	0.04	0.02	0.03
Bahrain	0.19	0.19	0.04	0.04	0.03	0.03
Belgium (Flemish)	0.10	0.11	0.01	0.01	0.01	0.01
Bulgaria	0.25	0.33	0.06	0.11	0.05	0.10
Canada	0.13	0.19	0.02	0.04	0.01	0.03
Chile	0.21	0.22	0.05	0.05	0.03	0.03
Chinese Taipei	0.21	0.22	0.04	0.05	0.04	0.04
Croatia	0.19	0.21	0.04	0.04	0.03	0.03
Cyprus	0.18	0.24	0.03	0.06	0.03	0.04
Czech Republic	0.08	0.07	0.01	0.00	0.01	0.00
Denmark	0.14	0.12	0.02	0.01	0.01	0.01
England	-	-	-	-	-	-
Finland	0.12	0.16	0.01	0.03	0.01	0.02
France	0.16	0.15	0.03	0.02	0.02	0.02
Georgia	0.07	0.10	0.00	0.01	0.01	0.01
Germany	0.08	0.08	0.01	0.01	0.01	0.01
Hong Kong SAR	0.20	0.20	0.04	0.04	0.04	0.04
Hungary	0.14	0.13	0.02	0.02	0.03	0.03
Indonesia	0.17	0.15	0.03	0.02	0.02	0.02
Iran, Islamic Rep. of	0.25	0.25	0.06	0.06	0.05	0.04
Ireland	0.20	0.21	0.04	0.04	0.03	0.03
Italy	0.13	0.15	0.02	0.02	0.01	0.01
Japan	0.18	0.15	0.03	0.02	0.02	0.02
Jordan	0.25	-	0.06	-	0.05	-
Kazakhstan	0.12	0.14	0.01	0.02	0.01	0.01
Korea, Rep. of	0.27	0.24	0.07	0.06	0.06	0.05
Kuwait	0.15	0.17	0.02	0.03	0.02	0.02
Lithuania	0.11	0.09	0.01	0.01	0.01	0.01
Morocco	0.12	0.17	0.01	0.03	0.02	0.03
Netherlands	0.01	0.06	0.00	0.00	0.00	0.01
New Zealand	0.21	0.23	0.04	0.05	0.04	0.04
Northern Ireland	0.17	0.20	0.03	0.04	0.01	0.02
Norway (5)	0.18	0.18	0.03	0.03	0.02	0.02
Oman	0.17	0.20	0.03	0.04	0.02	0.03
Poland	0.13	0.13	0.02	0.02	0.01	0.01
Portugal	0.17	0.19	0.03	0.04	0.02	0.03
Qatar	0.23	0.23	0.05	0.05	0.04	0.04
Russian Federation	0.12	0.16	0.01	0.03	0.01	0.01
Saudi Arabia	0.05	0.09	0.00	0.01	0.00	0.01
Serbia	0.20	0.20	0.04	0.04	0.05	0.06
Singapore	0.19	0.22	0.04	0.05	0.03	0.04
Slovak Republic	0.14	0.12	0.02	0.02	0.02	0.02
Slovenia	0.10	0.11	0.01	0.01	0.01	0.01
South Africa (5)	0.23	-	0.05	-	0.05	-
Spain	0.18	0.20	0.03	0.04	0.03	0.03
Sweden	0.15	0.14	0.02	0.02	0.01	0.01
Turkey	0.38	0.38	0.15	0.15	0.13	0.13
United Arab Emirates	0.21	0.23	0.05	0.05	0.04	0.04
United States	-	-	-	-	-	-
International Median	0.17	0.18	0.03	0.03	0.02	0.03
Benchmarking Participants						
Buenos Aires, Argentina	0.25	0.24	0.06	0.06	0.06	0.03
Ontario, Canada	0.15	0.19	0.02	0.04	0.02	0.03
Quebec, Canada	0.16	0.18	0.02	0.03	0.02	0.02
Norway (4)	0.17	0.15	0.03	0.02	0.03	0.03
Abu Dhabi, UAE	0.20	0.21	0.04	0.04	0.03	0.03
Dubai, UAE	0.22	0.23	0.05	0.05	0.04	0.04
Florida, US	-	-	-	-	-	-

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Home Resources for Learning Scale, Fourth Grade

The Home Resources for Learning (HRL) scale was created based on students' and parents' responses concerning the availability of five resources described below.

Items in the TIMSS 2015 Home Resources for Learning Scale, Fourth Grade

T | ASBG04

Number of books in the home (students):

1) 0-10
2) 11-25
3) 26-100
4) 101-200
5) More than 200

T | ASBH14

Number of children's books in the home (parents):

1) 0-10
2) 11-25
3) 26-50
4) 51-100
5) More than 100

T | ASDG05S[1]

Number of home study supports (students):

1) None
2) Internet connection or own room
3) Both

T | ASDHEDUP[1]

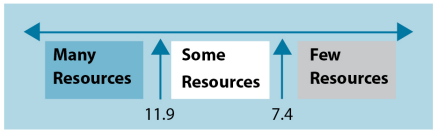
Highest level of education of either parent (parents):

1) Finished some primary or lower secondary or did not go to school
2) Finished lower secondary
3) Finished upper secondary
4) Finished post-secondary education
5) Finished university or higher

T | ASDHOCCP[1]

Highest level of occupation of either parent (parents):

1) Has never worked outside home for pay, general laborer, or semi-professional (skilled agricultural or fishery worker, craft or trade worker, plant or machine operator)
2) Clerical (clerk or service or sales worker)
3) Small business owner
4) Professional (corporate manager or senior official, professional, or technician or associate professional)



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.
1 Derived variable. For more details, see Supplement 3 of the User Guide for the TIMSS 2015 International Database.

Item Parameters for the TIMSS 2015 Home Resources for Learning Scale, Fourth Grade

Item	delta	tau_1	tau_2	tau_3	tau_4	Infit
ASBG04	0.50877	-1.25665	-0.44740	0.93994	0.76411	1.01
ASBH14	0.58514	-0.74466	-0.46122	0.43512	0.77076	0.96
ASDG05S	-0.78604	-0.78596	0.78596			1.08
ASDHEDUP	-0.40313	-0.37335	-0.98713	0.84623	0.51425	0.94
ASDHOCCP	0.09526	-0.32617	0.95244	-0.62627		1.02

Scale Transformation Constants for the TIMSS 2015 Home Resources for Learning Scale, Fourth Grade

Scale Transformation Constants	
A = 9.487504	Transformed Scale Score = 9.487504 + 1.844284 • Logit Scale Score
B = 1.844284	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Home Resources for Learning Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.68952	
1	5.69990	
2	6.65832	
3	7.34373	7.4
4	7.90391	
5	8.38881	
6	8.82316	
7	9.21608	
8	9.57946	
9	9.92615	
10	10.27747	
11	10.63489	
12	11.01616	
13	11.43841	
14	11.92828	11.9
15	12.52570	
16	13.35902	
17	15.03850	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Home Resources for Learning Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item				
			ASBG04	ASBH14	ASDG05S	ASDHEDUP	ASDHOCCP
Australia	0.62	41	0.66	0.66	0.33	0.74	0.73
Bahrain	0.55	36	0.50	0.64	0.26	0.75	0.71
Belgium (Flemish)	0.70	47	0.67	0.72	0.34	0.79	0.79
Bulgaria	0.83	60	0.78	0.82	0.48	0.89	0.82
Canada	0.56	37	0.70	0.70	0.33	0.61	0.62
Chile	0.66	43	0.52	0.68	0.41	0.82	0.76
Chinese Taipei	0.71	48	0.78	0.80	0.21	0.77	0.72
Croatia	0.68	46	0.68	0.75	0.22	0.79	0.76
Cyprus	0.62	41	0.65	0.73	0.25	0.76	0.67
Czech Republic	0.67	44	0.71	0.74	0.20	0.76	0.73
Denmark	0.64	42	0.71	0.72	0.29	0.68	0.72
England	-	-	-	-	-	-	-
Finland	0.60	39	0.65	0.69	0.10	0.75	0.72
France	0.72	48	0.72	0.76	0.32	0.81	0.74
Georgia	0.66	44	0.68	0.75	0.36	0.74	0.70
Germany	0.65	43	0.73	0.74	0.09	0.76	0.69
Hong Kong SAR	0.76	52	0.75	0.82	0.29	0.82	0.78
Hungary	0.80	57	0.78	0.84	0.27	0.87	0.83
Indonesia	0.58	37	0.46	0.55	0.37	0.79	0.76
Iran, Islamic Rep. of	0.74	49	0.69	0.72	0.57	0.79	0.70
Ireland	0.68	45	0.72	0.75	0.17	0.77	0.75
Italy	0.67	44	0.66	0.74	0.11	0.80	0.77
Japan	0.61	40	0.68	0.74	0.30	0.71	0.62
Jordan	0.55	36	0.50	0.49	0.50	0.74	0.71
Kazakhstan	0.61	40	0.63	0.63	0.54	0.68	0.65
Korea, Rep. of	0.63	41	0.72	0.72	0.38	0.73	0.59
Kuwait	0.42	31	0.45	0.56	0.12	0.71	0.70
Lithuania	0.72	48	0.70	0.76	0.39	0.78	0.75
Morocco	0.71	45	0.68	0.63	0.62	0.77	0.65
Netherlands	0.62	41	0.63	0.68	0.01	0.81	0.72
New Zealand	0.65	42	0.68	0.72	0.34	0.73	0.71
Northern Ireland	0.70	46	0.72	0.75	0.17	0.80	0.76
Norway (5)	0.65	43	0.66	0.73	0.25	0.78	0.73
Oman	0.59	38	0.42	0.59	0.36	0.82	0.76
Poland	0.73	49	0.68	0.74	0.32	0.84	0.80
Portugal	0.75	50	0.72	0.78	0.24	0.82	0.80
Qatar	0.53	35	0.46	0.66	0.26	0.73	0.71
Russian Federation	0.65	42	0.65	0.72	0.31	0.75	0.72
Saudi Arabia	0.50	33	0.36	0.51	0.33	0.79	0.74
Serbia	0.71	47	0.67	0.77	0.26	0.80	0.77
Singapore	0.68	45	0.69	0.71	0.33	0.78	0.72
Slovak Republic	0.77	53	0.78	0.82	0.28	0.82	0.79
Slovenia	0.65	43	0.62	0.72	0.06	0.80	0.77
South Africa (5)	0.62	39	0.57	0.55	0.58	0.69	0.70
Spain	0.69	46	0.67	0.74	0.15	0.83	0.78
Sweden	0.67	46	0.71	0.76	0.42	0.74	0.70
Turkey	0.74	49	0.67	0.74	0.59	0.80	0.69
United Arab Emirates	0.58	37	0.58	0.71	0.33	0.68	0.66
United States	-	-	-	-	-	-	-
Benchmarking Participants							
Buenos Aires, Argentina	0.70	46	0.60	0.75	0.31	0.80	0.81
Ontario, Canada	0.55	36	0.65	0.66	0.35	0.62	0.65
Quebec, Canada	0.62	40	0.74	0.75	0.34	0.66	0.60
Norway (4)	0.64	43	0.65	0.69	0.27	0.80	0.75
Abu Dhabi, UAE	0.59	38	0.56	0.70	0.30	0.72	0.69
Dubai, UAE	0.59	38	0.69	0.78	0.36	0.61	0.56
Florida, US	-	-	-	-	-	-	-

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Home Resources for Learning Scale, Fourth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.38	0.40	0.15	0.16	0.11	0.12
Bahrain	0.30	0.28	0.09	0.08	0.05	0.04
Belgium (Flemish)	0.43	0.50	0.18	0.25	0.11	0.16
Bulgaria	0.35	0.46	0.13	0.22	0.10	0.16
Canada	0.33	0.39	0.11	0.15	0.07	0.09
Chile	0.34	0.37	0.11	0.13	0.06	0.07
Chinese Taipei	0.39	0.42	0.15	0.18	0.10	0.12
Croatia	0.40	0.41	0.16	0.16	0.08	0.09
Cyprus	0.34	0.39	0.12	0.15	0.07	0.08
Czech Republic	0.47	0.46	0.22	0.21	0.14	0.13
Denmark	0.35	0.37	0.12	0.13	0.09	0.10
England	-	-	-	-	-	-
Finland	0.33	0.36	0.11	0.13	0.08	0.08
France	0.46	0.46	0.21	0.21	0.15	0.15
Georgia	0.35	0.38	0.12	0.15	0.06	0.07
Germany	0.43	0.47	0.18	0.22	0.11	0.14
Hong Kong SAR	0.40	0.39	0.16	0.15	0.12	0.12
Hungary	0.57	0.56	0.33	0.32	0.25	0.24
Indonesia	0.29	0.30	0.08	0.09	0.05	0.06
Iran, Islamic Rep. of	0.46	0.45	0.21	0.20	0.14	0.14
Ireland	0.45	0.45	0.20	0.21	0.13	0.14
Italy	0.34	0.39	0.11	0.15	0.06	0.07
Japan	0.41	0.38	0.17	0.14	0.08	0.07
Jordan	0.38	-	0.14	-	0.06	-
Kazakhstan	0.19	0.21	0.04	0.04	0.02	0.02
Korea, Rep. of	0.47	0.46	0.23	0.22	0.16	0.15
Kuwait	0.24	0.24	0.06	0.06	0.02	0.02
Lithuania	0.45	0.46	0.21	0.21	0.11	0.11
Morocco	0.15	0.15	0.02	0.02	0.02	0.03
Netherlands	0.25	0.35	0.06	0.12	0.04	0.08
New Zealand	0.43	0.49	0.18	0.24	0.12	0.16
Northern Ireland	0.49	0.51	0.24	0.26	0.17	0.19
Norway (5)	0.35	0.37	0.12	0.14	0.09	0.10
Oman	0.24	0.24	0.06	0.06	0.03	0.03
Poland	0.44	0.44	0.19	0.19	0.13	0.13
Portugal	0.40	0.38	0.16	0.14	0.11	0.09
Qatar	0.39	0.37	0.15	0.14	0.08	0.07
Russian Federation	0.32	0.39	0.11	0.15	0.05	0.07
Saudi Arabia	0.12	0.17	0.01	0.03	0.01	0.02
Serbia	0.44	0.43	0.19	0.19	0.11	0.11
Singapore	0.48	0.52	0.23	0.28	0.15	0.18
Slovak Republic	0.53	0.55	0.28	0.31	0.19	0.21
Slovenia	0.41	0.39	0.17	0.15	0.10	0.09
South Africa (5)	0.41	-	0.17	-	0.12	-
Spain	0.40	0.40	0.16	0.16	0.10	0.11
Sweden	0.44	0.48	0.19	0.23	0.13	0.16
Turkey	0.51	0.48	0.26	0.23	0.19	0.17
United Arab Emirates	0.42	0.42	0.18	0.17	0.09	0.08
United States	-	-	-	-	-	-
International Median	0.40	0.39	0.16	0.16	0.10	0.10
Benchmarking Participants						
Buenos Aires, Argentina	0.45	0.32	0.20	0.10	0.10	0.07
Ontario, Canada	0.35	0.38	0.12	0.14	0.08	0.10
Quebec, Canada	0.34	0.38	0.12	0.14	0.07	0.08
Norway (4)	0.40	0.45	0.16	0.20	0.10	0.13
Abu Dhabi, UAE	0.45	0.43	0.20	0.18	0.09	0.08
Dubai, UAE	0.41	0.39	0.17	0.15	0.10	0.08
Florida, US	-	-	-	-	-	-

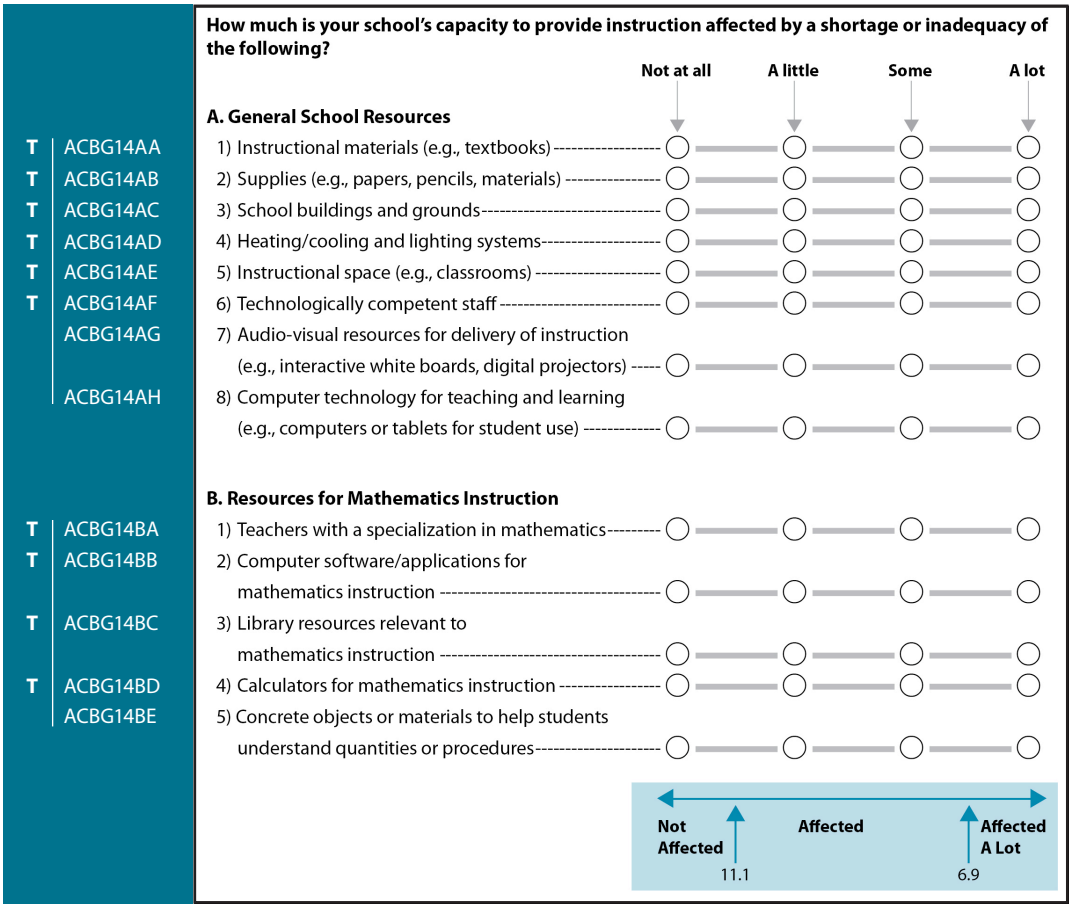
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Instruction Affected by Mathematics Resource Shortages–Principals' Reports Scale, Fourth Grade

The Instruction Affected by Mathematics Resource Shortages–Principals' Reports (MRS) scale was created based on principals' responses concerning thirteen school and classroom resources described below.

Items in the TIMSS 2015 Instruction Affected by Mathematics Resource Shortages–Principals' Reports Scale, Fourth Grade



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Instruction Affected by Mathematics Resource Shortages – Principals' Reports Scale, Fourth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
ACBG14AA	-0.11368	-0.14996	-0.16025	0.31021	0.88
ACBG14AB	-0.41885	-0.32199	0.24004	0.08195	0.86
ACBG14AC	0.07784	-0.85921	0.21812	0.64109	1.07
ACBG14AD	-0.21398	-0.48151	0.11638	0.36513	0.89
ACBG14AE	0.19673	-0.49556	-0.02468	0.52024	1.03
ACBG14AF	0.14704	-1.22945	-0.05377	1.28322	0.98
ACBG14AG	0.13794	-1.04602	0.15706	0.88896	0.97
ACBG14AH	0.36809	-1.19595	0.07061	1.12534	1.07
ACBG14BA	-0.05349	-0.40689	-0.11097	0.51786	1.04
ACBG14BB	0.18965	-1.45960	0.04141	1.41819	1.01
ACBG14BC	0.10994	-1.52282	0.10727	1.41555	1.08
ACBG14BD	-0.54492	-0.79258	0.20495	0.58763	1.28
ACBG14BE	0.11769	-1.09911	-0.18316	1.28227	0.87

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Instruction Affected by Mathematics Resource Shortages – Principals' Reports Scale, Fourth Grade

Scale Transformation Constants	
A = 8.983616	Transformed Scale Score = 8.983616 + 1.470593 • Logit Scale Score
B = 1.470593	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Instruction Affected by Mathematics Resources Shortages - Principals' Reports Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	2.83270	
1	4.48826	
2	5.27602	
3	5.80449	
4	6.20549	
5	6.53026	
6	6.80414	6.9
7	7.04261	
8	7.25461	
9	7.44645	
10	7.62264	
11	7.78577	
12	7.94054	
13	8.08763	
14	8.22857	
15	8.36472	
16	8.49731	
17	8.62738	
18	8.75594	
19	8.88387	
20	9.01304	
21	9.14126	
22	9.27241	
23	9.40635	
24	9.54404	
25	9.68650	
26	9.83482	
27	9.99025	
28	10.15341	
29	10.32815	
30	10.51618	
31	10.72077	
32	10.94627	
33	11.19873	11.1
34	11.48704	
35	11.82627	
36	12.24151	
37	12.78364	
38	13.58356	
39	15.25009	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Instruction Affected by Mathematics Resource Shortages - Principals' Reports Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item												
			ACBG14AA	ACBG14AB	ACBG14AC	ACBG14AD	ACBG14AE	ACBG14AF	ACBG14AG	ACBG14AH	ACBG14BA	ACBG14BB	ACBG14BC	ACBG14BD	ACBG14BE
Australia	0.89	43	0.68	0.61	0.53	0.45	0.54	0.75	0.69	0.72	0.56	0.75	0.69	0.71	0.77
Bahrain	0.95	62	0.90	0.87	0.83	0.90	0.90	0.79	0.90	0.78	0.81	0.68	0.55	0.44	0.74
Belgium (Flemish)	0.86	40	0.57	0.57	0.68	0.62	0.59	0.65	0.78	0.79	0.52	0.67	0.55	0.49	0.66
Bulgaria	0.82	35	0.67	0.75	0.71	0.66	0.44	0.54	0.69	0.63	0.59	0.41	0.56	0.37	0.57
Canada	0.87	39	0.67	0.62	0.59	0.47	0.62	0.66	0.69	0.67	0.46	0.63	0.75	0.60	0.66
Chile	0.91	49	0.69	0.72	0.70	0.57	0.74	0.70	0.79	0.71	0.67	0.63	0.74	0.68	0.76
Chinese Taipei	0.90	47	0.69	0.68	0.67	0.81	0.70	0.71	0.71	0.71	0.68	0.66	0.64	0.50	0.68
Croatia	0.88	41	0.64	0.67	0.59	0.66	0.65	0.63	0.70	0.61	0.52	0.67	0.66	0.61	0.73
Cyprus	0.91	50	0.84	0.72	0.71	0.72	0.77	0.79	0.74	0.54	0.57	0.72	0.59	0.64	0.75
Czech Republic	0.76	28	0.57	0.57	0.46	0.48	0.52	0.57	0.64	0.61	0.46	0.49	0.27	0.45	0.62
Denmark	0.85	36	0.76	0.61	0.66	0.56	0.61	0.54	0.64	0.73	0.43	0.64	0.49	0.50	0.55
England	0.87	41	0.75	0.63	0.40	0.50	0.44	0.65	0.72	0.70	0.59	0.72	0.70	0.64	0.73
Finland	0.80	30	0.51	0.57	0.66	0.66	0.69	0.56	0.58	0.66	0.48	0.46	0.30	0.31	0.53
France	0.85	35	0.73	0.63	0.49	0.53	0.48	0.53	0.66	0.62	0.65	0.63	0.60	0.58	0.56
Georgia	0.88	43	0.54	0.76	0.63	0.58	0.66	0.69	0.68	0.73	0.70	0.71	0.69	0.43	0.62
Germany	0.83	34	0.65	0.65	0.63	0.45	0.66	0.52	0.71	0.65	0.29	0.60	0.52	0.44	0.63
Hong Kong SAR	0.91	50	0.77	0.80	0.64	0.78	0.74	0.74	0.77	0.64	0.63	0.75	0.65	0.48	0.75
Hungary	0.90	45	0.65	0.73	0.76	0.70	0.65	0.60	0.68	0.71	0.61	0.65	0.58	0.58	0.79
Indonesia	0.86	37	0.63	0.60	0.49	0.70	0.45	0.67	0.67	0.69	0.42	0.67	0.66	0.56	0.63
Iran, Islamic Rep. of	0.84	36	0.75	0.77	0.71	0.81	0.79	0.68	0.52	0.13	0.65	0.42	0.35	0.31	0.46
Ireland	0.86	39	0.67	0.60	0.55	0.59	0.56	0.52	0.64	0.54	0.61	0.72	0.69	0.72	0.67
Italy	0.79	29	0.60	0.60	0.58	0.54	0.64	0.48	0.51	0.54	0.34	0.43	0.46	0.55	0.61
Japan	0.92	52	0.76	0.76	0.76	0.74	0.83	0.66	0.66	0.72	0.59	0.59	0.69	0.75	0.84
Jordan	0.88	42	0.64	0.72	0.73	0.71	0.73	0.69	0.56	0.67	0.65	0.62	0.51	0.50	0.64
Kazakhstan	0.94	58	0.80	0.71	0.69	0.79	0.79	0.79	0.75	0.67	0.83	0.73	0.86	0.63	0.79
Korea, Rep. of	0.90	48	0.76	0.75	0.77	0.73	0.78	0.83	0.66	0.79	0.53	0.56	0.60	0.49	0.66
Kuwait	0.91	50	0.82	0.75	0.75	0.84	0.86	0.72	0.37	0.56	0.83	0.61	0.55	0.48	0.83
Lithuania	0.90	46	0.73	0.74	0.64	0.64	0.57	0.71	0.73	0.63	0.52	0.67	0.69	0.63	0.83
Morocco	0.84	39	-0.05	0.29	0.46	0.57	-0.11	0.75	0.66	0.75	0.78	0.75	0.79	0.82	0.56
Netherlands	0.82	33	0.50	0.50	0.55	0.66	0.52	0.56	0.62	0.63	0.42	0.71	0.60	0.55	0.55
New Zealand	0.87	39	0.70	0.65	0.58	0.52	0.50	0.57	0.62	0.66	0.59	0.72	0.65	0.67	0.66
Northern Ireland	0.85	38	0.74	0.72	0.59	0.59	0.62	0.68	0.51	0.60	0.61	0.65	0.54	0.43	0.62
Norway (5)	0.84	36	0.73	0.71	0.75	0.74	0.70	0.54	0.60	0.62	0.33	0.58	0.57	0.32	0.37
Oman	0.92	50	0.73	0.72	0.67	0.76	0.74	0.78	0.62	0.67	0.83	0.72	0.65	0.52	0.75
Poland	0.91	47	0.74	0.71	0.54	0.71	0.67	0.63	0.72	0.73	0.57	0.74	0.73	0.58	0.81
Portugal	0.89	43	0.53	0.54	0.58	0.54	0.50	0.60	0.76	0.71	0.70	0.75	0.75	0.68	0.78
Qatar	0.98	77	0.93	0.92	0.86	0.94	0.92	0.93	0.89	0.89	0.91	0.80	0.83	0.71	0.87
Russian Federation	0.91	50	0.83	0.77	0.61	0.73	0.67	0.66	0.75	0.68	0.70	0.73	0.78	0.47	0.78
Saudi Arabia	0.88	43	0.71	0.70	0.69	0.78	0.77	0.67	0.70	0.47	0.73	0.65	0.49	0.46	0.55
Serbia	0.91	47	0.79	0.69	0.63	0.68	0.69	0.70	0.75	0.77	0.63	0.62	0.64	0.57	0.72
Singapore	0.97	73	0.90	0.89	0.84	0.90	0.86	0.81	0.91	0.91	0.76	0.76	0.73	0.91	0.89
Slovak Republic	0.91	49	0.80	0.79	0.61	0.72	0.67	0.72	0.81	0.78	0.79	0.66	0.28	0.62	0.70
Slovenia	0.84	36	0.56	0.52	0.57	0.47	0.57	0.52	0.70	0.73	0.33	0.71	0.75	0.57	0.62
South Africa (5)	0.82	37	-0.19	-0.11	0.33	0.63	0.16	0.71	0.84	0.81	0.45	0.83	0.83	0.59	0.67
Spain	0.88	41	0.63	0.66	0.60	0.69	0.55	0.67	0.70	0.71	0.61	0.65	0.67	0.48	0.68
Sweden	0.83	34	0.65	0.63	0.48	0.52	0.52	0.65	0.61	0.69	0.45	0.69	0.44	0.57	0.64
Turkey	0.87	40	0.75	0.71	0.60	0.70	0.69	0.53	0.71	0.51	0.65	0.66	0.62	0.34	0.67
United Arab Emirates	0.96	65	0.87	0.85	0.83	0.87	0.86	0.87	0.83	0.81	0.80	0.70	0.68	0.65	0.82
United States	0.90	46	0.69	0.70	0.69	0.66	0.59	0.70	0.69	0.62	0.61	0.74	0.70	0.67	0.74
Benchmarking Participants															
Buenos Aires, Argentina	0.93	54	0.74	0.78	0.69	0.67	0.83	0.78	0.74	0.69	0.59	0.74	0.77	0.75	0.75
Ontario, Canada	0.87	40	0.59	0.58	0.53	0.42	0.64	0.72	0.68	0.73	0.50	0.66	0.76	0.64	0.65
Quebec, Canada	0.89	44	0.79	0.77	0.67	0.50	0.76	0.59	0.71	0.64	0.36	0.54	0.75	0.56	0.79
Norway (4)	0.84	36	0.73	0.71	0.75	0.74	0.68	0.51	0.64	0.62	0.34	0.59	0.53	0.31	0.40
Abu Dhabi, UAE	0.95	63	0.84	0.84	0.84	0.83	0.85	0.84	0.81	0.77	0.79	0.61	0.69	0.75	0.85
Dubai, UAE	0.97	76	0.90	0.91	0.84	0.93	0.86	0.93	0.89	0.89	0.89	0.86	0.80	0.66	0.91
Florida, US	0.93	55	0.83	0.56	0.79	0.79	0.84	0.74	0.77	0.69	0.76	0.78	0.70	0.46	0.85

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Instruction Affected by Mathematics Resource Shortages - Principals' Reports Scale, Fourth Grade, and TIMSS 2015 Mathematics Achievement

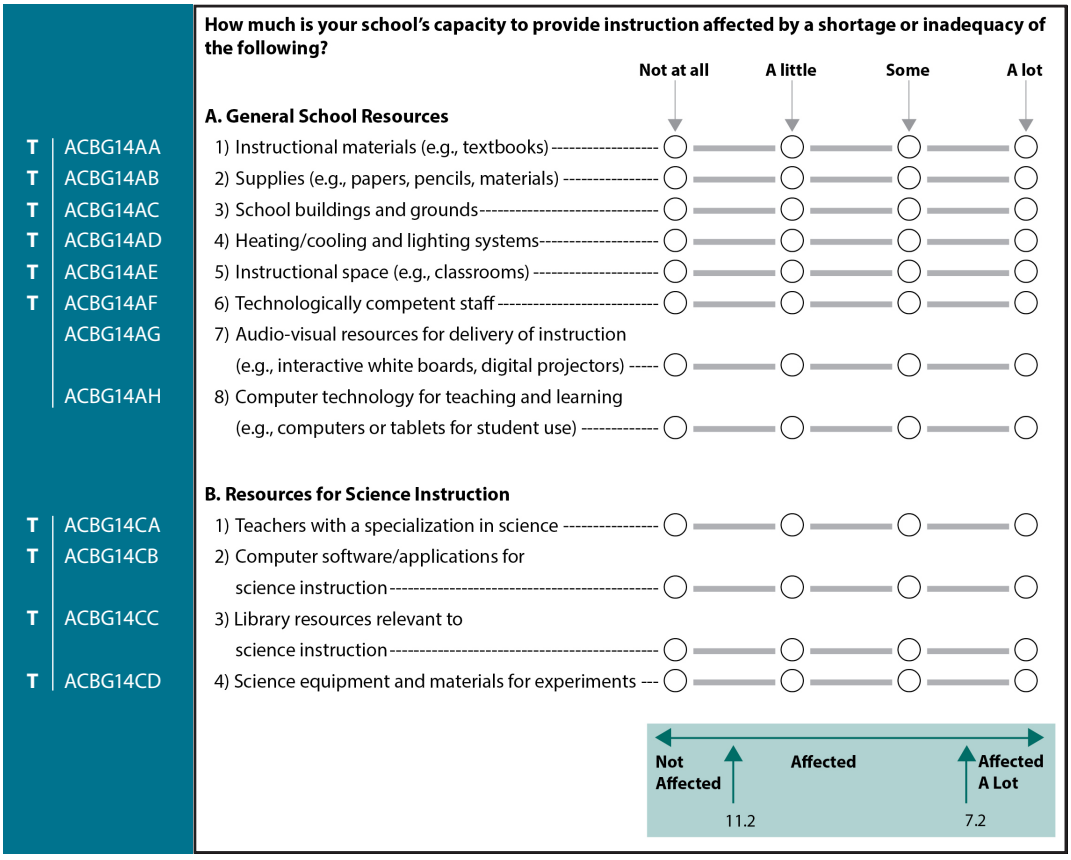
Country	Pearson's Correlation with Mathematics Achievement		Variance in Mathematics Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.12	0.01	0.01
Bahrain	0.08	0.01	0.01
Belgium (Flemish)	0.03	0.00	0.00
Bulgaria	0.10	0.01	0.01
Canada	0.08	0.01	0.01
Chile	0.14	0.02	0.02
Chinese Taipei	0.11	0.01	0.01
Croatia	0.03	0.00	0.00
Cyprus	0.08	0.01	0.01
Czech Republic	0.01	0.00	0.00
Denmark	-0.06	0.00	0.00
England	0.08	0.01	0.00
Finland	0.01	0.00	0.00
France	0.07	0.00	0.01
Georgia	0.09	0.01	0.01
Germany	0.04	0.00	0.00
Hong Kong SAR	0.19	0.04	0.04
Hungary	0.00	0.00	0.00
Indonesia	-0.25	0.06	0.02
Iran, Islamic Rep. of	-0.02	0.00	0.01
Ireland	0.04	0.00	0.00
Italy	0.05	0.00	0.01
Japan	0.00	0.00	0.00
Jordan	-0.07	0.01	0.04
Kazakhstan	-0.06	0.00	0.00
Korea, Rep. of	-0.05	0.00	0.00
Kuwait	0.06	0.00	0.02
Lithuania	-0.10	0.01	0.00
Morocco	-0.12	0.01	0.00
Netherlands	-0.01	0.00	0.00
New Zealand	0.07	0.01	0.01
Northern Ireland	0.02	0.00	0.00
Norway (5)	0.06	0.00	0.00
Oman	-0.02	0.00	0.01
Poland	0.02	0.00	0.01
Portugal	0.05	0.00	0.01
Qatar	0.20	0.04	0.04
Russian Federation	0.07	0.01	0.01
Saudi Arabia	0.04	0.00	0.01
Serbia	0.04	0.00	0.01
Singapore	-0.07	0.01	0.01
Slovak Republic	-0.03	0.00	0.00
Slovenia	-0.08	0.01	0.00
South Africa (5)	0.17	0.03	0.04
Spain	0.11	0.01	0.00
Sweden	0.01	0.00	0.00
Turkey	-0.08	0.01	0.02
United Arab Emirates	0.26	0.07	0.10
United States	0.11	0.01	0.01
International Median	0.04	0.00	0.01
Benchmarking Participants			
Buenos Aires, Argentina	0.10	0.01	0.01
Ontario, Canada	0.06	0.00	0.00
Quebec, Canada	0.15	0.02	0.01
Norway (4)	0.04	0.00	0.00
Abu Dhabi, UAE	0.20	0.04	0.10
Dubai, UAE	0.28	0.08	0.08
Florida, US	-0.07	0.00	0.02

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Instruction Affected by Science Resource Shortages–Principals' Reports Scale, Fourth Grade

The Instruction Affected by Science Resource Shortages–Principals' Reports (SRS) scale was created based on principals' responses concerning twelve school and classroom resources described below.

Items in the TIMSS 2015 Instruction Affected by Science Resource Shortages–Principals' Reports Scale, Fourth Grade



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Instruction Affected by Science Resource Shortages – Principals' Reports Scale, Fourth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
ACBG14AA	-0.24271	-0.15468	-0.15689	0.31157	0.88
ACBG14AB	-0.54779	-0.32899	0.24385	0.08514	0.89
ACBG14AC	-0.04867	-0.86218	0.22062	0.64156	1.04
ACBG14AD	-0.34143	-0.48719	0.12016	0.36703	0.88
ACBG14AE	0.06971	-0.49816	-0.02197	0.52013	1.02
ACBG14AF	0.01673	-1.23646	-0.04988	1.28634	0.96
ACBG14AG	0.00728	-1.05224	0.16138	0.89086	1.01
ACBG14AH	0.23712	-1.20141	0.07412	1.12729	1.06
ACBG14CA	0.01564	-0.59589	0.05252	0.54337	1.14
ACBG14CB	0.27596	-1.48062	0.01306	1.46756	1.02
ACBG14CC	-0.00723	-1.52053	0.04353	1.47700	0.99
ACBG14CD	0.56539	-1.15196	-0.06683	1.21879	0.99

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Instruction Affected by Science Resource Shortages – Principals' Reports Scale, Fourth Grade

Scale Transformation Constants	
A = 9.169706	Transformed Scale Score = 9.169706 + 1.448865 • Logit Scale Score
B = 1.448865	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Instruction Affected by Science Resource Shortages – Principals' Reports Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.19089	
1	4.82763	
2	5.60806	
3	6.13220	
4	6.52977	
5	6.85141	
6	7.12344	7.2
7	7.36033	
8	7.57143	
9	7.76318	
10	7.93955	
11	8.10599	
12	8.26361	
13	8.41441	
14	8.56013	
15	8.70226	
16	8.84212	
17	8.98089	
18	9.11966	
19	9.25946	
20	9.40134	
21	9.54635	
22	9.69564	
23	9.85047	
24	10.01218	
25	10.18145	
26	10.36189	
27	10.55547	
28	10.76551	
29	10.99648	
30	11.25452	11.2
31	11.54832	
32	11.89305	
33	12.31351	
34	12.86021	
35	13.66164	
36	15.31821	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Instruction Affected by Science Resource Shortages – Principals' Reports Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item											
			ACBG14AA	ACBG14AB	ACBG14AC	ACBG14AD	ACBG14AE	ACBG14AF	ACBG14AG	ACBG14AH	ACBG14CA	ACBG14CB	ACBG14CC	ACBG14CD
Australia	0.87	42	0.64	0.54	0.58	0.46	0.58	0.75	0.70	0.72	0.59	0.69	0.74	0.68
Bahrain	0.96	68	0.90	0.87	0.83	0.91	0.90	0.78	0.89	0.78	0.83	0.71	0.64	0.77
Belgium (Flemish)	0.86	42	0.56	0.53	0.64	0.60	0.58	0.73	0.79	0.79	0.56	0.71	0.63	0.62
Bulgaria	0.83	36	0.67	0.75	0.72	0.65	0.49	0.54	0.71	0.63	0.60	0.36	0.55	0.42
Canada	0.85	38	0.65	0.55	0.60	0.48	0.62	0.68	0.69	0.69	0.51	0.62	0.71	0.58
Chile	0.91	50	0.67	0.68	0.71	0.62	0.76	0.69	0.77	0.72	0.64	0.70	0.78	0.69
Chinese Taipei	0.91	50	0.74	0.71	0.68	0.83	0.71	0.70	0.73	0.72	0.71	0.64	0.63	0.69
Croatia	0.87	41	0.64	0.68	0.63	0.68	0.66	0.65	0.68	0.58	0.59	0.62	0.62	0.69
Cyprus	0.91	52	0.86	0.71	0.72	0.70	0.79	0.80	0.75	0.57	0.64	0.73	0.64	0.74
Czech Republic	0.78	30	0.51	0.53	0.46	0.47	0.53	0.60	0.63	0.62	0.39	0.71	0.45	0.63
Denmark	0.86	40	0.80	0.60	0.65	0.54	0.60	0.54	0.63	0.73	0.44	0.71	0.63	0.69
England	0.87	43	0.71	0.52	0.39	0.46	0.46	0.75	0.70	0.70	0.69	0.76	0.76	0.77
Finland	0.81	33	0.51	0.56	0.67	0.66	0.71	0.57	0.53	0.64	0.46	0.46	0.46	0.54
France	0.85	37	0.69	0.57	0.55	0.50	0.48	0.62	0.64	0.64	0.65	0.67	0.67	0.57
Georgia	0.88	44	0.54	0.74	0.59	0.60	0.66	0.70	0.69	0.73	0.66	0.66	0.72	0.63
Germany	0.83	36	0.68	0.67	0.66	0.43	0.66	0.53	0.67	0.59	0.34	0.51	0.62	0.72
Hong Kong SAR	0.91	52	0.76	0.77	0.63	0.77	0.73	0.80	0.82	0.70	0.57	0.65	0.65	0.74
Hungary	0.89	46	0.65	0.73	0.78	0.70	0.68	0.59	0.70	0.72	0.66	0.64	0.61	0.68
Indonesia	0.85	38	0.66	0.59	0.49	0.73	0.44	0.69	0.66	0.70	0.41	0.61	0.64	0.65
Iran, Islamic Rep. of	0.85	39	0.77	0.79	0.69	0.83	0.79	0.67	0.49	0.12	0.59	0.43	0.41	0.50
Ireland	0.85	38	0.61	0.57	0.51	0.57	0.51	0.58	0.60	0.57	0.65	0.76	0.74	0.65
Italy	0.76	28	0.56	0.52	0.53	0.48	0.67	0.52	0.56	0.59	0.41	0.49	0.45	0.49
Japan	0.92	55	0.73	0.73	0.77	0.74	0.83	0.68	0.68	0.75	0.68	0.70	0.73	0.83
Jordan	0.89	47	0.69	0.75	0.76	0.71	0.76	0.68	0.51	0.64	0.71	0.61	0.53	0.79
Kazakhstan	0.93	58	0.80	0.69	0.69	0.81	0.80	0.81	0.74	0.64	0.82	0.75	0.80	0.75
Korea, Rep. of	0.91	53	0.79	0.77	0.79	0.74	0.80	0.84	0.66	0.80	0.60	0.54	0.60	0.72
Kuwait	0.93	58	0.85	0.77	0.76	0.85	0.89	0.72	0.31	0.53	0.87	0.78	0.78	0.87
Lithuania	0.89	47	0.74	0.72	0.67	0.62	0.59	0.74	0.75	0.66	0.49	0.74	0.76	0.69
Morocco	0.81	38	-0.10	0.25	0.46	0.56	-0.15	0.74	0.71	0.77	0.80	0.77	0.80	0.68
Netherlands	0.81	32	0.47	0.38	0.63	0.58	0.60	0.53	0.61	0.70	0.44	0.66	0.58	0.53
New Zealand	0.86	40	0.68	0.61	0.59	0.55	0.53	0.64	0.66	0.64	0.58	0.63	0.68	0.74
Northern Ireland	0.84	37	0.67	0.67	0.64	0.64	0.59	0.65	0.53	0.63	0.64	0.55	0.50	0.54
Norway (5)	0.85	39	0.73	0.73	0.75	0.75	0.70	0.54	0.61	0.62	0.28	0.52	0.51	0.59
Oman	0.92	53	0.74	0.73	0.66	0.77	0.75	0.78	0.62	0.68	0.83	0.75	0.66	0.78
Poland	0.90	48	0.76	0.74	0.59	0.69	0.68	0.62	0.70	0.70	0.60	0.75	0.78	0.67
Portugal	0.88	43	0.51	0.52	0.62	0.57	0.54	0.59	0.76	0.71	0.68	0.76	0.75	0.78
Qatar	0.98	80	0.93	0.92	0.87	0.95	0.93	0.93	0.89	0.89	0.90	0.80	0.85	0.88
Russian Federation	0.91	52	0.80	0.75	0.58	0.73	0.66	0.68	0.75	0.70	0.69	0.73	0.79	0.74
Saudi Arabia	0.88	45	0.69	0.69	0.70	0.78	0.75	0.68	0.71	0.49	0.67	0.62	0.52	0.66
Serbia	0.90	49	0.78	0.68	0.65	0.69	0.71	0.72	0.76	0.78	0.63	0.67	0.64	0.62
Singapore	0.96	71	0.88	0.87	0.84	0.89	0.86	0.83	0.92	0.92	0.60	0.78	0.80	0.90
Slovak Republic	0.90	49	0.79	0.80	0.63	0.73	0.66	0.70	0.82	0.81	0.81	0.65	0.44	0.40
Slovenia	0.84	37	0.51	0.53	0.56	0.49	0.57	0.52	0.75	0.75	0.19	0.74	0.74	0.73
South Africa (5)	0.70	36	-0.22	-0.17	0.42	0.68	0.22	0.80	0.87	0.84	0.00	0.00	0.00	0.00
Spain	0.88	43	0.62	0.66	0.59	0.68	0.55	0.69	0.73	0.73	0.65	0.64	0.68	0.65
Sweden	0.83	36	0.66	0.62	0.50	0.56	0.58	0.66	0.59	0.69	0.38	0.64	0.52	0.74
Turkey	0.88	43	0.76	0.69	0.60	0.71	0.70	0.51	0.71	0.52	0.67	0.66	0.63	0.64
United Arab Emirates	0.96	69	0.86	0.85	0.84	0.88	0.87	0.87	0.82	0.82	0.82	0.74	0.76	0.83
United States	0.89	46	0.67	0.68	0.68	0.63	0.62	0.70	0.70	0.62	0.67	0.69	0.76	0.68
Benchmarking Participants														
Buenos Aires, Argentina	0.91	51	0.74	0.79	0.69	0.65	0.82	0.78	0.75	0.72	0.58	0.71	0.71	0.62
Ontario, Canada	0.86	40	0.59	0.46	0.56	0.45	0.66	0.72	0.64	0.71	0.61	0.74	0.71	0.61
Quebec, Canada	0.85	40	0.80	0.74	0.67	0.52	0.74	0.58	0.72	0.67	0.31	0.33	0.72	0.53
Norway (4)	0.84	38	0.73	0.73	0.78	0.76	0.71	0.50	0.63	0.60	0.28	0.47	0.48	0.55
Abu Dhabi, UAE	0.95	65	0.84	0.83	0.84	0.84	0.86	0.83	0.79	0.78	0.80	0.66	0.77	0.82
Dubai, UAE	0.98	80	0.90	0.91	0.85	0.93	0.87	0.93	0.89	0.89	0.89	0.88	0.87	0.91
Florida, US	0.94	59	0.81	0.50	0.80	0.80	0.82	0.75	0.78	0.72	0.74	0.81	0.80	0.86

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Instruction Affected by Science Resource Shortages – Principals' Reports Scale, Fourth Grade, and TIMSS 2015 Science Achievement

Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.11	0.01	0.01
Bahrain	0.06	0.00	0.01
Belgium (Flemish)	0.04	0.00	0.01
Bulgaria	0.10	0.01	0.01
Canada	0.05	0.00	0.00
Chile	0.14	0.02	0.02
Chinese Taipei	0.14	0.02	0.02
Croatia	0.03	0.00	0.00
Cyprus	0.06	0.00	0.01
Czech Republic	-0.02	0.00	0.00
Denmark	-0.03	0.00	0.00
England	0.11	0.01	0.01
Finland	0.01	0.00	0.00
France	0.05	0.00	0.00
Georgia	0.13	0.02	0.01
Germany	0.05	0.00	0.00
Hong Kong SAR	0.16	0.03	0.03
Hungary	0.01	0.00	0.00
Indonesia	-0.28	0.08	0.03
Iran, Islamic Rep. of	0.01	0.00	0.00
Ireland	0.01	0.00	0.00
Italy	0.04	0.00	0.00
Japan	0.01	0.00	0.00
Jordan	-	-	-
Kazakhstan	-0.06	0.00	0.00
Korea, Rep. of	-0.03	0.00	0.00
Kuwait	0.02	0.00	0.02
Lithuania	-0.09	0.01	0.01
Morocco	-0.11	0.01	0.00
Netherlands	-0.01	0.00	0.00
New Zealand	0.06	0.00	0.01
Northern Ireland	0.04	0.00	0.01
Norway (5)	0.03	0.00	0.00
Oman	-0.01	0.00	0.00
Poland	0.01	0.00	0.00
Portugal	0.05	0.00	0.01
Qatar	0.15	0.02	0.02
Russian Federation	0.09	0.01	0.01
Saudi Arabia	0.06	0.00	0.03
Serbia	0.02	0.00	0.01
Singapore	-0.07	0.01	0.01
Slovak Republic	-0.07	0.00	0.00
Slovenia	-0.09	0.01	0.01
South Africa (5)	-	-	-
Spain	0.13	0.02	0.01
Sweden	0.01	0.00	0.00
Turkey	-0.05	0.00	0.01
United Arab Emirates	0.22	0.05	0.07
United States	0.08	0.01	0.01
International Median	0.03	0.00	0.01
Benchmarking Participants			
Buenos Aires, Argentina	0.11	0.01	0.04
Ontario, Canada	0.04	0.00	0.00
Quebec, Canada	0.14	0.02	0.02
Norway (4)	0.03	0.00	0.00
Abu Dhabi, UAE	0.19	0.04	0.07
Dubai, UAE	0.22	0.05	0.05
Florida, US	-0.09	0.01	0.03

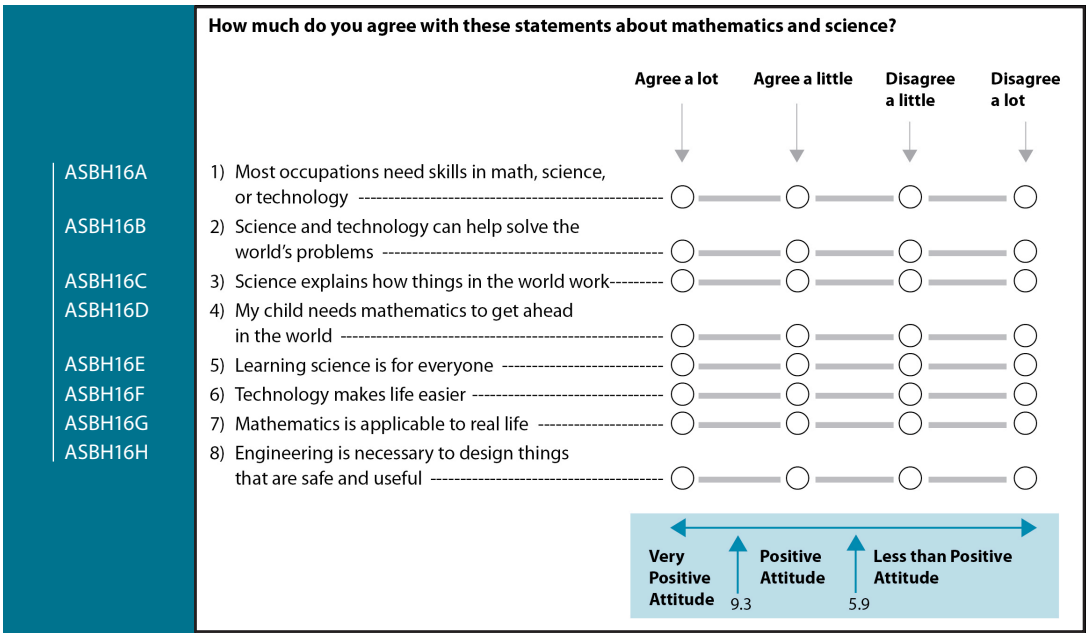
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Parental Attitude Toward Mathematics and Science Scale, Fourth Grade

The Parental Attitude Toward Mathematics and Science (AMS) scale was created based on parents' responses to the eight statements described below.

Items in the TIMSS 2015 Parental Attitude Toward Mathematics and Science Scale, Fourth Grade[1]



1 For the purpose of scaling, categories in which there were very few respondents were combined. The categories "Disagree a little" and "Disagree a lot" were combined for all variables. The scale statistics that are reported herein reflect analysis of the items following collapsing.

Item Parameters for the TIMSS 2015 Parental Attitude Towards Mathematics and Science Scale, Fourth Grade

Item	delta	tau_1	tau_2	Infit
ASBH16A	-0.13348	-1.30430	1.30430	1.06
ASBH16B	0.46466	-1.45183	1.45183	1.02
ASBH16C	-0.14365	-1.51755	1.51755	0.98
ASBH16D	0.26093	-1.15860	1.15860	0.98
ASBH16E	0.49246	-1.14023	1.14023	1.07
ASBH16F	-0.23279	-1.41401	1.41401	1.07
ASBH16G	-0.42471	-1.32106	1.32106	0.97
ASBH16H	-0.28342	-1.41733	1.41733	1.02

Scale Transformation Constants for the TIMSS 2015 Parental Attitude Towards Mathematics and Science Scale, Fourth Grade

Scale Transformation Constants	
A = 7.585537	Transformed Scale Score = 7.585537 + 1.203307 • Logit Scale Score
B = 1.203307	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Parental Attitude Towards Mathematics and Science Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	2.47515	
1	3.94784	
2	4.73109	
3	5.31751	
4	5.81902	5.9
5	6.28412	
6	6.72991	
7	7.16815	
8	7.60318	
9	8.03458	
10	8.46408	
11	8.89768	
12	9.34946	9.3
13	9.84146	
14	10.41768	
15	11.19234	
16	12.66016	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Parental Attitude Towards Mathematics and Science Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item							
			ASBH16A	ASBH16B	ASBH16C	ASBH16D	ASBH16E	ASBH16F	ASBH16G	ASBH16H
Australia	0.81	44	0.58	0.70	0.67	0.71	0.71	0.57	0.68	0.67
Bahrain	0.80	41	0.58	0.69	0.66	0.69	0.65	0.53	0.68	0.64
Belgium (Flemish)	0.84	47	0.61	0.69	0.68	0.75	0.67	0.67	0.71	0.69
Bulgaria	0.85	49	0.71	0.72	0.72	0.73	0.66	0.62	0.73	0.71
Canada	0.83	47	0.63	0.71	0.72	0.72	0.66	0.61	0.72	0.69
Chile	0.80	42	0.42	0.68	0.71	0.70	0.67	0.62	0.65	0.66
Chinese Taipei	0.87	53	0.72	0.77	0.77	0.67	0.73	0.73	0.73	0.70
Croatia	0.80	42	0.59	0.65	0.66	0.74	0.55	0.58	0.70	0.66
Cyprus	0.75	38	0.60	0.68	0.69	0.63	0.50	0.55	0.64	0.61
Czech Republic	0.82	45	0.66	0.68	0.67	0.70	0.70	0.63	0.64	0.68
Denmark	0.77	40	0.62	0.66	0.66	0.71	0.50	0.60	0.64	0.63
England	-	-	-	-	-	-	-	-	-	-
Finland	0.83	46	0.66	0.70	0.67	0.73	0.72	0.58	0.70	0.67
France	0.84	48	0.69	0.73	0.68	0.70	0.72	0.62	0.70	0.69
Georgia	0.80	42	0.54	0.58	0.65	0.70	0.67	0.69	0.70	0.63
Germany	0.80	42	0.60	0.60	0.63	0.70	0.63	0.67	0.69	0.65
Hong Kong SAR	0.83	47	0.67	0.72	0.72	0.68	0.69	0.66	0.65	0.69
Hungary	0.79	42	0.63	0.69	0.68	0.69	0.68	0.62	0.67	0.50
Indonesia	0.83	46	0.59	0.72	0.73	0.68	0.65	0.70	0.67	0.71
Iran, Islamic Rep. of	0.79	41	0.60	0.65	0.65	0.68	0.64	0.59	0.70	0.59
Ireland	0.79	42	0.57	0.68	0.65	0.71	0.64	0.58	0.70	0.63
Italy	0.80	42	0.58	0.69	0.67	0.69	0.54	0.62	0.67	0.69
Japan	0.85	49	0.66	0.73	0.71	0.73	0.76	0.66	0.65	0.70
Jordan	0.81	44	0.60	0.68	0.70	0.71	0.60	0.62	0.68	0.69
Kazakhstan	0.78	40	0.62	0.69	0.64	0.63	0.57	0.62	0.61	0.64
Korea, Rep. of	0.87	53	0.65	0.76	0.74	0.73	0.78	0.69	0.70	0.77
Kuwait	0.81	43	0.59	0.68	0.70	0.72	0.65	0.59	0.68	0.64
Lithuania	0.76	38	0.62	0.65	0.62	0.64	0.50	0.62	0.64	0.64
Morocco	0.84	47	0.63	0.71	0.70	0.70	0.65	0.70	0.68	0.71
Netherlands	0.80	43	0.65	0.67	0.70	0.69	0.51	0.61	0.71	0.71
New Zealand	0.83	46	0.64	0.73	0.67	0.74	0.70	0.56	0.72	0.67
Northern Ireland	0.81	43	0.59	0.71	0.65	0.65	0.68	0.62	0.69	0.67
Norway (5)	0.81	44	0.62	0.69	0.69	0.70	0.65	0.65	0.63	0.64
Oman	0.77	39	0.56	0.66	0.63	0.65	0.62	0.57	0.65	0.62
Poland	0.83	47	0.67	0.72	0.64	0.69	0.67	0.70	0.69	0.68
Portugal	0.76	38	0.48	0.64	0.66	0.62	0.57	0.58	0.65	0.68
Qatar	0.84	47	0.60	0.70	0.73	0.72	0.69	0.65	0.70	0.67
Russian Federation	0.82	44	0.64	0.70	0.67	0.71	0.69	0.59	0.66	0.67
Saudi Arabia	0.84	47	0.59	0.72	0.70	0.73	0.67	0.65	0.71	0.71
Serbia	0.84	48	0.65	0.72	0.73	0.75	0.63	0.62	0.70	0.71
Singapore	0.86	50	0.68	0.73	0.72	0.72	0.72	0.66	0.72	0.71
Slovak Republic	0.82	44	0.65	0.67	0.67	0.72	0.66	0.61	0.68	0.64
Slovenia	0.85	50	0.70	0.73	0.72	0.73	0.63	0.66	0.70	0.76
South Africa (5)	0.83	46	0.64	0.72	0.70	0.70	0.60	0.69	0.71	0.69
Spain	0.80	42	0.59	0.70	0.71	0.69	0.55	0.62	0.66	0.67
Sweden	0.82	45	0.60	0.70	0.70	0.72	0.61	0.69	0.64	0.70
Turkey	0.81	44	0.64	0.68	0.67	0.70	0.67	0.61	0.68	0.64
United Arab Emirates	0.85	49	0.65	0.71	0.73	0.71	0.71	0.65	0.73	0.67
United States	-	-	-	-	-	-	-	-	-	-
Benchmarking Participants										
Buenos Aires, Argentina	0.80	42	0.70	0.59	0.63	0.71	0.59	0.58	0.73	0.65
Ontario, Canada	0.82	45	0.57	0.70	0.68	0.72	0.67	0.62	0.71	0.64
Quebec, Canada	0.84	48	0.62	0.73	0.73	0.73	0.60	0.64	0.72	0.74
Norway (4)	0.81	44	0.66	0.72	0.69	0.72	0.65	0.60	0.61	0.65
Abu Dhabi, UAE	0.87	52	0.67	0.72	0.76	0.72	0.74	0.68	0.75	0.71
Dubai, UAE	0.83	45	0.62	0.68	0.72	0.72	0.69	0.60	0.70	0.65
Florida, US	-	-	-	-	-	-	-	-	-	-

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Parental Attitude Towards Mathematics and Science Scale, Fourth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.15	0.13	0.02	0.02	0.02	0.02
Bahrain	0.13	0.17	0.02	0.03	0.01	0.02
Belgium (Flemish)	0.08	0.08	0.01	0.01	0.01	0.01
Bulgaria	0.08	0.10	0.01	0.01	0.01	0.02
Canada	0.10	0.13	0.01	0.02	0.01	0.01
Chile	0.09	0.06	0.01	0.00	0.00	0.00
Chinese Taipei	0.09	0.10	0.01	0.01	0.01	0.01
Croatia	0.06	0.05	0.00	0.00	0.01	0.00
Cyprus	0.03	0.04	0.00	0.00	0.00	0.00
Czech Republic	0.05	0.06	0.00	0.00	0.00	0.00
Denmark	0.09	0.08	0.01	0.01	0.01	0.01
England	-	-	-	-	-	-
Finland	0.17	0.16	0.03	0.03	0.02	0.02
France	0.16	0.15	0.03	0.02	0.02	0.02
Georgia	0.02	0.05	0.00	0.00	0.00	0.00
Germany	0.07	0.06	0.00	0.00	0.00	0.00
Hong Kong SAR	0.15	0.18	0.02	0.03	0.02	0.02
Hungary	0.08	0.07	0.01	0.00	0.01	0.01
Indonesia	0.02	0.05	0.00	0.00	0.00	0.00
Iran, Islamic Rep. of	0.10	0.12	0.01	0.01	0.01	0.01
Ireland	0.13	0.12	0.02	0.01	0.01	0.01
Italy	0.04	0.03	0.00	0.00	0.00	0.00
Japan	0.17	0.18	0.03	0.03	0.03	0.03
Jordan	0.18	-	0.03	-	0.03	-
Kazakhstan	0.01	-0.02	0.00	0.00	0.00	0.00
Korea, Rep. of	0.20	0.18	0.04	0.03	0.03	0.03
Kuwait	0.13	0.14	0.02	0.02	0.02	0.02
Lithuania	0.06	0.02	0.00	0.00	0.01	0.00
Morocco	0.10	0.12	0.01	0.02	0.01	0.02
Netherlands	0.17	0.20	0.03	0.04	0.02	0.04
New Zealand	0.16	0.15	0.03	0.02	0.02	0.02
Northern Ireland	0.08	0.10	0.01	0.01	0.00	0.01
Norway (5)	0.14	0.15	0.02	0.02	0.01	0.01
Oman	0.11	0.13	0.01	0.02	0.01	0.01
Poland	0.13	0.14	0.02	0.02	0.02	0.02
Portugal	0.08	0.11	0.01	0.01	0.00	0.01
Qatar	0.19	0.18	0.03	0.03	0.03	0.02
Russian Federation	-0.01	-0.02	0.00	0.00	0.00	0.00
Saudi Arabia	0.07	0.07	0.01	0.01	0.01	0.01
Serbia	0.04	0.05	0.00	0.00	0.01	0.01
Singapore	0.13	0.13	0.02	0.02	0.01	0.02
Slovak Republic	-0.05	-0.06	0.00	0.00	0.00	0.00
Slovenia	0.10	0.10	0.01	0.01	0.01	0.01
South Africa (5)	0.04	-	0.00	-	0.00	-
Spain	0.10	0.10	0.01	0.01	0.01	0.01
Sweden	0.14	0.14	0.02	0.02	0.02	0.02
Turkey	0.07	0.07	0.00	0.00	0.01	0.01
United Arab Emirates	0.20	0.23	0.04	0.05	0.04	0.05
United States	-	-	-	-	-	-
International Median	0.10	0.10	0.01	0.01	0.01	0.01
Benchmarking Participants						
Buenos Aires, Argentina	0.16	0.08	0.02	0.01	0.01	0.01
Ontario, Canada	0.14	0.12	0.02	0.01	0.01	0.01
Quebec, Canada	0.16	0.14	0.02	0.02	0.02	0.01
Norway (4)	0.06	0.15	0.00	0.02	0.00	0.02
Abu Dhabi, UAE	0.22	0.25	0.05	0.06	0.05	0.06
Dubai, UAE	0.15	0.18	0.02	0.03	0.02	0.03
Florida, US	-	-	-	-	-	-

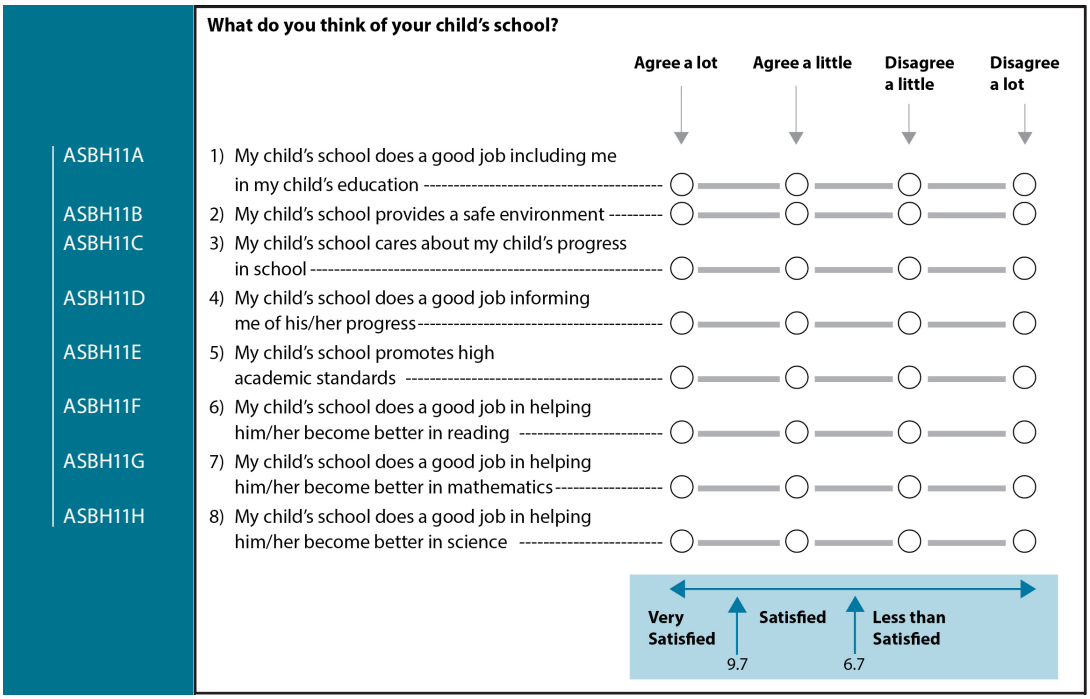
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Parents' Perceptions of School Performance Scale, Fourth Grade

The Parents' Perceptions of School Performance (PSP) scale was created based on parents' responses to the eight statements described below.

Items in the TIMSS 2015 Parents' Perceptions of School Performance Scale, Fourth Grade[1]



1 For the purpose of scaling, categories in which there were very few respondents were combined. The categories "Disagree a little" and "Disagree a lot" were combined for all variables. The scale statistics that are reported herein reflect analysis of the items following collapsing.

Item Parameters for the TIMSS 2015 Parents' Perceptions of School Performance Scale, Fourth Grade

Item	delta	tau_1	tau_2	Infit
ASBH11A	0.11460	-1.73494	1.73494	1.12
ASBH11B	-0.67540	-1.75855	1.75855	1.32
ASBH11C	-0.56176	-1.77592	1.77592	0.86
ASBH11D	0.01006	-1.43467	1.43467	1.02
ASBH11E	0.89136	-1.72307	1.72307	1.18
ASBH11F	-0.12622	-1.56127	1.56127	0.87
ASBH11G	0.02192	-1.62039	1.62039	0.86
ASBH11H	0.32544	-1.66119	1.66119	0.95

Scale Transformation Constants for the TIMSS 2015 Parents' Perceptions of School Performance Scale, Fourth Grade

Scale Transformation Constants	
A = 8.205877	Transformed Scale Score = 8.205877 + 0.922019 • Logit Scale Score
B = 0.922019	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Parents' Perceptions of School Performance Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.94852	
1	5.10034	
2	5.72134	
3	6.19579	
4	6.61062	6.7
5	7.00360	
6	7.39360	
7	7.79675	
8	8.21220	
9	8.62605	
10	9.02464	
11	9.41083	
12	9.79839	9.7
13	10.20989	
14	10.68380	
15	11.30495	
16	12.45977	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Parents' Perceptions of School Performance Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item							
			ASBH11A	ASBH11B	ASBH11C	ASBH11D	ASBH11E	ASBH11F	ASBH11G	ASBH11H
Australia	0.90	60	0.78	0.51	0.81	0.81	0.74	0.83	0.84	0.81
Bahrain	0.90	60	0.74	0.67	0.82	0.76	0.79	0.81	0.81	0.79
Belgium (Flemish)	0.88	55	0.76	0.62	0.80	0.79	0.59	0.77	0.81	0.78
Bulgaria	0.91	63	0.71	0.71	0.84	0.78	0.78	0.84	0.83	0.84
Canada	0.91	61	0.77	0.59	0.83	0.80	0.78	0.80	0.84	0.82
Chile	0.91	61	0.78	0.64	0.82	0.80	0.75	0.80	0.82	0.79
Chinese Taipei	0.91	62	0.77	0.67	0.84	0.84	0.72	0.77	0.86	0.83
Croatia	0.91	62	0.73	0.69	0.82	0.74	0.76	0.85	0.85	0.85
Cyprus	0.89	57	0.68	0.60	0.82	0.73	0.76	0.82	0.83	0.77
Czech Republic	0.90	60	0.70	0.57	0.81	0.78	0.76	0.84	0.87	0.86
Denmark	0.90	60	0.78	0.64	0.82	0.80	0.80	0.77	0.81	0.76
England	-	-	-	-	-	-	-	-	-	-
Finland	0.89	57	0.70	0.58	0.80	0.72	0.68	0.82	0.86	0.84
France	0.89	58	0.74	0.63	0.80	0.78	0.71	0.80	0.83	0.78
Georgia	0.87	54	0.61	0.63	0.77	0.74	0.64	0.80	0.82	0.81
Germany	0.89	57	0.79	0.60	0.79	0.79	0.59	0.80	0.83	0.82
Hong Kong SAR	0.89	57	0.76	0.55	0.79	0.80	0.75	0.80	0.80	0.76
Hungary	0.90	58	0.73	0.61	0.78	0.77	0.73	0.82	0.83	0.82
Indonesia	0.83	48	0.64	0.54	0.72	0.72	0.58	0.72	0.80	0.78
Iran, Islamic Rep. of	0.86	51	0.67	0.62	0.74	0.70	0.65	0.78	0.78	0.77
Ireland	0.88	56	0.78	0.58	0.80	0.79	0.78	0.76	0.79	0.70
Italy	0.90	59	0.77	0.55	0.79	0.78	0.74	0.81	0.82	0.83
Japan	0.86	51	0.61	0.58	0.70	0.70	0.74	0.80	0.78	0.77
Jordan	0.93	66	0.78	0.71	0.85	0.82	0.82	0.85	0.84	0.83
Kazakhstan	0.88	54	0.68	0.60	0.76	0.69	0.77	0.80	0.78	0.78
Korea, Rep. of	0.91	62	0.64	0.67	0.79	0.78	0.85	0.82	0.86	0.85
Kuwait	0.92	65	0.77	0.72	0.83	0.81	0.83	0.83	0.82	0.81
Lithuania	0.89	57	0.64	0.63	0.78	0.72	0.69	0.84	0.85	0.83
Morocco	0.88	55	0.68	0.66	0.80	0.72	0.69	0.80	0.81	0.77
Netherlands	0.89	56	0.76	0.56	0.80	0.78	0.70	0.83	0.85	0.70
New Zealand	0.91	61	0.81	0.56	0.82	0.82	0.78	0.81	0.83	0.77
Northern Ireland	0.89	58	0.79	0.55	0.83	0.81	0.75	0.80	0.81	0.69
Norway (5)	0.91	63	0.79	0.65	0.83	0.79	0.79	0.82	0.84	0.83
Oman	0.88	55	0.72	0.64	0.77	0.71	0.73	0.76	0.80	0.80
Poland	0.90	58	0.69	0.68	0.83	0.73	0.75	0.80	0.80	0.80
Portugal	0.90	59	0.78	0.59	0.81	0.76	0.71	0.83	0.85	0.81
Qatar	0.92	63	0.77	0.68	0.82	0.79	0.80	0.82	0.82	0.83
Russian Federation	0.89	58	0.62	0.66	0.79	0.70	0.70	0.85	0.87	0.86
Saudi Arabia	0.92	65	0.75	0.73	0.82	0.80	0.81	0.84	0.84	0.83
Serbia	0.92	66	0.81	0.70	0.86	0.82	0.77	0.84	0.84	0.85
Singapore	0.89	58	0.77	0.58	0.82	0.78	0.72	0.77	0.81	0.79
Slovak Republic	0.90	59	0.69	0.62	0.80	0.72	0.77	0.82	0.85	0.84
Slovenia	0.91	61	0.65	0.70	0.82	0.76	0.72	0.85	0.86	0.87
South Africa (5)	0.85	50	0.67	0.58	0.74	0.70	0.70	0.75	0.76	0.73
Spain	0.90	60	0.77	0.64	0.80	0.79	0.71	0.79	0.84	0.83
Sweden	0.91	63	0.77	0.65	0.82	0.80	0.81	0.81	0.83	0.84
Turkey	0.90	60	0.71	0.67	0.78	0.75	0.81	0.81	0.82	0.81
United Arab Emirates	0.91	62	0.78	0.67	0.83	0.79	0.80	0.80	0.81	0.81
United States	-	-	-	-	-	-	-	-	-	-
Benchmarking Participants										
Buenos Aires, Argentina	0.91	61	0.71	0.65	0.83	0.76	0.77	0.81	0.85	0.81
Ontario, Canada	0.91	61	0.79	0.56	0.84	0.80	0.79	0.79	0.84	0.83
Quebec, Canada	0.90	59	0.70	0.65	0.82	0.81	0.75	0.81	0.84	0.77
Norway (4)	0.91	62	0.79	0.62	0.84	0.80	0.76	0.80	0.84	0.81
Abu Dhabi, UAE	0.92	63	0.78	0.69	0.83	0.80	0.82	0.82	0.80	0.82
Dubai, UAE	0.90	59	0.76	0.61	0.83	0.78	0.79	0.77	0.80	0.80
Florida, US	-	-	-	-	-	-	-	-	-	-

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Parents' Perceptions of School Performance Scale, Fourth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement (r)		Pearson's Correlation with Achievement (r^2)		Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.10	0.05	0.01	0.00	0.01	0.01
Bahrain	0.13	0.17	0.02	0.03	0.02	0.03
Belgium (Flemish)	-0.03	-0.05	0.00	0.00	0.00	0.00
Bulgaria	-0.01	-0.04	0.00	0.00	0.00	0.00
Canada	0.00	0.02	0.00	0.00	0.00	0.00
Chile	0.04	0.04	0.00	0.00	0.00	0.00
Chinese Taipei	-0.02	-0.05	0.00	0.00	0.00	0.00
Croatia	-0.02	-0.03	0.00	0.00	0.00	0.00
Cyprus	-0.02	-0.04	0.00	0.00	0.00	0.00
Czech Republic	-0.09	-0.10	0.01	0.01	0.01	0.01
Denmark	0.05	0.04	0.00	0.00	0.01	0.00
England	-	-	-	-	-	-
Finland	0.01	0.01	0.00	0.00	0.00	0.00
France	0.01	-0.01	0.00	0.00	0.00	0.00
Georgia	0.04	0.04	0.00	0.00	0.00	0.00
Germany	0.06	0.02	0.00	0.00	0.01	0.01
Hong Kong SAR	0.11	0.09	0.01	0.01	0.01	0.01
Hungary	0.04	0.04	0.00	0.00	0.00	0.00
Indonesia	0.03	0.06	0.00	0.00	0.00	0.00
Iran, Islamic Rep. of	-0.01	-0.01	0.00	0.00	0.00	0.00
Ireland	-0.03	-0.02	0.00	0.00	0.00	0.00
Italy	0.01	-0.02	0.00	0.00	0.00	0.00
Japan	0.02	0.04	0.00	0.00	0.00	0.00
Jordan	0.16	-	0.03	-	0.03	-
Kazakhstan	0.05	0.02	0.00	0.00	0.00	0.00
Korea, Rep. of	0.05	0.02	0.00	0.00	0.00	0.00
Kuwait	0.06	0.07	0.00	0.00	0.00	0.01
Lithuania	0.04	-0.02	0.00	0.00	0.00	0.00
Morocco	0.15	0.22	0.02	0.05	0.02	0.04
Netherlands	0.06	0.05	0.00	0.00	0.01	0.01
New Zealand	0.04	-0.01	0.00	0.00	0.01	0.00
Northern Ireland	-0.03	-0.07	0.00	0.01	0.00	0.01
Norway (5)	0.12	0.03	0.02	0.00	0.01	0.00
Oman	0.14	0.14	0.02	0.02	0.02	0.02
Poland	-0.04	-0.06	0.00	0.00	0.00	0.00
Portugal	0.09	0.06	0.01	0.00	0.01	0.00
Qatar	0.13	0.14	0.02	0.02	0.02	0.02
Russian Federation	-0.02	-0.05	0.00	0.00	0.00	0.00
Saudi Arabia	0.05	0.03	0.00	0.00	0.01	0.00
Serbia	-0.07	-0.10	0.00	0.01	0.01	0.01
Singapore	0.08	0.06	0.01	0.00	0.01	0.01
Slovak Republic	-0.08	-0.11	0.01	0.01	0.01	0.01
Slovenia	0.01	-0.01	0.00	0.00	0.00	0.00
South Africa (5)	0.13	-	0.02	-	0.01	-
Spain	0.03	0.01	0.00	0.00	0.00	0.00
Sweden	0.03	-0.02	0.00	0.00	0.00	0.00
Turkey	-0.01	0.01	0.00	0.00	0.00	0.00
United Arab Emirates	0.16	0.17	0.03	0.03	0.03	0.03
United States	-	-	-	-	-	-
International Median	0.04	0.02	0.00	0.00	0.00	0.00
Benchmarking Participants						
Buenos Aires, Argentina	0.07	0.09	0.00	0.01	0.00	0.01
Ontario, Canada	0.08	0.05	0.01	0.00	0.01	0.01
Quebec, Canada	-0.04	-0.06	0.00	0.00	0.00	0.00
Norway (4)	0.03	-0.02	0.00	0.00	0.00	0.00
Abu Dhabi, UAE	0.17	0.19	0.03	0.03	0.03	0.03
Dubai, UAE	0.15	0.15	0.02	0.02	0.02	0.02
Florida, US	-	-	-	-	-	-

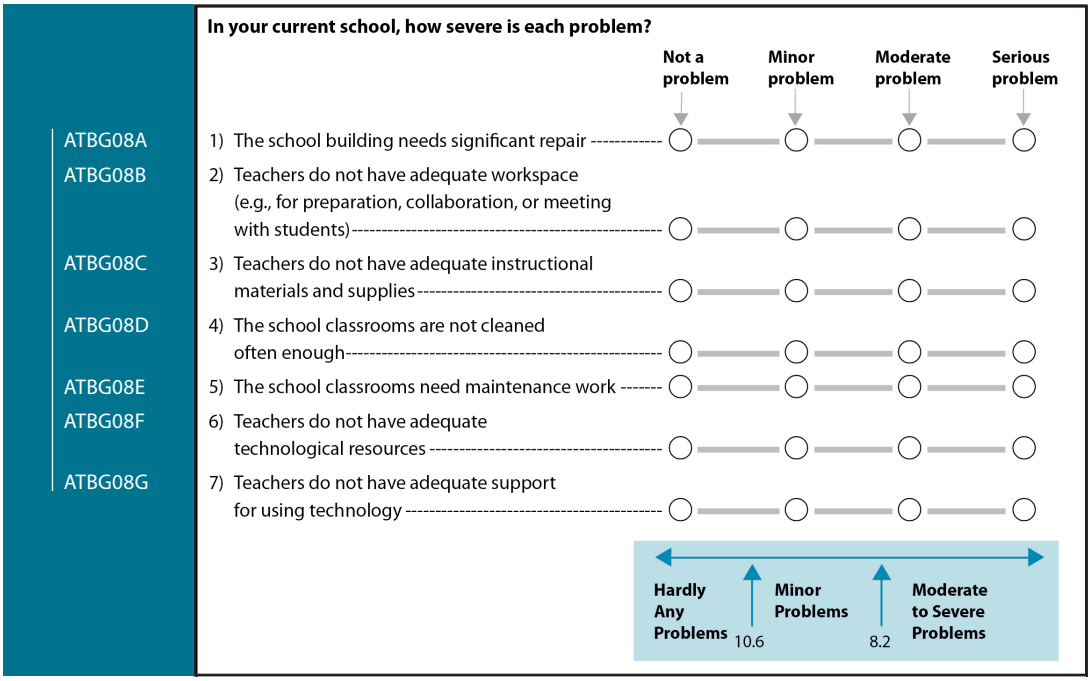
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Problems with School Conditions and Resources–Teachers' Reports Scale, Fourth Grade

The Problems with School Conditions and Resources–Teachers' Reports (SCR) scale was created based on teachers' responses concerning seven conditions and resources described below.

Items in the Problems with School Conditions and Resources–Teachers' Reports Scale, Fourth Grade



Item Parameters for the TIMSS 2015 Problems with School Conditions and Resources – Teachers' Reports Scale, Fourth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
ATBG08A	0.25146	-1.10267	-0.04789	1.15056	1.15
ATBG08B	0.10778	-0.98715	0.06755	0.91960	1.14
ATBG08C	-0.00295	-1.33876	0.01594	1.32282	0.95
ATBG08D	-0.67894	-0.79406	0.02136	0.77270	1.14
ATBG08E	-0.05211	-1.13587	-0.15567	1.29154	0.97
ATBG08F	0.24992	-1.09700	-0.04657	1.14357	0.90
ATBG08G	0.12484	-1.05906	-0.07924	1.13830	1.02

Scale Transformation Constants for the TIMSS 2015 Problems with School Conditions and Resources – Teachers' Reports Scale, Fourth Grade

Scale Transformation Constants	
A = 8.325487	Transformed Scale Score = 8.325487 + 1.363794 • Logit Scale Score
B = 1.363794	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Problems with School Conditions and Resources – Teachers' Reports Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.19241	
1	4.74715	
2	5.50395	
3	6.02702	
4	6.44003	
5	6.78968	
6	7.10030	
7	7.38690	
8	7.65644	
9	7.91569	
10	8.17000	8.2
11	8.42379	
12	8.68129	
13	8.94698	
14	9.22610	
15	9.52520	
16	9.85013	
17	10.21875	
18	10.65400	10.6
19	11.20171	
20	11.98622	
21	13.57043	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Problems with School Conditions and Resources – Teachers' Reports Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item						
			ATBG08A	ATBG08B	ATBG08C	ATBG08D	ATBG08E	ATBG08F	ATBG08G
Australia	0.83	51	0.76	0.68	0.77	0.50	0.75	0.73	0.75
Bahrain	0.85	54	0.61	0.74	0.79	0.70	0.68	0.84	0.76
Belgium (Flemish)	0.80	46	0.73	0.67	0.70	0.49	0.71	0.73	0.70
Bulgaria	0.87	57	0.71	0.65	0.82	0.66	0.79	0.81	0.80
Canada	0.80	47	0.73	0.56	0.69	0.64	0.75	0.67	0.72
Chile	0.85	53	0.75	0.77	0.75	0.56	0.72	0.76	0.77
Chinese Taipei	0.84	52	0.54	0.67	0.75	0.69	0.77	0.80	0.79
Croatia	0.88	59	0.72	0.75	0.83	0.52	0.84	0.86	0.78
Cyprus	0.86	54	0.76	0.70	0.77	0.56	0.83	0.75	0.73
Czech Republic	0.81	49	0.50	0.69	0.75	0.53	0.73	0.82	0.82
Denmark	0.82	49	0.76	0.53	0.69	0.58	0.81	0.77	0.70
England	0.86	55	0.71	0.68	0.79	0.64	0.80	0.81	0.72
Finland	0.83	51	0.75	0.75	0.78	0.56	0.79	0.71	0.62
France	0.78	44	0.76	0.68	0.68	0.46	0.73	0.70	0.60
Georgia	0.84	52	0.75	0.66	0.74	0.65	0.76	0.80	0.66
Germany	0.83	51	0.67	0.74	0.73	0.67	0.71	0.77	0.70
Hong Kong SAR	0.89	60	0.72	0.76	0.82	0.72	0.81	0.80	0.77
Hungary	0.84	51	0.60	0.66	0.79	0.61	0.75	0.86	0.71
Indonesia	0.88	59	0.79	0.72	0.75	0.66	0.80	0.81	0.81
Iran, Islamic Rep. of	0.83	49	0.78	0.81	0.71	0.50	0.80	0.68	0.57
Ireland	0.84	51	0.80	0.68	0.71	0.64	0.84	0.69	0.62
Italy	0.86	53	0.75	0.67	0.79	0.63	0.82	0.77	0.67
Japan	0.78	44	0.65	0.60	0.70	0.47	0.65	0.77	0.76
Jordan	0.90	62	0.78	0.79	0.82	0.69	0.80	0.82	0.80
Kazakhstan	0.86	56	0.63	0.83	0.78	0.67	0.78	0.80	0.69
Korea, Rep. of	0.87	57	0.69	0.67	0.80	0.61	0.78	0.86	0.86
Kuwait	0.87	56	0.67	0.69	0.82	0.68	0.78	0.79	0.79
Lithuania	0.84	51	0.65	0.75	0.80	0.33	0.75	0.81	0.79
Morocco	0.88	58	0.70	0.82	0.76	0.72	0.81	0.79	0.74
Netherlands	0.75	41	0.47	0.66	0.68	0.56	0.55	0.79	0.72
New Zealand	0.83	50	0.74	0.74	0.64	0.59	0.75	0.75	0.68
Northern Ireland	0.86	55	0.79	0.71	0.74	0.66	0.84	0.74	0.70
Norway (5)	0.81	48	0.72	0.69	0.75	0.50	0.72	0.73	0.69
Oman	0.85	53	0.67	0.65	0.74	0.72	0.75	0.81	0.73
Poland	0.84	51	0.70	0.72	0.78	0.57	0.74	0.79	0.70
Portugal	0.86	55	0.76	0.77	0.79	0.51	0.82	0.78	0.71
Qatar	0.87	56	0.62	0.62	0.68	0.76	0.83	0.86	0.84
Russian Federation	0.82	49	0.64	0.65	0.84	0.42	0.67	0.83	0.77
Saudi Arabia	0.88	58	0.69	0.76	0.82	0.67	0.77	0.83	0.79
Serbia	0.88	59	0.76	0.67	0.85	0.66	0.78	0.85	0.80
Singapore	0.87	56	0.70	0.75	0.78	0.67	0.79	0.77	0.77
Slovak Republic	0.85	54	0.61	0.70	0.85	0.59	0.76	0.84	0.76
Slovenia	0.85	54	0.71	0.69	0.85	0.59	0.76	0.80	0.72
South Africa (5)	0.90	62	0.79	0.75	0.82	0.70	0.83	0.84	0.77
Spain	0.85	54	0.72	0.72	0.82	0.58	0.75	0.80	0.72
Sweden	0.81	47	0.74	0.58	0.66	0.68	0.81	0.69	0.61
Turkey	0.89	60	0.69	0.76	0.80	0.64	0.79	0.85	0.85
United Arab Emirates	0.87	57	0.75	0.65	0.77	0.71	0.80	0.80	0.78
United States	0.83	50	0.72	0.66	0.69	0.65	0.78	0.74	0.71
Benchmarking Participants									
Buenos Aires, Argentina	0.88	58	0.80	0.77	0.77	0.72	0.85	0.71	0.71
Ontario, Canada	0.81	47	0.72	0.60	0.71	0.66	0.77	0.67	0.65
Quebec, Canada	0.82	50	0.73	0.39	0.71	0.64	0.76	0.74	0.86
Norway (4)	0.83	51	0.79	0.69	0.79	0.48	0.79	0.72	0.69
Abu Dhabi, UAE	0.87	57	0.77	0.65	0.76	0.71	0.78	0.81	0.77
Dubai, UAE	0.80	47	0.78	0.52	0.66	0.56	0.78	0.73	0.73
Florida, US	0.87	57	0.81	0.72	0.62	0.75	0.83	0.79	0.73

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Problems with School Conditions and Resources – Teachers' Reports Scale, Fourth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.01	0.03	0.00	0.00	0.00	0.00
Bahrain	0.03	0.02	0.00	0.00	0.00	0.00
Belgium (Flemish)	0.02	0.03	0.00	0.00	0.00	0.00
Bulgaria	0.01	0.01	0.00	0.00	0.00	0.00
Canada	-0.05	-0.03	0.00	0.00	0.00	0.00
Chile	0.17	0.17	0.03	0.03	0.04	0.04
Chinese Taipei	0.06	0.01	0.00	0.00	0.00	0.00
Croatia	-0.07	-0.07	0.00	0.00	0.00	0.00
Cyprus	0.06	0.04	0.00	0.00	0.00	0.00
Czech Republic	0.02	0.02	0.00	0.00	0.00	0.00
Denmark	-0.02	0.04	0.00	0.00	0.00	0.00
England	-0.02	-0.02	0.00	0.00	0.00	0.01
Finland	0.01	0.01	0.00	0.00	0.00	0.00
France	0.08	0.07	0.01	0.01	0.01	0.00
Georgia	0.08	0.09	0.01	0.01	0.00	0.01
Germany	0.07	0.09	0.00	0.01	0.01	0.01
Hong Kong SAR	0.16	0.18	0.03	0.03	0.01	0.01
Hungary	-0.10	-0.08	0.01	0.01	0.01	0.00
Indonesia	0.13	0.13	0.02	0.02	0.02	0.04
Iran, Islamic Rep. of	0.22	0.20	0.05	0.04	0.03	0.03
Ireland	0.00	0.03	0.00	0.00	0.00	0.00
Italy	0.04	0.03	0.00	0.00	0.01	0.00
Japan	-0.04	-0.01	0.00	0.00	0.00	0.00
Jordan	0.20	-	0.04	-	0.03	-
Kazakhstan	0.09	0.09	0.01	0.01	0.00	0.00
Korea, Rep. of	0.09	0.04	0.01	0.00	0.01	0.00
Kuwait	0.06	0.10	0.00	0.01	0.00	0.00
Lithuania	-0.02	-0.02	0.00	0.00	0.00	0.00
Morocco	0.19	0.25	0.04	0.06	0.05	0.07
Netherlands	-0.05	-0.06	0.00	0.00	0.01	0.01
New Zealand	0.05	0.05	0.00	0.00	0.00	0.00
Northern Ireland	0.01	0.03	0.00	0.00	0.00	0.00
Norway (5)	0.09	0.09	0.01	0.01	0.02	0.01
Oman	0.01	-0.02	0.00	0.00	0.01	0.00
Poland	0.02	0.01	0.00	0.00	0.00	0.00
Portugal	0.04	0.05	0.00	0.00	0.01	0.01
Qatar	-0.05	-0.02	0.00	0.00	0.01	0.00
Russian Federation	0.06	0.08	0.00	0.01	0.00	0.00
Saudi Arabia	0.17	0.03	0.03	0.00	0.02	0.00
Serbia	0.00	-0.02	0.00	0.00	0.00	0.00
Singapore	-0.04	-0.04	0.00	0.00	0.00	0.00
Slovak Republic	-0.04	-0.02	0.00	0.00	0.01	0.00
Slovenia	-0.04	-0.05	0.00	0.00	0.00	0.00
South Africa (5)	0.39	-	0.15	-	0.14	-
Spain	0.05	0.05	0.00	0.00	0.00	0.00
Sweden	0.11	0.11	0.01	0.01	0.00	0.00
Turkey	0.24	0.23	0.06	0.05	0.05	0.04
United Arab Emirates	0.15	0.18	0.02	0.03	0.03	0.04
United States	0.09	0.10	0.01	0.01	0.01	0.01
International Median	0.04	0.03	0.00	0.00	0.00	0.00
Benchmarking Participants						
Buenos Aires, Argentina	0.23	0.20	0.05	0.04	0.04	0.04
Ontario, Canada	0.03	0.01	0.00	0.00	0.00	0.00
Quebec, Canada	0.01	0.02	0.00	0.00	0.01	0.01
Norway (4)	0.04	0.04	0.00	0.00	0.00	0.00
Abu Dhabi, UAE	-0.01	0.04	0.00	0.00	0.02	0.02
Dubai, UAE	0.15	0.23	0.02	0.05	0.02	0.04
Florida, US	0.07	0.04	0.00	0.00	0.01	0.01

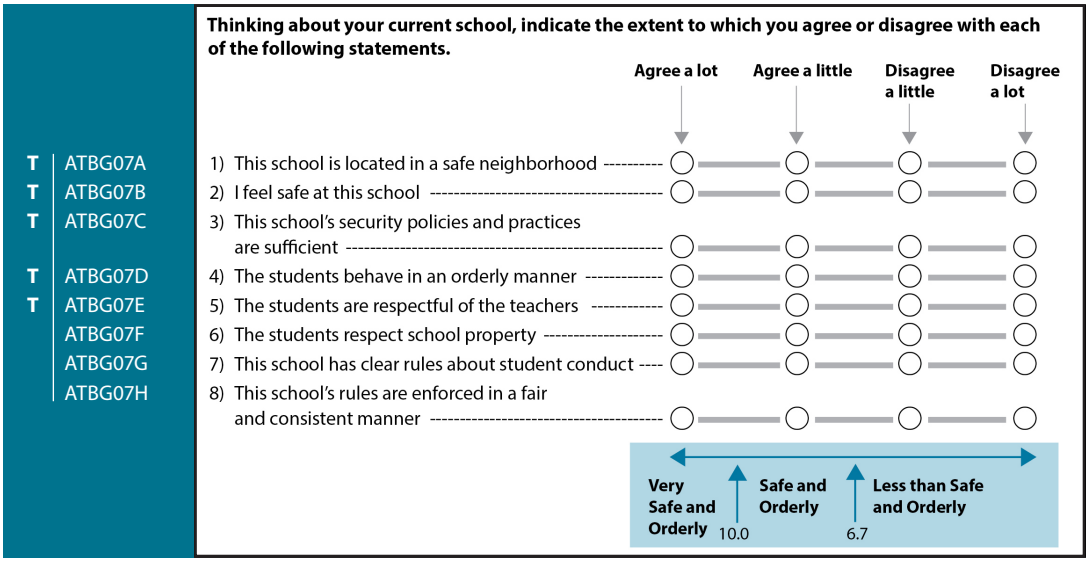
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Safe and Orderly School–Teachers' Reports Scale, Fourth Grade

The Safe and Orderly School – Teachers' Reports (SOS) scale was created based on teachers' degree of agreement with the eight statements described below.

Items in the TIMSS 2015 Safe and Orderly School–Teachers' Reports Scale, Fourth Grade[1]



1 For the purpose of scaling, categories in which there were very few respondents were combined. The categories "Disagree a little" and "Disagree a lot" were combined for all variables. The scale statistics that are reported herein reflect analysis of the items following collapsing.

T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Safe and Orderly School – Teachers' Reports Scale, Fourth Grade

Item	delta	tau_1	tau_2	Infit
ATBG07A	-0.40272	-1.05787	1.05787	1.40
ATBG07B	-1.33285	-1.23553	1.23553	1.00
ATBG07C	-0.54308	-1.43816	1.43816	1.08
ATBG07D	0.97878	-1.91297	1.91297	0.84
ATBG07E	0.55100	-1.90039	1.90039	0.87
ATBG07F	1.18574	-1.83791	1.83791	0.89
ATBG07G	-0.48880	-1.35559	1.35559	1.08
ATBG07H	0.05193	-1.51487	1.51487	1.00

Scale Transformation Constants for the TIMSS 2015 Safe and Orderly School – Teachers' Reports Scale, Fourth Grade

Scale Transformation Constants	
A = 8.379152	Transformed Scale Score = 8.379152 + 1.021142 • Logit Scale Score
B = 1.021142	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Safe and Orderly School – Teachers' Reports Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.75218	
1	5.02760	
2	5.71019	
3	6.22383	
4	6.66369	6.7
5	7.06780	
6	7.45682	
7	7.84491	
8	8.23956	
9	8.65006	
10	9.08289	
11	9.54538	
12	10.04965	10.0
13	10.61012	
14	11.25092	
15	12.04413	
16	13.41271	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Safe and Orderly School – Teachers' Reports Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item							
			ATBG07A	ATBG07B	ATBG07C	ATBG07D	ATBG07E	ATBG07F	ATBG07G	ATBG07H
Australia	0.86	52	0.64	0.66	0.66	0.83	0.81	0.81	0.62	0.71
Bahrain	0.89	57	0.51	0.65	0.73	0.86	0.78	0.82	0.81	0.82
Belgium (Flemish)	0.83	46	0.49	0.59	0.66	0.78	0.77	0.73	0.65	0.72
Bulgaria	0.83	46	0.55	0.68	0.64	0.78	0.76	0.75	0.58	0.66
Canada	0.86	51	0.52	0.60	0.64	0.81	0.79	0.80	0.73	0.76
Chile	0.88	54	0.59	0.70	0.72	0.79	0.83	0.81	0.66	0.77
Chinese Taipei	0.89	56	0.70	0.75	0.73	0.76	0.77	0.76	0.78	0.76
Croatia	0.88	55	0.63	0.72	0.73	0.77	0.78	0.74	0.74	0.81
Cyprus	0.87	53	0.70	0.67	0.70	0.77	0.77	0.79	0.72	0.69
Czech Republic	0.83	47	0.56	0.73	0.68	0.70	0.74	0.63	0.72	0.72
Denmark	0.83	47	0.54	0.51	0.63	0.78	0.77	0.76	0.68	0.74
England	0.86	52	0.48	0.64	0.61	0.83	0.80	0.77	0.71	0.85
Finland	0.82	45	0.43	0.63	0.55	0.79	0.78	0.69	0.70	0.74
France	0.84	48	0.73	0.78	0.72	0.74	0.70	0.71	0.50	0.58
Georgia	0.83	47	0.58	0.69	0.73	0.72	0.71	0.49	0.79	0.73
Germany	0.85	49	0.70	0.76	0.68	0.79	0.79	0.76	0.53	0.56
Hong Kong SAR	0.88	55	0.55	0.68	0.67	0.78	0.76	0.82	0.82	0.83
Hungary	0.86	51	0.50	0.67	0.74	0.77	0.80	0.77	0.71	0.69
Indonesia	0.85	50	0.62	0.70	0.67	0.81	0.74	0.81	0.59	0.70
Iran, Islamic Rep. of	0.84	47	0.62	0.70	0.69	0.80	0.74	0.77	0.65	0.47
Ireland	0.86	53	0.62	0.67	0.55	0.83	0.84	0.83	0.66	0.73
Italy	0.82	45	0.50	0.61	0.57	0.76	0.73	0.79	0.62	0.71
Japan	0.74	36	0.63	0.64	0.52	0.72	0.54	0.70	0.44	0.57
Jordan	0.87	53	0.55	0.62	0.76	0.79	0.75	0.78	0.75	0.77
Kazakhstan	0.88	54	0.67	0.76	0.62	0.73	0.74	0.79	0.80	0.79
Korea, Rep. of	0.89	57	0.60	0.70	0.75	0.82	0.80	0.80	0.77	0.79
Kuwait	0.86	51	0.49	0.57	0.72	0.80	0.81	0.79	0.72	0.75
Lithuania	0.83	46	0.46	0.70	0.72	0.71	0.75	0.72	0.53	0.73
Morocco	0.88	56	0.67	0.76	0.71	0.80	0.70	0.79	0.79	0.74
Netherlands	0.84	47	0.66	0.62	0.64	0.84	0.82	0.75	0.43	0.64
New Zealand	0.86	53	0.66	0.69	0.67	0.79	0.80	0.77	0.71	0.72
Northern Ireland	0.81	47	0.50	0.60	0.63	0.83	0.85	0.81	0.57	0.56
Norway (5)	0.87	53	0.60	0.61	0.67	0.83	0.82	0.78	0.72	0.76
Oman	0.84	47	0.46	0.52	0.63	0.77	0.76	0.74	0.78	0.75
Poland	0.83	46	0.54	0.64	0.68	0.72	0.77	0.72	0.65	0.67
Portugal	0.86	51	0.66	0.69	0.80	0.75	0.71	0.78	0.64	0.67
Qatar	0.85	49	0.39	0.55	0.62	0.75	0.82	0.81	0.77	0.79
Russian Federation	0.80	44	0.53	0.62	0.56	0.77	0.77	0.75	0.42	0.76
Saudi Arabia	0.85	51	0.33	0.42	0.63	0.83	0.82	0.84	0.82	0.83
Serbia	0.89	57	0.62	0.74	0.79	0.80	0.80	0.78	0.68	0.81
Singapore	0.89	56	0.58	0.63	0.74	0.81	0.81	0.82	0.78	0.80
Slovak Republic	0.85	49	0.37	0.68	0.65	0.76	0.80	0.79	0.72	0.75
Slovenia	0.84	47	0.61	0.62	0.74	0.72	0.71	0.66	0.65	0.76
South Africa (5)	0.88	55	0.66	0.74	0.70	0.80	0.74	0.79	0.72	0.75
Spain	0.85	49	0.57	0.66	0.71	0.78	0.78	0.79	0.59	0.70
Sweden	0.84	49	0.61	0.74	0.72	0.75	0.78	0.77	0.46	0.72
Turkey	0.89	57	0.76	0.76	0.74	0.75	0.76	0.75	0.75	0.76
United Arab Emirates	0.89	56	0.48	0.63	0.71	0.82	0.81	0.84	0.80	0.82
United States	0.88	55	0.62	0.67	0.70	0.85	0.81	0.82	0.70	0.75
Benchmarking Participants										
Buenos Aires, Argentina	0.87	52	0.49	0.65	0.59	0.78	0.82	0.74	0.80	0.82
Ontario, Canada	0.86	51	0.53	0.59	0.63	0.79	0.80	0.78	0.75	0.80
Quebec, Canada	0.83	47	0.58	0.65	0.60	0.76	0.67	0.74	0.73	0.73
Norway (4)	0.87	54	0.74	0.71	0.70	0.81	0.79	0.79	0.70	0.65
Abu Dhabi, UAE	0.87	53	0.34	0.59	0.67	0.82	0.79	0.84	0.79	0.82
Dubai, UAE	0.88	54	0.39	0.56	0.66	0.79	0.82	0.85	0.84	0.85
Florida, US	0.90	60	0.64	0.71	0.70	0.88	0.85	0.92	0.77	0.67

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Safe and Orderly School – Teachers' Reports Scale, Fourth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement (r)		Pearson's Correlation with Achievement (r^2)		Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.24	0.22	0.06	0.05	0.05	0.04
Bahrain	0.18	0.13	0.03	0.02	0.02	0.01
Belgium (Flemish)	0.16	0.17	0.03	0.03	0.01	0.01
Bulgaria	0.20	0.22	0.04	0.05	0.03	0.03
Canada	0.06	0.10	0.00	0.01	0.00	0.01
Chile	0.24	0.28	0.06	0.08	0.04	0.06
Chinese Taipei	0.01	-0.02	0.00	0.00	0.00	0.00
Croatia	-0.03	-0.03	0.00	0.00	0.00	0.00
Cyprus	0.08	0.07	0.01	0.00	0.01	0.00
Czech Republic	0.06	0.07	0.00	0.01	0.00	0.00
Denmark	0.12	0.13	0.01	0.02	0.02	0.03
England	0.13	0.12	0.02	0.02	0.01	0.01
Finland	0.06	0.07	0.00	0.00	0.01	0.01
France	0.18	0.17	0.03	0.03	0.04	0.04
Georgia	0.04	0.05	0.00	0.00	0.00	0.00
Germany	0.16	0.18	0.03	0.03	0.02	0.02
Hong Kong SAR	0.06	0.14	0.00	0.02	0.00	0.01
Hungary	0.18	0.17	0.03	0.03	0.02	0.02
Indonesia	0.01	0.01	0.00	0.00	0.00	0.00
Iran, Islamic Rep. of	0.09	0.09	0.01	0.01	0.01	0.01
Ireland	0.14	0.19	0.02	0.03	0.02	0.03
Italy	0.06	0.05	0.00	0.00	0.01	0.01
Japan	0.04	0.05	0.00	0.00	0.01	0.01
Jordan	0.13	-	0.02	-	0.01	-
Kazakhstan	0.07	0.08	0.01	0.01	0.00	0.00
Korea, Rep. of	0.10	0.08	0.01	0.01	0.01	0.01
Kuwait	0.04	0.11	0.00	0.01	0.00	0.00
Lithuania	0.02	0.01	0.00	0.00	0.00	0.00
Morocco	0.13	0.13	0.02	0.02	0.02	0.02
Netherlands	0.10	0.14	0.01	0.02	0.01	0.02
New Zealand	0.25	0.23	0.06	0.05	0.05	0.04
Northern Ireland	0.11	0.10	0.01	0.01	0.01	0.01
Norway (5)	0.09	0.12	0.01	0.01	0.01	0.01
Oman	0.03	0.02	0.00	0.00	0.00	0.00
Poland	0.02	0.04	0.00	0.00	0.00	0.00
Portugal	0.16	0.14	0.02	0.02	0.01	0.01
Qatar	0.08	0.14	0.01	0.02	0.01	0.03
Russian Federation	0.05	0.02	0.00	0.00	0.00	0.00
Saudi Arabia	0.18	0.14	0.03	0.02	0.03	0.02
Serbia	0.03	0.03	0.00	0.00	0.00	0.00
Singapore	0.10	0.12	0.01	0.02	0.00	0.02
Slovak Republic	0.13	0.13	0.02	0.02	0.02	0.03
Slovenia	0.04	0.05	0.00	0.00	0.00	0.00
South Africa (5)	0.08	-	0.01	-	0.01	-
Spain	0.22	0.23	0.05	0.05	0.04	0.04
Sweden	0.22	0.24	0.05	0.06	0.05	0.06
Turkey	0.16	0.16	0.03	0.02	0.02	0.02
United Arab Emirates	0.33	0.34	0.11	0.11	0.08	0.07
United States	0.21	0.22	0.05	0.05	0.04	0.04
International Median	0.10	0.12	0.01	0.02	0.01	0.01
Benchmarking Participants						
Buenos Aires, Argentina	0.20	0.19	0.04	0.04	0.03	0.03
Ontario, Canada	0.07	0.07	0.00	0.00	0.00	0.01
Quebec, Canada	0.09	0.08	0.01	0.01	0.00	0.00
Norway (4)	0.07	0.09	0.00	0.01	0.01	0.03
Abu Dhabi, UAE	0.24	0.22	0.06	0.05	0.06	0.02
Dubai, UAE	0.31	0.33	0.10	0.11	0.08	0.09
Florida, US	0.22	0.20	0.05	0.04	0.06	0.05

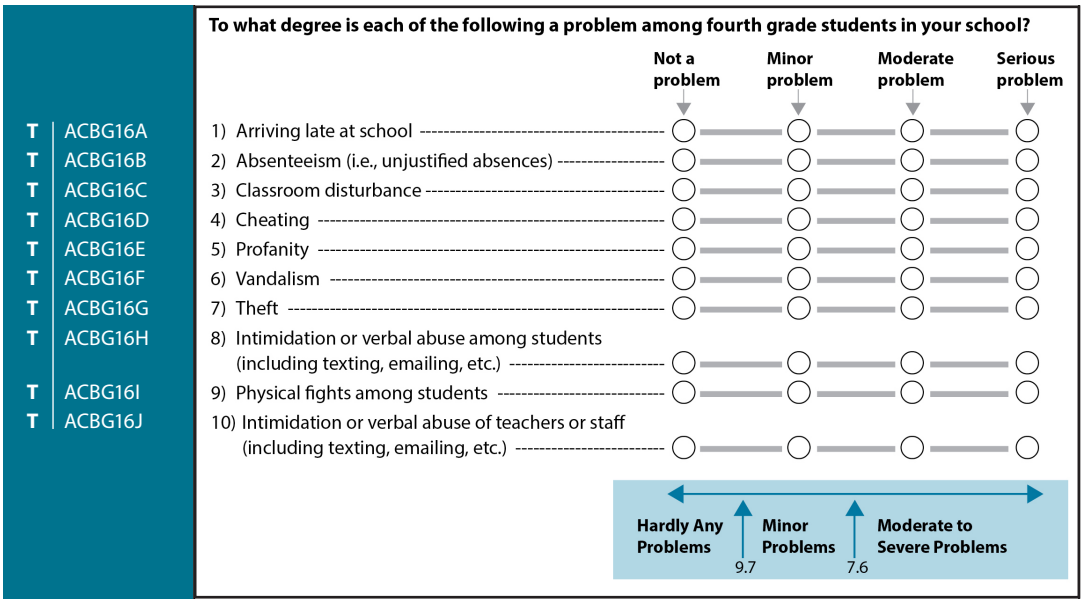
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

School Discipline Problems–Principals' Reports Scale, Fourth Grade

The School Discipline Problems–Principals' Reports (DAS) scale was created based on principals' responses concerning the ten potential school problems described below.

Items in the TIMSS 2015 School Discipline Problems–Principals' Reports Scale, Fourth Grade



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 School Discipline Problems - Principals' Reports Scale, Fourth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
ACBG16A	-0.04434	-2.20733	-0.33916	2.54649	1.32
ACBG16B	0.26055	-1.25742	-0.52690	1.78432	1.23
ACBG16C	0.73852	-2.23001	-0.29453	2.52454	0.99
ACBG16D	-0.48580	-0.99657	-0.85069	1.84726	0.96
ACBG16E	0.48637	-1.57910	-0.46416	2.04326	0.90
ACBG16F	-0.25161	-0.42885	-0.69852	1.12737	0.80
ACBG16G	-0.46856	0.19761	-1.13779	0.94018	0.75
ACBG16H	0.20843	-1.29153	-0.75176	2.04329	0.93
ACBG16I	0.26742	-1.29267	-0.85001	2.14268	0.87
ACBG16J	-0.71098	0.19104	-0.78670	0.59566	0.85

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 School Discipline Problems - Principals' Reports Scale, Fourth Grade

Scale Transformation Constants	
A = 7.80934	Transformed Scale Score = 7.80934 + 0.969053 • Logit Scale Score
B = 0.969053	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 School Discipline Problems - Principals' Reports Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.69215	
1	4.77953	
2	5.28846	
3	5.62589	
4	5.88225	
5	6.09144	
6	6.27112	
7	6.43124	
8	6.57814	
9	6.71457	
10	6.84760	
11	6.97770	
12	7.10707	
13	7.23779	
14	7.37193	
15	7.51249	7.6
16	7.65937	
17	7.81721	
18	7.98823	
19	8.17529	
20	8.38218	
21	8.61094	
22	8.86392	
23	9.14220	
24	9.44664	
25	9.77698	9.7
26	10.13829	
27	10.54381	
28	11.02588	
29	11.67067	
30	12.88232	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 School Discipline Problems - Principals' Reports Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item									
			ACBG16A	ACBG16B	ACBG16C	ACBG16D	ACBG16E	ACBG16F	ACBG16G	ACBG16H	ACBG16I	ACBG16J
Australia	0.92	62	0.71	0.79	0.78	0.74	0.84	0.82	0.76	0.77	0.85	0.77
Bahrain	0.97	78	0.80	0.84	0.82	0.92	0.90	0.93	0.91	0.92	0.87	0.93
Belgium (Flemish)	0.87	46	0.56	0.62	0.67	0.57	0.64	0.72	0.71	0.78	0.75	0.73
Bulgaria	0.93	61	0.79	0.71	0.82	0.74	0.84	0.83	0.69	0.78	0.83	0.75
Canada	0.86	49	0.63	0.55	0.69	0.69	0.78	0.80	0.76	0.68	0.76	0.58
Chile	0.86	46	0.52	0.65	0.72	0.67	0.82	0.68	0.72	0.66	0.75	0.52
Chinese Taipei	0.91	57	0.73	0.66	0.78	0.70	0.83	0.83	0.78	0.79	0.82	0.57
Croatia	0.81	38	0.44	0.39	0.62	0.56	0.70	0.71	0.61	0.78	0.72	0.47
Cyprus	0.93	62	0.71	0.74	0.84	0.77	0.78	0.80	0.81	0.80	0.85	0.78
Czech Republic	0.88	49	0.58	0.61	0.65	0.73	0.73	0.76	0.75	0.76	0.76	0.65
Denmark	0.83	40	0.63	0.69	0.63	0.36	0.68	0.70	0.61	0.69	0.63	0.63
England	0.82	41	0.58	0.57	0.69	0.42	0.71	0.70	0.52	0.69	0.75	0.72
Finland	0.83	43	0.62	0.62	0.61	0.69	0.74	0.67	0.74	0.61	0.67	0.58
France	0.90	53	0.61	0.65	0.71	0.67	0.80	0.79	0.76	0.77	0.76	0.75
Georgia	0.95	71	0.66	0.76	0.88	0.84	0.91	0.85	0.89	0.85	0.87	0.87
Germany	0.90	54	0.71	0.71	0.77	0.66	0.73	0.78	0.73	0.75	0.77	0.69
Hong Kong SAR	0.83	39	0.59	0.67	0.72	0.57	0.75	0.70	0.59	0.56	0.71	0.27
Hungary	0.92	60	0.71	0.80	0.79	0.77	0.69	0.80	0.78	0.84	0.80	0.73
Indonesia	0.97	80	0.78	0.89	0.83	0.89	0.94	0.89	0.93	0.93	0.92	0.92
Iran, Islamic Rep. of	0.92	58	0.57	0.67	0.65	0.75	0.85	0.82	0.85	0.82	0.79	0.77
Ireland	0.87	51	0.53	0.55	0.64	0.65	0.81	0.80	0.79	0.72	0.83	0.77
Italy	0.95	69	0.56	0.88	0.70	0.78	0.69	0.92	0.93	0.90	0.92	0.93
Japan	0.92	61	0.54	0.63	0.78	0.85	0.85	0.84	0.90	0.84	0.58	0.87
Jordan	0.94	67	0.62	0.71	0.68	0.86	0.87	0.84	0.90	0.87	0.90	0.86
Kazakhstan	0.98	81	0.85	0.89	0.89	0.74	0.95	0.95	0.94	0.94	0.92	0.94
Korea, Rep. of	0.96	76	0.75	0.88	0.76	0.92	0.84	0.93	0.93	0.88	0.92	0.91
Kuwait	0.94	67	0.68	0.78	0.85	0.80	0.86	0.89	0.82	0.83	0.85	0.79
Lithuania	0.82	39	0.47	0.52	0.65	0.72	0.73	0.58	0.73	0.67	0.66	0.43
Morocco	0.95	68	0.47	0.64	0.86	0.85	0.87	0.89	0.89	0.89	0.92	0.86
Netherlands	0.76	35	0.43	0.50	0.54	0.54	0.62	0.58	0.25	0.78	0.83	0.61
New Zealand	0.87	48	0.63	0.60	0.63	0.65	0.76	0.79	0.72	0.66	0.79	0.65
Northern Ireland	0.83	45	0.50	0.43	0.67	0.67	0.81	0.73	0.60	0.76	0.77	0.64
Norway (5)	0.84	43	0.73	0.69	0.60	0.60	0.77	0.77	0.54	0.64	0.65	0.52
Oman	0.95	69	0.75	0.80	0.78	0.87	0.88	0.90	0.90	0.85	0.75	0.79
Poland	0.84	41	0.61	0.40	0.66	0.64	0.70	0.72	0.71	0.68	0.67	0.58
Portugal	0.93	63	0.63	0.82	0.68	0.75	0.68	0.90	0.90	0.83	0.81	0.88
Qatar	0.96	75	0.67	0.76	0.78	0.92	0.90	0.90	0.89	0.93	0.93	0.91
Russian Federation	0.76	33	0.43	0.39	0.63	0.50	0.67	0.65	0.68	0.71	0.64	0.33
Saudi Arabia	0.96	73	0.59	0.63	0.82	0.91	0.90	0.93	0.93	0.92	0.92	0.92
Serbia	0.93	63	0.64	0.72	0.79	0.82	0.77	0.86	0.84	0.85	0.83	0.79
Singapore	0.88	49	0.64	0.67	0.71	0.74	0.72	0.72	0.73	0.80	0.70	0.52
Slovak Republic	0.88	48	0.57	0.66	0.59	0.75	0.77	0.76	0.74	0.71	0.72	0.64
Slovenia	0.88	49	0.71	0.72	0.68	0.68	0.69	0.75	0.63	0.70	0.70	0.71
South Africa (5)	0.87	47	0.54	0.60	0.69	0.71	0.68	0.74	0.76	0.72	0.79	0.56
Spain	0.94	68	0.66	0.80	0.77	0.78	0.79	0.90	0.89	0.86	0.86	0.92
Sweden	0.90	52	0.63	0.68	0.75	0.58	0.75	0.78	0.70	0.80	0.79	0.74
Turkey	0.96	73	0.71	0.82	0.82	0.89	0.83	0.89	0.92	0.91	0.85	0.87
United Arab Emirates	0.93	62	0.64	0.74	0.77	0.81	0.81	0.85	0.85	0.79	0.78	0.82
United States	0.88	49	0.62	0.68	0.72	0.67	0.78	0.67	0.74	0.71	0.73	0.67
Benchmarking Participants												
Buenos Aires, Argentina	0.90	54	0.38	0.60	0.65	0.71	0.81	0.81	0.85	0.81	0.78	0.81
Ontario, Canada	0.88	52	0.57	0.46	0.73	0.74	0.84	0.84	0.78	0.74	0.80	0.62
Quebec, Canada	0.80	39	0.62	0.63	0.56	0.65	0.72	0.58	0.63	0.65	0.61	0.58
Norway (4)	0.86	45	0.57	0.62	0.73	0.48	0.81	0.64	0.62	0.79	0.73	0.66
Abu Dhabi, UAE	0.86	48	0.60	0.69	0.76	0.60	0.72	0.74	0.70	0.64	0.74	0.73
Dubai, UAE	0.94	67	0.66	0.75	0.83	0.85	0.86	0.83	0.89	0.83	0.77	0.87
Florida, US	0.87	54	0.29	0.33	0.74	0.86	0.83	0.85	0.80	0.82	0.78	0.80

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 School Discipline Problems - Principals' Reports Scale, Fourth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.28	0.25	0.08	0.06	0.07	0.06
Bahrain	0.11	0.15	0.01	0.02	0.01	0.02
Belgium (Flemish)	0.14	0.18	0.02	0.03	0.02	0.02
Bulgaria	0.20	0.25	0.04	0.06	0.04	0.05
Canada	0.16	0.13	0.03	0.02	0.02	0.02
Chile	0.15	0.15	0.02	0.02	0.02	0.02
Chinese Taipei	0.13	0.15	0.02	0.02	0.01	0.01
Croatia	-0.04	-0.04	0.00	0.00	0.00	0.00
Cyprus	0.07	0.09	0.01	0.01	0.01	0.01
Czech Republic	0.08	0.08	0.01	0.01	0.01	0.01
Denmark	0.13	0.14	0.02	0.02	0.02	0.02
England	0.18	0.19	0.03	0.03	0.02	0.02
Finland	0.04	0.03	0.00	0.00	0.00	0.00
France	0.15	0.14	0.02	0.02	0.03	0.02
Georgia	-0.01	-0.03	0.00	0.00	0.02	0.02
Germany	0.17	0.18	0.03	0.03	0.02	0.02
Hong Kong SAR	0.17	0.14	0.03	0.02	0.00	0.00
Hungary	0.21	0.22	0.04	0.05	0.05	0.06
Indonesia	0.05	0.05	0.00	0.00	0.01	0.01
Iran, Islamic Rep. of	0.20	0.21	0.04	0.05	0.03	0.04
Ireland	0.17	0.17	0.03	0.03	0.02	0.02
Italy	0.04	0.03	0.00	0.00	0.00	0.00
Japan	0.03	0.03	0.00	0.00	0.00	0.00
Jordan	0.12	-	0.01	-	0.03	-
Kazakhstan	0.02	0.07	0.00	0.00	0.01	0.01
Korea, Rep. of	0.02	0.01	0.00	0.00	0.00	0.00
Kuwait	0.12	0.13	0.01	0.02	0.02	0.02
Lithuania	0.07	0.07	0.01	0.00	0.01	0.01
Morocco	0.06	0.10	0.00	0.01	0.01	0.01
Netherlands	0.11	0.15	0.01	0.02	0.00	0.01
New Zealand	0.26	0.26	0.07	0.07	0.06	0.06
Northern Ireland	0.15	0.13	0.02	0.02	0.01	0.01
Norway (5)	0.12	0.10	0.01	0.01	0.01	0.01
Oman	-0.06	-0.06	0.00	0.00	0.01	0.00
Poland	-0.03	-0.03	0.00	0.00	0.00	0.00
Portugal	0.07	0.06	0.00	0.00	0.01	0.00
Qatar	0.05	0.05	0.00	0.00	0.00	0.01
Russian Federation	0.09	0.10	0.01	0.01	0.00	0.00
Saudi Arabia	0.04	0.05	0.00	0.00	0.00	0.00
Serbia	-0.05	-0.08	0.00	0.01	0.00	0.00
Singapore	0.07	0.08	0.01	0.01	0.00	0.00
Slovak Republic	0.20	0.22	0.04	0.05	0.04	0.05
Slovenia	0.02	0.03	0.00	0.00	0.00	0.00
South Africa (5)	0.15	-	0.02	-	0.02	-
Spain	0.20	0.18	0.04	0.03	0.03	0.02
Sweden	0.21	0.24	0.04	0.06	0.05	0.07
Turkey	0.16	0.15	0.03	0.02	0.05	0.05
United Arab Emirates	0.28	0.28	0.08	0.08	0.06	0.06
United States	0.24	0.23	0.06	0.05	0.05	0.05
International Median	0.12	0.13	0.01	0.02	0.01	0.01
Benchmarking Participants						
Buenos Aires, Argentina	0.16	0.22	0.03	0.05	0.02	0.05
Ontario, Canada	0.12	0.11	0.01	0.01	0.02	0.01
Quebec, Canada	0.22	0.20	0.05	0.04	0.02	0.02
Norway (4)	0.06	0.05	0.00	0.00	0.02	0.02
Abu Dhabi, UAE	0.12	0.12	0.01	0.01	0.02	0.02
Dubai, UAE	0.36	0.37	0.13	0.14	0.10	0.11
Florida, US	0.20	0.18	0.04	0.03	0.05	0.04

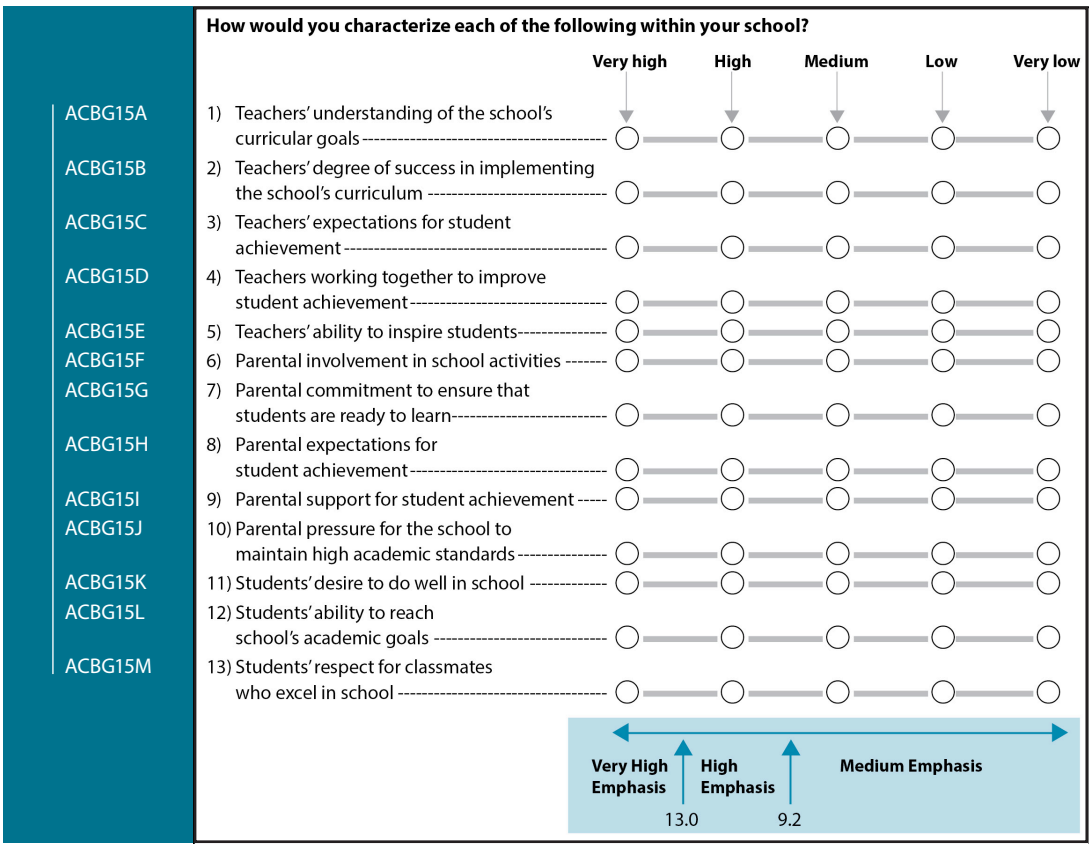
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

School Emphasis on Academic Success–Principals' Reports Scale, Fourth Grade

The School Emphasis on Academic Success–Principals' Reports (EAS) scale was created based on principals' responses characterizing the thirteen aspects described below.

Items in the TIMSS 2015 School Emphasis on Academic Success–Principals' Reports Scale, Fourth Grade[1]



1 For the purpose of scaling, categories in which there were very few respondents were combined. The categories "Low" and "Very low" were combined for all variables. The scale statistics that are reported herein reflect analysis of the items following collapsing.

Item Parameters for the TIMSS 2015 School Emphasis on Academic Success - Principals' Reports Scale, Fourth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
ACBG15A	-1.49153	-3.26339	0.01543	3.24796	1.11
ACBG15B	-1.14521	-3.76020	0.21124	3.54896	0.95
ACBG15C	-0.95253	-3.19800	-0.09325	3.29125	0.94
ACBG15D	-0.84577	-2.65178	-0.07563	2.72741	1.11
ACBG15E	-0.77543	-3.34641	0.10015	3.24626	0.95
ACBG15F	1.23139	-2.36291	0.07932	2.28359	1.08
ACBG15G	1.35745	-2.55669	0.11018	2.44651	0.82
ACBG15H	-0.12575	-2.38828	-0.21068	2.59896	1.05
ACBG15I	1.17337	-2.68711	0.13967	2.54744	0.86
ACBG15J	0.95539	-2.12628	-0.10531	2.23159	1.30
ACBG15K	0.25637	-3.18819	0.01950	3.16869	0.87
ACBG15L	0.45531	-3.64831	0.12426	3.52405	0.87
ACBG15M	-0.09306	-2.86040	-0.25037	3.11077	1.11

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 School Emphasis on Academic Success - Principals' Reports Scale, Fourth Grade

Scale Transformation Constants	
A = 9.225455	Transformed Scale Score = 9.225455 + 1.162825 • Logit Scale Score
B = 1.162825	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 School Emphasis on Academic Success - Principals' Reports Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	1.11861	
2	3.38565	
3	3.98611	
4	4.49199	
5	4.94072	
6	5.35139	
7	5.73260	
8	6.08989	
9	6.42657	
10	6.74506	
11	7.04762	
12	7.33657	
13	7.61508	
14	7.88540	
15	8.15003	
16	8.41127	
17	8.67110	
18	8.93106	
19	9.19207	9.2
20	9.45487	
21	9.71913	
22	9.98452	
23	10.25046	
24	10.51641	
25	10.78212	
26	11.04771	
27	11.31374	
28	11.58121	
29	11.85159	
30	12.12605	
31	12.40830	
32	12.70126	
33	13.00978	13.0
34	13.34166	
35	13.70576	
36	14.12459	
37	14.63845	
38	15.34805	
39	16.73753	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 School Emphasis on Academic Success - Principals' Reports Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item												
			ACBG15A	ACBG15B	ACBG15C	ACBG15D	ACBG15E	ACBG15F	ACBG15G	ACBG15H	ACBG15I	ACBG15J	ACBG15K	ACBG15L	ACBG15M
Australia	0.93	57	0.68	0.75	0.74	0.66	0.72	0.66	0.83	0.79	0.80	0.76	0.84	0.81	0.72
Bahrain	0.91	48	0.63	0.78	0.75	0.75	0.79	0.56	0.72	0.63	0.70	0.53	0.80	0.70	0.60
Belgium (Flemish)	0.80	32	0.07	0.34	0.58	0.29	0.39	0.66	0.79	0.64	0.72	0.59	0.65	0.72	0.48
Bulgaria	0.92	53	0.54	0.72	0.75	0.66	0.71	0.83	0.85	0.72	0.80	0.66	0.74	0.79	0.65
Canada	0.94	58	0.71	0.77	0.82	0.71	0.75	0.76	0.84	0.78	0.82	0.70	0.77	0.76	0.65
Chile	0.91	48	0.67	0.75	0.63	0.63	0.68	0.68	0.79	0.71	0.74	0.68	0.70	0.72	0.65
Chinese Taipei	0.92	53	0.73	0.82	0.74	0.64	0.76	0.75	0.67	0.67	0.80	0.67	0.76	0.81	0.63
Croatia	0.90	47	0.69	0.73	0.67	0.77	0.73	0.67	0.71	0.55	0.74	0.72	0.68	0.57	0.62
Cyprus	0.91	50	0.40	0.64	0.72	0.53	0.65	0.78	0.86	0.79	0.82	0.73	0.76	0.76	0.61
Czech Republic	0.84	35	0.41	0.48	0.51	0.52	0.67	0.63	0.67	0.64	0.61	0.69	0.66	0.64	0.52
Denmark	0.89	44	0.74	0.70	0.77	0.67	0.63	0.59	0.76	0.72	0.68	0.37	0.72	0.62	0.60
England	0.91	49	0.63	0.72	0.74	0.67	0.72	0.65	0.76	0.69	0.74	0.66	0.68	0.78	0.69
Finland	0.85	36	0.54	0.63	0.66	0.57	0.67	0.59	0.70	0.65	0.60	0.45	0.63	0.52	0.57
France	0.80	32	0.29	0.40	0.40	0.29	0.49	0.45	0.83	0.64	0.75	0.46	0.71	0.71	0.61
Georgia	0.90	47	0.60	0.66	0.72	0.68	0.72	0.75	0.73	0.58	0.75	0.67	0.72	0.67	0.64
Germany	0.80	32	0.23	0.39	0.61	0.30	0.41	0.64	0.80	0.63	0.78	0.51	0.54	0.71	0.40
Hong Kong SAR	0.92	53	0.66	0.77	0.65	0.60	0.75	0.66	0.81	0.79	0.83	0.69	0.76	0.82	0.60
Hungary	0.90	45	0.54	0.65	0.53	0.49	0.69	0.61	0.74	0.77	0.76	0.67	0.74	0.71	0.71
Indonesia	0.92	51	0.63	0.70	0.55	0.69	0.67	0.77	0.79	0.76	0.79	0.71	0.77	0.72	0.69
Iran, Islamic Rep. of	0.90	47	0.73	0.73	0.53	0.61	0.71	0.70	0.71	0.63	0.72	0.64	0.78	0.74	0.62
Ireland	0.90	48	0.50	0.69	0.67	0.51	0.67	0.67	0.81	0.82	0.80	0.64	0.75	0.73	0.63
Italy	0.85	37	0.56	0.65	0.65	0.57	0.73	0.71	0.66	0.51	0.60	0.57	0.69	0.62	0.27
Japan	0.89	43	0.57	0.57	0.60	0.49	0.62	0.70	0.81	0.82	0.75	0.60	0.68	0.70	0.50
Jordan	0.91	49	0.67	0.68	0.60	0.74	0.67	0.70	0.82	0.75	0.73	0.58	0.74	0.78	0.63
Kazakhstan	0.92	51	0.59	0.65	0.63	0.68	0.78	0.71	0.82	0.68	0.83	0.73	0.76	0.73	0.66
Korea, Rep. of	0.92	51	0.57	0.57	0.66	0.61	0.61	0.83	0.85	0.76	0.78	0.64	0.81	0.82	0.72
Kuwait	0.93	56	0.75	0.79	0.85	0.81	0.78	0.61	0.79	0.77	0.63	0.52	0.75	0.84	0.75
Lithuania	0.88	41	0.43	0.59	0.60	0.62	0.69	0.74	0.77	0.72	0.68	0.36	0.71	0.62	0.70
Morocco	0.90	45	0.62	0.67	0.62	0.72	0.62	0.67	0.75	0.72	0.73	0.66	0.67	0.71	0.51
Netherlands	0.81	32	0.45	0.59	0.58	0.20	0.56	0.49	0.61	0.64	0.71	0.63	0.64	0.52	0.58
New Zealand	0.92	52	0.59	0.68	0.68	0.53	0.67	0.75	0.80	0.83	0.80	0.75	0.76	0.73	0.72
Northern Ireland	0.87	39	0.27	0.42	0.51	0.48	0.48	0.68	0.74	0.77	0.76	0.68	0.68	0.75	0.66
Norway (5)	0.88	43	0.54	0.64	0.64	0.58	0.59	0.74	0.75	0.67	0.79	0.68	0.65	0.64	0.52
Oman	0.89	44	0.52	0.59	0.69	0.68	0.64	0.74	0.77	0.69	0.76	0.40	0.69	0.71	0.62
Poland	0.87	40	0.52	0.56	0.57	0.48	0.70	0.65	0.79	0.64	0.77	0.62	0.71	0.61	0.58
Portugal	0.89	45	0.55	0.70	0.73	0.57	0.68	0.68	0.81	0.77	0.80	0.55	0.68	0.62	0.52
Qatar	0.92	55	0.66	0.76	0.80	0.71	0.82	0.68	0.78	0.69	0.82	0.58	0.80	0.78	0.71
Russian Federation	0.82	36	0.57	0.63	0.60	0.53	0.62	0.75	0.67	0.38	0.77	0.00	0.71	0.65	0.51
Saudi Arabia	0.91	48	0.68	0.70	0.64	0.72	0.67	0.72	0.74	0.74	0.72	0.60	0.74	0.70	0.61
Serbia	0.87	41	0.64	0.65	0.54	0.68	0.76	0.69	0.77	0.28	0.73	0.47	0.69	0.67	0.53
Singapore	0.93	55	0.66	0.78	0.79	0.67	0.71	0.73	0.81	0.74	0.83	0.66	0.80	0.79	0.62
Slovak Republic	0.85	37	0.60	0.66	0.56	0.64	0.61	0.57	0.65	0.49	0.59	0.53	0.64	0.69	0.61
Slovenia	0.83	35	0.75	0.79	0.63	0.76	0.74	0.48	0.53	0.46	0.57	0.46	0.46	0.35	0.43
South Africa (5)	0.89	43	0.64	0.63	0.58	0.66	0.69	0.66	0.75	0.55	0.69	0.56	0.74	0.75	0.56
Spain	0.91	49	0.54	0.74	0.77	0.65	0.59	0.74	0.82	0.80	0.78	0.61	0.68	0.70	0.61
Sweden	0.90	46	0.60	0.65	0.76	0.57	0.68	0.64	0.74	0.74	0.72	0.66	0.74	0.71	0.51
Turkey	0.90	46	0.56	0.69	0.61	0.48	0.62	0.71	0.79	0.73	0.79	0.73	0.72	0.77	0.50
United Arab Emirates	0.93	54	0.73	0.75	0.77	0.75	0.74	0.71	0.79	0.68	0.77	0.62	0.75	0.79	0.71
United States	0.94	59	0.64	0.74	0.74	0.67	0.75	0.85	0.86	0.81	0.85	0.80	0.80	0.75	0.67
Benchmarking Participants															
Buenos Aires, Argentina	0.92	53	0.71	0.80	0.74	0.63	0.65	0.72	0.82	0.73	0.84	0.74	0.68	0.71	0.62
Ontario, Canada	0.92	52	0.60	0.68	0.80	0.60	0.66	0.76	0.82	0.78	0.85	0.70	0.75	0.77	0.54
Quebec, Canada	0.90	47	0.63	0.78	0.75	0.75	0.71	0.63	0.80	0.64	0.66	0.64	0.63	0.59	0.62
Norway (4)	0.88	43	0.60	0.66	0.69	0.57	0.61	0.72	0.74	0.66	0.76	0.69	0.65	0.64	0.46
Abu Dhabi, UAE	0.92	51	0.73	0.82	0.78	0.73	0.70	0.65	0.74	0.56	0.70	0.59	0.75	0.79	0.69
Dubai, UAE	0.94	60	0.75	0.73	0.82	0.76	0.78	0.79	0.80	0.77	0.82	0.65	0.84	0.83	0.76
Florida, US	0.90	47	0.47	0.64	0.46	0.36	0.51	0.81	0.87	0.82	0.83	0.72	0.79	0.78	0.59

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 School Emphasis on Academic Success - Principals' Reports Scale, Fourth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.30	0.28	0.09	0.08	0.06	0.06
Bahrain	0.15	0.16	0.02	0.03	0.02	0.02
Belgium (Flemish)	0.21	0.23	0.04	0.05	0.02	0.03
Bulgaria	0.26	0.32	0.07	0.10	0.06	0.10
Canada	0.22	0.12	0.05	0.02	0.04	0.01
Chile	0.25	0.23	0.06	0.06	0.03	0.02
Chinese Taipei	0.16	0.15	0.03	0.02	0.03	0.02
Croatia	0.05	0.04	0.00	0.00	0.00	0.00
Cyprus	0.13	0.13	0.02	0.02	0.02	0.02
Czech Republic	0.11	0.10	0.01	0.01	0.01	0.00
Denmark	0.09	0.10	0.01	0.01	0.00	0.00
England	0.20	0.23	0.04	0.05	0.03	0.04
Finland	0.06	0.04	0.00	0.00	0.00	0.00
France	0.19	0.19	0.04	0.04	0.01	0.01
Georgia	0.15	0.13	0.02	0.02	0.01	0.00
Germany	0.18	0.19	0.03	0.04	0.02	0.03
Hong Kong SAR	0.27	0.26	0.07	0.07	0.06	0.05
Hungary	0.32	0.33	0.10	0.11	0.06	0.06
Indonesia	0.09	0.11	0.01	0.01	0.02	0.02
Iran, Islamic Rep. of	0.11	0.11	0.01	0.01	0.01	0.01
Ireland	0.15	0.15	0.02	0.02	0.02	0.02
Italy	0.09	0.08	0.01	0.01	0.00	0.00
Japan	0.10	0.10	0.01	0.01	0.01	0.01
Jordan	0.23	-	0.05	-	0.02	-
Kazakhstan	0.14	0.12	0.02	0.01	0.00	0.00
Korea, Rep. of	0.14	0.13	0.02	0.02	0.02	0.01
Kuwait	0.19	0.20	0.04	0.04	0.04	0.04
Lithuania	0.20	0.17	0.04	0.03	0.02	0.01
Morocco	0.18	0.20	0.03	0.04	0.02	0.03
Netherlands	0.06	0.08	0.00	0.01	0.00	0.00
New Zealand	0.26	0.26	0.07	0.07	0.05	0.05
Northern Ireland	0.12	0.09	0.01	0.01	0.01	0.01
Norway (5)	0.15	0.14	0.02	0.02	0.01	0.01
Oman	-0.01	-0.01	0.00	0.00	0.00	0.00
Poland	0.12	0.11	0.01	0.01	0.01	0.01
Portugal	0.22	0.18	0.05	0.03	0.05	0.03
Qatar	0.20	0.21	0.04	0.05	0.03	0.04
Russian Federation	0.13	0.14	0.02	0.02	0.00	0.01
Saudi Arabia	0.12	0.14	0.02	0.02	0.01	0.01
Serbia	0.19	0.19	0.04	0.03	0.04	0.03
Singapore	0.22	0.23	0.05	0.05	0.04	0.05
Slovak Republic	0.23	0.23	0.05	0.05	0.04	0.04
Slovenia	0.02	0.02	0.00	0.00	0.00	0.00
South Africa (5)	0.17	-	0.03	-	0.00	-
Spain	0.27	0.27	0.07	0.07	0.06	0.06
Sweden	0.22	0.22	0.05	0.05	0.03	0.03
Turkey	0.35	0.33	0.13	0.11	0.07	0.07
United Arab Emirates	0.35	0.35	0.12	0.12	0.11	0.11
United States	0.28	0.29	0.08	0.08	0.08	0.08
International Median	0.18	0.16	0.03	0.03	0.02	0.02
Benchmarking Participants						
Buenos Aires, Argentina	0.28	0.30	0.08	0.09	0.06	0.08
Ontario, Canada	0.19	0.13	0.03	0.02	0.03	0.01
Quebec, Canada	0.12	0.07	0.01	0.01	0.01	0.00
Norway (4)	0.10	0.10	0.01	0.01	0.01	0.01
Abu Dhabi, UAE	0.34	0.34	0.11	0.12	0.09	0.09
Dubai, UAE	0.38	0.37	0.15	0.14	0.12	0.12
Florida, US	0.21	0.16	0.04	0.03	0.02	0.01

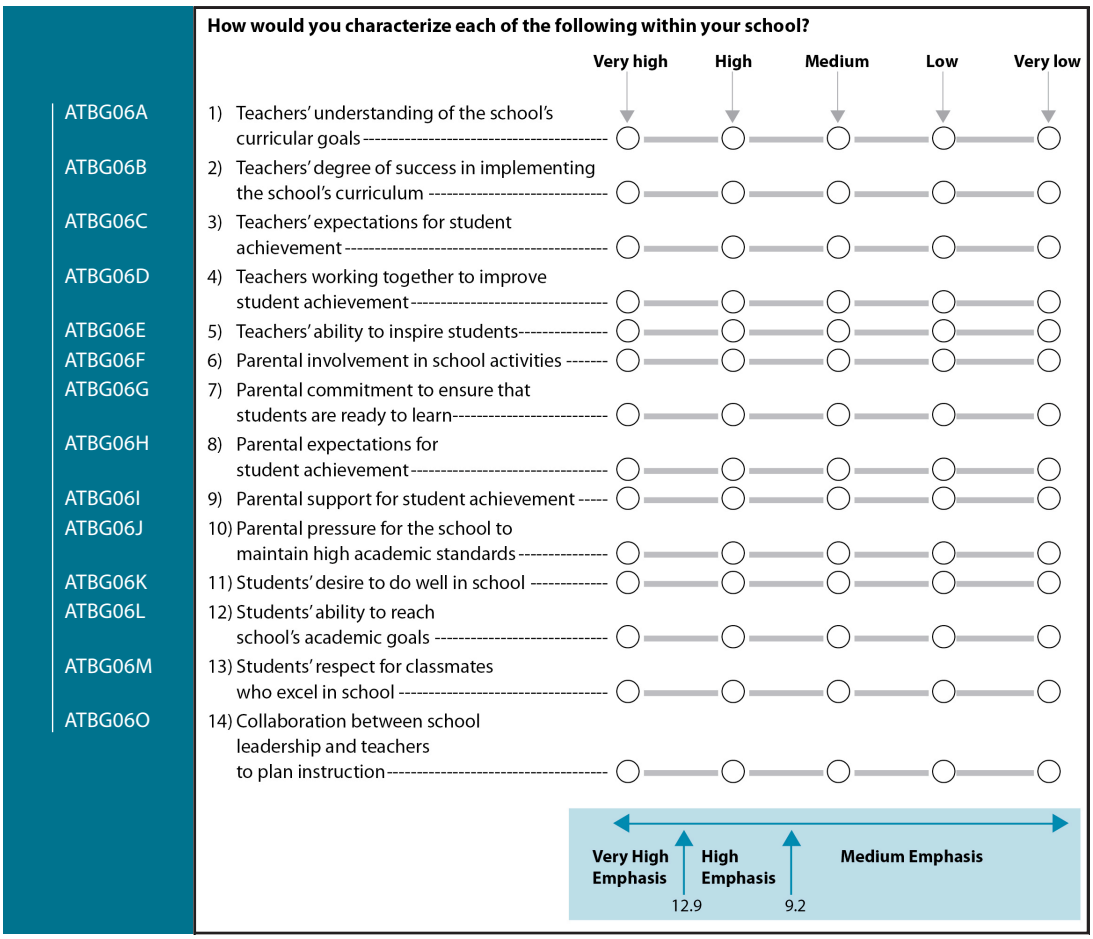
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

School Emphasis on Academic Success–Teachers' Reports Scale, Fourth Grade

The School Emphasis on Academic Success–Teachers' Reports (EAS) scale was created based on teachers' responses characterizing the fourteen aspects described below.

Items in the TIMSS 2015 School Emphasis on Academic Success–Teachers' Reports Scale, Fourth Grade[1]



1 For the purpose of scaling, categories in which there were very few respondents were combined. The categories "Low" and "Very low" were combined for all variables. The scale statistics that are reported herein reflect analysis of the items following collapsing.

Item Parameters for the TIMSS 2015 School Emphasis on Academic Success – Teachers' Reports Scale, Fourth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
ATBG06A	-1.44621	-2.99618	-0.10920	3.10538	1.03
ATBG06B	-1.02745	-3.33623	-0.02415	3.36038	0.92
ATBG06C	-0.80942	-3.00204	-0.03625	3.03829	0.97
ATBG06D	-0.82375	-2.16113	-0.18841	2.34954	1.12
ATBG06E	-1.03209	-3.02365	-0.12507	3.14872	0.94
ATBG06F	1.06140	-2.19239	0.10160	2.09079	0.99
ATBG06G	1.33471	-2.43171	0.10214	2.32957	0.84
ATBG06H	0.09125	-2.39276	-0.14839	2.54115	1.00
ATBG06I	1.18060	-2.53725	0.11920	2.41805	0.81
ATBG06J	0.99194	-2.19510	0.01274	2.18236	1.18
ATBG06K	0.18650	-2.93168	0.00378	2.92790	0.91
ATBG06L	0.72569	-3.47712	0.18892	3.28820	0.85
ATBG06M	-0.16081	-2.70547	-0.18329	2.88876	1.11
ATBG06O	-0.27236	-1.68993	-0.37720	2.06713	1.22

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 School Emphasis on Academic Success – Teachers' Reports Scale, Fourth Grade

Scale Transformation Constants	
A = 9.063358	Transformed Scale Score = 9.063358 + 1.313036 • Logit Scale Score
B = 1.313036	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 School Emphasis on Academic Success – Teachers' Reports Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	0.32674	
1	1.95328	
2	2.81824	
3	3.45663	
4	3.98402	
5	4.44252	
6	4.85355	
7	5.22828	
8	5.57462	
9	5.89827	
10	6.20320	
11	6.49407	
12	6.77317	
13	7.04306	
14	7.30603	
15	7.56425	
16	7.81962	
17	8.07381	
18	8.32820	
19	8.58380	
20	8.84122	
21	9.10064	9.2
22	9.36202	
23	9.62473	
24	9.88825	
25	10.15200	
26	10.41565	
27	10.67922	
28	10.94307	
29	11.20798	
30	11.47508	
31	11.74519	
32	12.02119	
33	12.30494	
34	12.59942	
35	12.90857	12.9
36	13.23796	
37	13.59643	
38	13.99453	
39	14.45744	
40	15.03090	
41	15.82855	
42	17.39737	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 School Emphasis on Academic Success – Teachers' Reports Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item													
			ATBG06A	ATBG06B	ATBG06C	ATBG06D	ATBG06E	ATBG06F	ATBG06G	ATBG06H	ATBG06I	ATBG06J	ATBG06K	ATBG06L	ATBG06M	ATBG06O
Australia	0.90	45	0.57	0.63	0.68	0.59	0.71	0.71	0.77	0.68	0.80	0.63	0.73	0.71	0.64	0.49
Bahrain	0.90	46	0.54	0.64	0.75	0.57	0.65	0.67	0.78	0.70	0.76	0.62	0.74	0.74	0.67	0.55
Belgium (Flemish)	0.85	35	0.37	0.52	0.60	0.49	0.58	0.67	0.75	0.69	0.75	0.62	0.66	0.55	0.48	0.44
Bulgaria	0.89	43	0.63	0.73	0.68	0.58	0.60	0.77	0.73	0.65	0.69	0.59	0.71	0.69	0.54	0.54
Canada	0.91	47	0.59	0.62	0.65	0.56	0.64	0.74	0.83	0.75	0.82	0.65	0.72	0.73	0.61	0.58
Chile	0.90	44	0.52	0.59	0.58	0.53	0.53	0.72	0.82	0.76	0.78	0.69	0.72	0.70	0.71	0.58
Chinese Taipei	0.90	43	0.64	0.57	0.63	0.65	0.72	0.65	0.72	0.66	0.71	0.47	0.71	0.73	0.61	0.66
Croatia	0.90	44	0.56	0.60	0.57	0.70	0.68	0.75	0.71	0.57	0.80	0.80	0.59	0.62	0.61	0.61
Cyprus	0.87	39	0.44	0.57	0.68	0.40	0.53	0.68	0.79	0.70	0.77	0.64	0.73	0.69	0.60	0.37
Czech Republic	0.88	40	0.60	0.64	0.68	0.71	0.64	0.65	0.72	0.62	0.67	0.54	0.71	0.65	0.51	0.50
Denmark	0.86	37	0.45	0.52	0.55	0.40	0.63	0.68	0.76	0.69	0.75	0.56	0.68	0.65	0.62	0.34
England	0.92	49	0.63	0.66	0.66	0.66	0.62	0.75	0.81	0.76	0.81	0.64	0.75	0.73	0.66	0.67
Finland	0.85	36	0.53	0.64	0.59	0.57	0.58	0.61	0.71	0.64	0.67	0.42	0.66	0.61	0.53	0.51
France	0.78	29	0.21	0.27	0.35	0.21	0.32	0.61	0.80	0.72	0.79	0.45	0.68	0.80	0.49	0.19
Georgia	0.90	45	0.63	0.62	0.64	0.66	0.63	0.72	0.75	0.75	0.73	0.68	0.60	0.61	0.69	0.68
Germany	0.85	36	0.59	0.63	0.64	0.45	0.56	0.75	0.79	0.57	0.75	0.47	0.47	0.66	0.39	0.50
Hong Kong SAR	0.90	44	0.61	0.69	0.70	0.58	0.67	0.66	0.75	0.74	0.72	0.56	0.68	0.77	0.47	0.57
Hungary	0.89	42	0.42	0.67	0.57	0.49	0.60	0.71	0.80	0.67	0.77	0.70	0.78	0.73	0.61	0.41
Indonesia	0.91	47	0.60	0.65	0.57	0.65	0.62	0.76	0.78	0.74	0.81	0.59	0.69	0.73	0.72	0.64
Iran, Islamic Rep. of	0.89	43	0.67	0.62	0.45	0.54	0.64	0.76	0.78	0.63	0.76	0.69	0.70	0.72	0.60	0.57
Ireland	0.91	47	0.58	0.70	0.76	0.57	0.70	0.66	0.80	0.71	0.80	0.60	0.78	0.69	0.59	0.62
Italy	0.88	41	0.63	0.69	0.61	0.53	0.72	0.66	0.73	0.59	0.73	0.57	0.63	0.71	0.48	0.64
Japan	0.87	39	0.45	0.54	0.69	0.49	0.59	0.64	0.79	0.74	0.81	0.53	0.59	0.72	0.45	0.54
Jordan	0.89	42	0.55	0.59	0.55	0.65	0.64	0.65	0.78	0.61	0.73	0.71	0.63	0.73	0.60	0.63
Kazakhstan	0.93	52	0.70	0.72	0.67	0.73	0.74	0.74	0.82	0.71	0.82	0.66	0.72	0.76	0.55	0.69
Korea, Rep. of	0.91	48	0.63	0.64	0.70	0.66	0.66	0.75	0.78	0.75	0.76	0.67	0.71	0.69	0.62	0.62
Kuwait	0.88	39	0.57	0.53	0.65	0.55	0.60	0.67	0.76	0.64	0.67	0.54	0.67	0.70	0.62	0.51
Lithuania	0.89	42	0.49	0.62	0.64	0.58	0.67	0.69	0.75	0.78	0.76	0.61	0.64	0.65	0.52	0.58
Morocco	0.91	47	0.61	0.63	0.60	0.68	0.60	0.76	0.80	0.69	0.78	0.71	0.71	0.73	0.55	0.66
Netherlands	0.77	28	0.08	0.25	0.19	0.25	0.49	0.65	0.75	0.66	0.78	0.60	0.59	0.66	0.48	0.38
New Zealand	0.89	42	0.57	0.63	0.60	0.55	0.61	0.60	0.75	0.72	0.74	0.66	0.73	0.72	0.57	0.53
Northern Ireland	0.90	45	0.58	0.60	0.65	0.61	0.60	0.75	0.83	0.76	0.83	0.65	0.69	0.72	0.39	0.57
Norway (5)	0.87	39	0.49	0.53	0.67	0.55	0.53	0.80	0.72	0.74	0.75	0.55	0.60	0.60	0.52	0.58
Oman	0.89	42	0.50	0.62	0.61	0.60	0.59	0.71	0.81	0.71	0.74	0.49	0.62	0.71	0.62	0.62
Poland	0.87	39	0.53	0.68	0.61	0.55	0.62	0.71	0.76	0.58	0.77	0.54	0.61	0.67	0.57	0.47
Portugal	0.87	41	0.62	0.72	0.62	0.44	0.53	0.74	0.81	0.72	0.79	0.55	0.65	0.59	0.49	0.49
Qatar	0.88	40	0.57	0.59	0.66	0.48	0.64	0.69	0.77	0.64	0.73	0.42	0.69	0.75	0.57	0.53
Russian Federation	0.82	34	0.58	0.59	0.63	0.66	0.71	0.65	0.67	0.52	0.57	-0.07	0.60	0.65	0.49	0.53
Saudi Arabia	0.92	50	0.65	0.67	0.70	0.70	0.71	0.71	0.76	0.74	0.80	0.65	0.77	0.77	0.59	0.61
Serbia	0.87	40	0.59	0.60	0.68	0.66	0.70	0.73	0.73	0.43	0.78	0.46	0.62	0.61	0.41	0.67
Singapore	0.90	45	0.56	0.56	0.60	0.58	0.62	0.68	0.80	0.73	0.80	0.68	0.76	0.77	0.56	0.58
Slovak Republic	0.88	40	0.54	0.64	0.62	0.58	0.61	0.72	0.76	0.47	0.73	0.57	0.74	0.66	0.62	0.51
Slovenia	0.81	31	0.57	0.66	0.63	0.64	0.69	0.62	0.64	0.29	0.62	0.15	0.54	0.54	0.33	0.60
South Africa (5)	0.89	42	0.49	0.41	0.51	0.60	0.58	0.69	0.78	0.68	0.76	0.73	0.74	0.73	0.71	0.57
Spain	0.90	43	0.47	0.71	0.71	0.56	0.55	0.73	0.81	0.71	0.80	0.70	0.69	0.68	0.43	0.50
Sweden	0.88	41	0.62	0.60	0.68	0.52	0.69	0.66	0.76	0.65	0.72	0.66	0.60	0.69	0.53	0.46
Turkey	0.90	45	0.60	0.70	0.62	0.51	0.57	0.77	0.79	0.71	0.78	0.66	0.71	0.79	0.49	0.58
United Arab Emirates	0.91	47	0.59	0.68	0.68	0.68	0.72	0.69	0.77	0.63	0.76	0.56	0.75	0.77	0.61	0.61
United States	0.91	48	0.54	0.65	0.65	0.55	0.66	0.77	0.82	0.81	0.82	0.72	0.75	0.71	0.63	0.55
Benchmarking Participants																
Buenos Aires, Argentina	0.90	43	0.60	0.62	0.64	0.72	0.55	0.63	0.73	0.73	0.69	0.64	0.64	0.72	0.53	0.67
Ontario, Canada	0.90	46	0.55	0.51	0.64	0.43	0.51	0.76	0.83	0.78	0.84	0.74	0.75	0.73	0.62	0.59
Quebec, Canada	0.88	42	0.74	0.71	0.62	0.69	0.73	0.66	0.80	0.65	0.72	0.43	0.60	0.65	0.42	0.54
Norway (4)	0.87	38	0.55	0.64	0.69	0.54	0.60	0.71	0.72	0.67	0.62	0.44	0.64	0.64	0.63	0.52
Abu Dhabi, UAE	0.90	45	0.53	0.69	0.63	0.68	0.78	0.74	0.79	0.57	0.76	0.49	0.74	0.77	0.49	0.60
Dubai, UAE	0.89	42	0.61	0.64	0.72	0.62	0.62	0.61	0.74	0.62	0.75	0.45	0.75	0.71	0.62	0.61
Florida, US	0.93	54	0.69	0.80	0.64	0.71	0.74	0.81	0.81	0.81	0.83	0.79	0.68	0.67	0.63	0.63

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 School Emphasis on Academic Success – Teachers' Reports Scale, Fourth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.24	0.22	0.06	0.05	0.05	0.04
Bahrain	0.11	0.02	0.01	0.00	0.02	0.03
Belgium (Flemish)	0.20	0.22	0.04	0.05	0.03	0.03
Bulgaria	0.23	0.28	0.05	0.08	0.04	0.06
Canada	0.14	0.06	0.02	0.00	0.03	0.01
Chile	0.24	0.25	0.06	0.06	0.03	0.03
Chinese Taipei	0.07	0.02	0.01	0.00	0.01	0.00
Croatia	0.02	0.02	0.00	0.00	0.00	0.00
Cyprus	0.15	0.16	0.02	0.03	0.02	0.02
Czech Republic	0.08	0.10	0.01	0.01	0.00	0.01
Denmark	0.15	0.16	0.02	0.02	0.01	0.01
England	0.20	0.21	0.04	0.04	0.05	0.04
Finland	0.05	0.06	0.00	0.00	0.00	0.01
France	0.20	0.18	0.04	0.03	0.04	0.03
Georgia	0.14	0.17	0.02	0.03	0.02	0.02
Germany	0.18	0.21	0.03	0.04	0.02	0.03
Hong Kong SAR	0.25	0.18	0.06	0.03	0.05	0.03
Hungary	0.25	0.26	0.06	0.07	0.05	0.05
Indonesia	0.14	0.14	0.02	0.02	0.02	0.02
Iran, Islamic Rep. of	0.15	0.14	0.02	0.02	0.03	0.03
Ireland	0.17	0.19	0.03	0.04	0.03	0.04
Italy	0.07	0.05	0.00	0.00	0.00	0.00
Japan	0.11	0.14	0.01	0.02	0.00	0.01
Jordan	0.21	-	0.04	-	0.02	-
Kazakhstan	0.09	0.08	0.01	0.01	0.01	0.00
Korea, Rep. of	0.22	0.17	0.05	0.03	0.03	0.02
Kuwait	0.17	0.12	0.03	0.01	0.03	0.01
Lithuania	0.12	0.12	0.02	0.01	0.03	0.02
Morocco	0.24	0.23	0.06	0.05	0.07	0.05
Netherlands	0.12	0.17	0.01	0.03	0.00	0.01
New Zealand	0.23	0.22	0.05	0.05	0.04	0.04
Northern Ireland	0.15	0.13	0.02	0.02	0.02	0.01
Norway (5)	0.15	0.13	0.02	0.02	0.03	0.02
Oman	0.08	0.06	0.01	0.00	0.01	0.00
Poland	0.13	0.12	0.02	0.01	0.02	0.01
Portugal	0.23	0.19	0.05	0.04	0.03	0.02
Qatar	0.12	0.18	0.01	0.03	0.02	0.02
Russian Federation	0.07	0.11	0.01	0.01	0.01	0.01
Saudi Arabia	0.21	0.16	0.04	0.03	0.03	0.01
Serbia	0.10	0.11	0.01	0.01	0.01	0.02
Singapore	0.26	0.28	0.07	0.08	0.06	0.07
Slovak Republic	0.20	0.22	0.04	0.05	0.03	0.03
Slovenia	0.01	0.02	0.00	0.00	0.00	0.00
South Africa (5)	0.05	-	0.00	-	0.00	-
Spain	0.25	0.25	0.06	0.06	0.06	0.06
Sweden	0.17	0.15	0.03	0.02	0.02	0.01
Turkey	0.28	0.26	0.08	0.07	0.06	0.05
United Arab Emirates	0.34	0.35	0.11	0.13	0.09	0.10
United States	0.23	0.24	0.05	0.06	0.04	0.05
International Median	0.15	0.16	0.02	0.03	0.03	0.02
Benchmarking Participants						
Buenos Aires, Argentina	0.18	0.20	0.03	0.04	0.03	0.04
Ontario, Canada	0.11	0.07	0.01	0.01	0.02	0.02
Quebec, Canada	0.03	0.02	0.00	0.00	0.00	0.00
Norway (4)	0.10	0.13	0.01	0.02	0.01	0.01
Abu Dhabi, UAE	0.37	0.37	0.13	0.14	0.09	0.08
Dubai, UAE	0.28	0.29	0.08	0.08	0.05	0.07
Florida, US	0.34	0.28	0.11	0.08	0.08	0.06

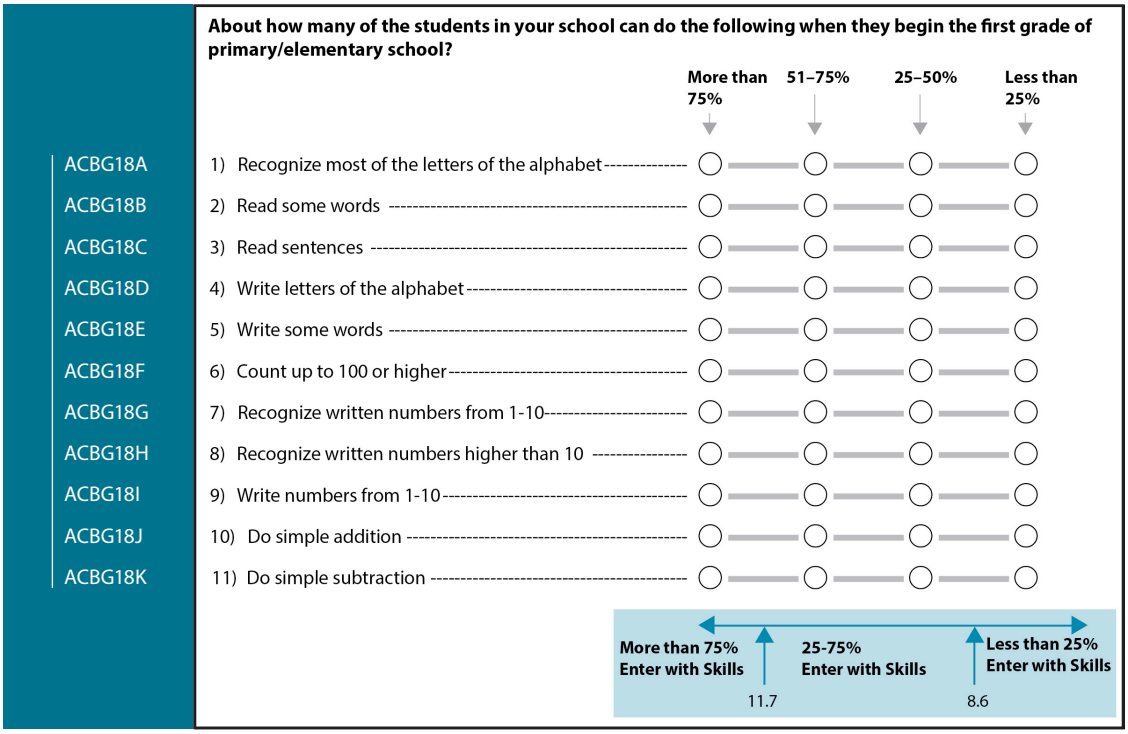
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Schools Where Students Enter the Primary Grades with Literacy and Numeracy Skills Scale, Fourth Grade

The Schools Where Students Enter the Primary Grades with Literacy and Numeracy Skills (LNS) scale was created based on principals' responses about the percentage of children in the school who began first grade with the eleven key skills described below.

Items in the TIMSS 2015 Schools Where Students Enter the Primary Grades with Literacy and Numeracy Skills Scale, Fourth Grade



Item Parameters for the TIMSS 2015 Schools Where Students Enter the Primary Grades with Literacy and Numeracy Skills Scale, Fourth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
ACBG18A	-0.95602	-1.74763	0.14297	1.60466	1.24
ACBG18B	0.12688	-1.85096	0.04000	1.81096	0.98
ACBG18C	1.51017	-1.41087	-0.14993	1.56080	0.99
ACBG18D	-0.71076	-2.06675	0.21261	1.85414	1.22
ACBG18E	0.44307	-1.83523	0.12227	1.71296	0.94
ACBG18F	0.94633	-2.15667	0.04262	2.11405	1.39
ACBG18G	-2.31455	-2.27679	0.44943	1.82736	1.18
ACBG18H	-0.10805	-2.00446	-0.00426	2.00872	1.13
ACBG18I	-1.08180	-1.80290	0.25691	1.54599	1.12
ACBG18J	0.76680	-1.99761	0.02009	1.97752	1.07
ACBG18K	1.37793	-1.79326	-0.02855	1.82181	1.14

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Schools Where Students Enter the Primary Grades with Literacy and Numeracy Skills Scale, Fourth Grade

Scale Transformation Constants	
A = 10.111117	Transformed Scale Score = 10.111117 + 0.64701 • Logit Scale Score
B = 0.64701	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Schools Where Students Enter the Primary Grades with Literacy and Numeracy Skills Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	6.26128	
1	7.18133	
2	7.67242	
3	8.01378	
4	8.28032	
5	8.50311	8.6
6	8.69803	
7	8.87309	
8	9.03362	
9	9.18319	
10	9.32436	
11	9.45882	
12	9.58860	
13	9.71450	
14	9.83751	
15	9.95849	
16	10.07824	
17	10.19745	
18	10.31684	
19	10.43711	
20	10.55900	
21	10.68334	
22	10.81104	
23	10.94315	
24	11.08052	
25	11.22538	
26	11.37954	
27	11.54578	
28	11.72807	11.7
29	11.93264	
30	12.16926	
31	12.46093	
32	12.86502	
33	13.64705	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Schools Where Students Enter the Primary Grades with Literacy and Numeracy Skills Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item										
			ACBG18A	ACBG18B	ACBG18C	ACBG18D	ACBG18E	ACBG18F	ACBG18G	ACBG18H	ACBG18I	ACBG18J	ACBG18K
Australia	0.97	78	0.85	0.91	0.87	0.91	0.91	0.88	0.86	0.89	0.91	0.88	0.85
Bahrain	0.97	76	0.84	0.92	0.86	0.89	0.90	0.86	0.80	0.88	0.85	0.89	0.86
Belgium (Flemish)	0.88	47	0.72	0.71	0.54	0.66	0.71	0.52	0.71	0.71	0.74	0.76	0.73
Bulgaria	0.95	66	0.82	0.86	0.77	0.84	0.85	0.64	0.77	0.83	0.81	0.85	0.84
Canada	0.96	69	0.79	0.88	0.83	0.83	0.88	0.83	0.79	0.84	0.82	0.84	0.81
Chile	0.95	66	0.73	0.86	0.82	0.85	0.88	0.84	0.76	0.83	0.78	0.77	0.77
Chinese Taipei	0.95	67	0.80	0.87	0.84	0.89	0.84	0.80	0.66	0.77	0.73	0.89	0.92
Croatia	0.92	55	0.71	0.82	0.71	0.78	0.81	0.67	0.72	0.71	0.76	0.77	0.72
Cyprus	0.92	57	0.77	0.84	0.60	0.79	0.77	0.64	0.74	0.79	0.75	0.81	0.78
Czech Republic	0.86	42	0.66	0.66	0.34	0.71	0.68	0.59	0.70	0.76	0.67	0.65	0.61
Denmark	0.92	55	0.72	0.78	0.75	0.52	0.75	0.74	0.78	0.82	0.75	0.76	0.78
England	0.97	78	0.90	0.93	0.88	0.91	0.93	0.73	0.88	0.87	0.90	0.87	0.86
Finland	0.92	55	0.68	0.74	0.61	0.72	0.74	0.68	0.73	0.81	0.78	0.85	0.82
France	0.88	46	0.59	0.70	0.57	0.67	0.71	0.62	0.66	0.72	0.67	0.77	0.74
Georgia	0.96	72	0.82	0.86	0.86	0.90	0.91	0.81	0.77	0.88	0.86	0.84	0.85
Germany	0.91	55	0.70	0.75	0.71	0.69	0.81	0.65	0.72	0.75	0.76	0.81	0.80
Hong Kong SAR	0.91	54	0.59	0.76	0.78	0.80	0.80	0.66	0.61	0.70	0.68	0.82	0.82
Hungary	0.84	40	0.55	0.47	0.32	0.60	0.62	0.66	0.72	0.76	0.70	0.71	0.67
Indonesia	0.96	71	0.79	0.88	0.87	0.86	0.91	0.76	0.78	0.84	0.84	0.87	0.87
Iran, Islamic Rep. of	0.95	69	0.75	0.85	0.84	0.89	0.85	0.79	0.77	0.88	0.82	0.86	0.84
Ireland	0.84	59	0.86	0.92	0.81	0.91	0.90	0.37	0.91	0.47	0.87	0.76	0.39
Italy	0.95	66	0.78	0.88	0.81	0.76	0.86	0.71	0.76	0.86	0.83	0.86	0.83
Japan	0.94	65	0.70	0.76	0.85	0.88	0.87	0.76	0.73	0.81	0.83	0.83	0.79
Jordan	0.97	77	0.86	0.91	0.85	0.88	0.90	0.84	0.84	0.88	0.87	0.90	0.90
Kazakhstan	0.94	64	0.74	0.83	0.79	0.84	0.83	0.73	0.72	0.76	0.81	0.87	0.88
Korea, Rep. of	0.95	69	0.86	0.69	0.87	0.90	0.83	0.80	0.82	0.86	0.88	0.81	0.82
Kuwait	0.97	79	0.90	0.94	0.90	0.91	0.92	0.86	0.81	0.90	0.84	0.90	0.89
Lithuania	0.94	62	0.75	0.81	0.77	0.76	0.80	0.71	0.71	0.78	0.78	0.87	0.86
Morocco	0.97	74	0.87	0.91	0.90	0.92	0.90	0.80	0.87	0.87	0.87	0.83	0.74
Netherlands	0.88	45	0.59	0.63	0.67	0.61	0.73	0.72	0.55	0.65	0.74	0.71	0.74
New Zealand	0.96	73	0.82	0.89	0.89	0.85	0.93	0.87	0.80	0.86	0.86	0.82	0.83
Northern Ireland	-	-	-	-	-	-	-	-	-	-	-	-	-
Norway (5)	0.95	65	0.84	0.82	0.77	0.78	0.83	0.77	0.78	0.85	0.84	0.81	0.79
Oman	0.96	74	0.82	0.92	0.85	0.85	0.89	0.86	0.78	0.90	0.82	0.88	0.87
Poland	0.95	66	0.79	0.84	0.81	0.89	0.88	0.66	0.79	0.78	0.83	0.85	0.82
Portugal	0.95	65	0.82	0.83	0.76	0.78	0.86	0.71	0.76	0.84	0.80	0.87	0.85
Qatar	0.98	82	0.85	0.92	0.87	0.92	0.94	0.91	0.86	0.93	0.91	0.92	0.90
Russian Federation	0.94	63	0.79	0.87	0.81	0.79	0.78	0.71	0.78	0.82	0.75	0.83	0.81
Saudi Arabia	0.96	70	0.77	0.85	0.82	0.88	0.89	0.83	0.74	0.85	0.80	0.88	0.87
Serbia	0.93	58	0.69	0.81	0.76	0.82	0.81	0.67	0.77	0.82	0.84	0.73	0.63
Singapore	0.95	69	0.82	0.84	0.83	0.83	0.80	0.74	0.84	0.84	0.85	0.85	0.86
Slovak Republic	0.91	54	0.78	0.78	0.66	0.77	0.69	0.68	0.73	0.77	0.74	0.78	0.73
Slovenia	0.92	55	0.81	0.83	0.50	0.81	0.78	0.60	0.76	0.80	0.77	0.75	0.72
South Africa (5)	0.96	73	0.80	0.88	0.81	0.85	0.90	0.83	0.83	0.86	0.87	0.89	0.89
Spain	0.94	65	0.84	0.87	0.85	0.86	0.87	0.59	0.80	0.72	0.84	0.85	0.77
Sweden	0.94	64	0.82	0.85	0.76	0.76	0.83	0.73	0.82	0.83	0.81	0.83	0.76
Turkey	0.93	60	0.81	0.85	0.78	0.80	0.85	0.65	0.72	0.79	0.71	0.75	0.75
United Arab Emirates	0.97	79	0.87	0.91	0.86	0.92	0.92	0.87	0.86	0.89	0.89	0.90	0.87
United States	0.98	81	0.89	0.92	0.89	0.91	0.93	0.90	0.89	0.90	0.90	0.88	0.86
Benchmarking Participants													
Buenos Aires, Argentina	0.97	75	0.87	0.89	0.82	0.84	0.88	0.88	0.81	0.91	0.85	0.87	0.88
Ontario, Canada	0.96	73	0.87	0.90	0.87	0.90	0.86	0.83	0.82	0.84	0.83	0.84	0.84
Quebec, Canada	0.93	58	0.62	0.77	0.73	0.69	0.86	0.79	0.70	0.84	0.76	0.81	0.77
Norway (4)	0.94	63	0.79	0.80	0.75	0.76	0.81	0.75	0.79	0.83	0.84	0.80	0.78
Abu Dhabi, UAE	0.97	77	0.86	0.90	0.85	0.89	0.89	0.87	0.86	0.90	0.88	0.88	0.85
Dubai, UAE	0.98	85	0.92	0.94	0.87	0.96	0.95	0.87	0.93	0.92	0.94	0.93	0.89
Florida, US	0.97	77	0.89	0.93	0.92	0.90	0.87	0.84	0.87	0.89	0.84	0.86	0.82

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Schools Where Students Enter the Primary Grades with Literacy and Numeracy Skills Scale, Fourth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.20	0.18	0.04	0.03	0.05	0.05
Bahrain	0.08	0.04	0.01	0.00	0.00	0.00
Belgium (Flemish)	0.05	0.07	0.00	0.01	0.00	0.00
Bulgaria	0.19	0.27	0.04	0.07	0.03	0.06
Canada	0.11	0.12	0.01	0.02	0.02	0.02
Chile	0.23	0.21	0.05	0.04	0.03	0.02
Chinese Taipei	0.08	0.05	0.01	0.00	0.02	0.01
Croatia	0.11	0.13	0.01	0.02	0.01	0.01
Cyprus	0.10	0.11	0.01	0.01	0.00	0.00
Czech Republic	0.08	0.07	0.01	0.00	0.00	0.00
Denmark	0.05	0.05	0.00	0.00	0.00	0.01
England	0.16	0.20	0.03	0.04	0.03	0.04
Finland	0.12	0.12	0.01	0.01	0.01	0.02
France	0.13	0.13	0.02	0.02	0.00	0.00
Georgia	0.02	0.01	0.00	0.00	0.00	0.00
Germany	0.10	0.12	0.01	0.01	0.01	0.01
Hong Kong SAR	0.14	0.11	0.02	0.01	0.02	0.02
Hungary	0.22	0.23	0.05	0.05	0.03	0.03
Indonesia	0.25	0.27	0.06	0.08	0.05	0.05
Iran, Islamic Rep. of	0.09	0.06	0.01	0.00	0.01	0.01
Ireland	0.07	0.06	0.01	0.00	0.00	0.00
Italy	0.07	0.05	0.01	0.00	0.00	0.00
Japan	0.06	0.04	0.00	0.00	0.01	0.01
Jordan	0.17	-	0.03	-	0.02	-
Kazakhstan	0.01	0.01	0.00	0.00	0.00	0.00
Korea, Rep. of	0.21	0.19	0.05	0.04	0.03	0.02
Kuwait	0.23	0.21	0.06	0.04	0.06	0.05
Lithuania	0.11	0.10	0.01	0.01	0.01	0.01
Morocco	0.19	0.19	0.03	0.04	0.03	0.03
Netherlands	0.05	0.08	0.00	0.01	0.00	0.01
New Zealand	0.23	0.24	0.05	0.06	0.04	0.04
Northern Ireland	-	-	-	-	-	-
Norway (5)	0.08	0.08	0.01	0.01	0.01	0.01
Oman	0.01	0.01	0.00	0.00	0.00	0.00
Poland	0.04	0.03	0.00	0.00	0.00	0.00
Portugal	0.16	0.14	0.03	0.02	0.01	0.01
Qatar	0.13	0.12	0.02	0.01	0.02	0.02
Russian Federation	0.20	0.24	0.04	0.06	0.02	0.03
Saudi Arabia	0.15	0.19	0.02	0.04	0.03	0.05
Serbia	0.16	0.18	0.03	0.03	0.03	0.04
Singapore	0.14	0.15	0.02	0.02	0.02	0.03
Slovak Republic	0.21	0.23	0.05	0.05	0.03	0.04
Slovenia	-0.01	-0.01	0.00	0.00	0.00	0.00
South Africa (5)	0.07	-	0.00	-	0.03	-
Spain	0.18	0.18	0.03	0.03	0.04	0.04
Sweden	0.15	0.15	0.02	0.02	0.01	0.01
Turkey	0.01	0.02	0.00	0.00	0.02	0.01
United Arab Emirates	0.19	0.22	0.04	0.05	0.04	0.05
United States	0.20	0.22	0.04	0.05	0.03	0.04
International Median	0.12	0.12	0.02	0.02	0.02	0.01
Benchmarking Participants						
Buenos Aires, Argentina	0.25	0.25	0.06	0.06	0.07	0.08
Ontario, Canada	0.13	0.13	0.02	0.02	0.02	0.02
Quebec, Canada	0.10	0.08	0.01	0.01	0.01	0.01
Norway (4)	-0.02	0.01	0.00	0.00	0.00	0.00
Abu Dhabi, UAE	0.28	0.27	0.08	0.07	0.07	0.06
Dubai, UAE	0.12	0.18	0.01	0.03	0.02	0.04
Florida, US	0.20	0.18	0.04	0.03	0.03	0.02

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

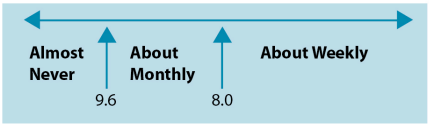
Student Bullying Scale, Fourth Grade

The Student Bullying (SB) scale was created based on students' responses to how often they experienced the eight bullying behaviors described below.

Items in the TIMSS 2015 Student Bullying Scale, Fourth Grade

During this school year, how often have other students from your school done any of the following things to you (including through texting or the Internet)?

		Never	A few times a year	Once or twice a month	At least once a week
ASBG12A	1) Made fun of me or called me names	○	○	○	○
ASBG12B	2) Left me out of their games or activities	○	○	○	○
ASBG12C	3) Spread lies about me	○	○	○	○
ASBG12D	4) Stole something from me	○	○	○	○
ASBG12E	5) Hit or hurt me (*e.g., shoving, hitting, kicking*)	○	○	○	○
ASBG12F	6) Made me do things I didn't want to do	○	○	○	○
ASBG12G	7) Shared embarrassing information about me	○	○	○	○
ASBG12H	8) Threatened me	○	○	○	○



Item Parameters for the TIMSS 2015 Student Bullying Scale, Fourth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
ASBG12A	0.46618	0.24420	-0.31625	0.07205	1.09
ASBG12B	0.28450	0.07329	-0.01726	-0.05603	1.19
ASBG12C	0.16218	0.09498	-0.07059	-0.02439	0.96
ASBG12D	-0.27878	0.38164	-0.13690	-0.24474	1.12
ASBG12E	0.15176	0.07103	-0.16425	0.09322	1.01
ASBG12F	-0.31617	0.31731	0.10905	-0.42636	0.97
ASBG12G	-0.16420	0.27826	-0.07753	-0.20073	0.94
ASBG12H	-0.30547	0.43020	0.06771	-0.49791	0.94

Scale Transformation Constants for the TIMSS 2015 Student Bullying Scale, Fourth Grade

Scale Transformation Constants	
A = 7.986312	Transformed Scale Score = 7.986312 + 1.843301 • Logit Scale Score
B = 1.843301	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Student Bullying Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.45583	
1	4.98767	
2	5.62711	
3	6.04410	
4	6.36087	
5	6.61949	
6	6.85019	
7	7.05738	
8	7.24822	
9	7.42814	
10	7.60130	
11	7.77094	
12	7.93577	8.0
13	8.10996	
14	8.28412	
15	8.46483	
16	8.65532	
17	8.85956	
18	9.08276	
19	9.32730	
20	9.61409	9.6
21	9.96469	
22	10.42778	
23	11.14791	
24	12.87429	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Student Bullying Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item							
			ASBG12A	ASBG12B	ASBG12C	ASBG12D	ASBG12E	ASBG12F	ASBG12G	ASBG12H
Australia	0.87	52	0.74	0.68	0.78	0.63	0.73	0.71	0.76	0.73
Bahrain	0.85	48	0.63	0.61	0.71	0.66	0.74	0.72	0.72	0.74
Belgium (Flemish)	0.86	50	0.76	0.71	0.74	0.50	0.73	0.63	0.80	0.74
Bulgaria	0.83	47	0.70	0.50	0.73	0.59	0.75	0.70	0.76	0.72
Canada	0.87	52	0.73	0.68	0.77	0.65	0.73	0.71	0.74	0.74
Chile	0.86	52	0.70	0.67	0.77	0.64	0.76	0.71	0.76	0.75
Chinese Taipei	0.84	47	0.71	0.66	0.74	0.53	0.67	0.68	0.75	0.71
Croatia	0.84	49	0.64	0.68	0.75	0.56	0.71	0.70	0.78	0.72
Cyprus	0.85	48	0.71	0.63	0.74	0.62	0.73	0.71	0.68	0.71
Czech Republic	0.84	47	0.75	0.60	0.76	0.55	0.67	0.69	0.75	0.70
Denmark	0.84	48	0.73	0.65	0.76	0.50	0.72	0.69	0.73	0.74
England	0.86	50	0.72	0.67	0.77	0.60	0.74	0.70	0.74	0.70
Finland	0.87	52	0.74	0.69	0.79	0.61	0.70	0.68	0.78	0.76
France	0.81	43	0.65	0.63	0.73	0.52	0.68	0.61	0.71	0.68
Georgia	0.81	48	0.57	0.53	0.74	0.70	0.67	0.76	0.77	0.76
Germany	0.84	48	0.69	0.66	0.75	0.59	0.71	0.72	0.72	0.70
Hong Kong SAR	0.83	47	0.58	0.65	0.74	0.59	0.67	0.74	0.73	0.75
Hungary	0.81	44	0.67	0.61	0.73	0.51	0.72	0.66	0.66	0.69
Indonesia	0.83	47	0.61	0.49	0.72	0.69	0.71	0.72	0.77	0.75
Iran, Islamic Rep. of	0.79	42	0.60	0.50	0.70	0.57	0.68	0.70	0.69	0.71
Ireland	0.85	49	0.72	0.69	0.77	0.59	0.70	0.69	0.73	0.71
Italy	0.80	42	0.68	0.60	0.69	0.55	0.65	0.63	0.68	0.68
Japan	0.84	49	0.73	0.72	0.71	0.62	0.71	0.74	0.68	0.65
Jordan	0.86	52	0.66	0.63	0.71	0.69	0.74	0.76	0.78	0.77
Kazakhstan	0.82	47	0.66	0.59	0.73	0.66	0.71	0.72	0.72	0.68
Korea, Rep. of	0.81	44	0.68	0.65	0.71	0.51	0.71	0.70	0.69	0.66
Kuwait	0.82	44	0.61	0.58	0.68	0.61	0.71	0.70	0.70	0.72
Lithuania	0.83	46	0.69	0.62	0.74	0.60	0.71	0.68	0.70	0.66
Morocco	0.80	43	0.59	0.60	0.65	0.61	0.68	0.69	0.70	0.70
Netherlands	0.83	46	0.73	0.64	0.73	0.57	0.74	0.69	0.69	0.64
New Zealand	0.87	51	0.72	0.66	0.77	0.65	0.74	0.73	0.74	0.73
Northern Ireland	0.85	49	0.71	0.66	0.77	0.61	0.71	0.69	0.72	0.71
Norway (5)	0.86	50	0.71	0.66	0.77	0.58	0.71	0.72	0.79	0.71
Oman	0.81	44	0.63	0.55	0.70	0.66	0.67	0.68	0.70	0.67
Poland	0.86	51	0.70	0.66	0.77	0.62	0.74	0.70	0.81	0.72
Portugal	0.83	47	0.71	0.65	0.75	0.55	0.74	0.64	0.69	0.71
Qatar	0.87	52	0.64	0.66	0.75	0.69	0.74	0.74	0.77	0.75
Russian Federation	0.82	45	0.72	0.48	0.73	0.53	0.75	0.63	0.78	0.68
Saudi Arabia	0.87	53	0.68	0.61	0.75	0.69	0.76	0.76	0.78	0.77
Serbia	0.84	48	0.68	0.67	0.78	0.56	0.70	0.63	0.79	0.68
Singapore	0.85	48	0.64	0.66	0.77	0.61	0.69	0.71	0.75	0.73
Slovak Republic	0.85	49	0.70	0.63	0.74	0.60	0.73	0.69	0.76	0.72
Slovenia	0.85	49	0.71	0.67	0.76	0.59	0.69	0.70	0.78	0.72
South Africa (5)	0.80	42	0.59	0.62	0.68	0.58	0.66	0.69	0.71	0.66
Spain	0.83	46	0.65	0.64	0.71	0.58	0.71	0.70	0.67	0.74
Sweden	0.82	45	0.72	0.62	0.74	0.55	0.71	0.67	0.67	0.68
Turkey	0.80	43	0.59	0.65	0.69	0.57	0.66	0.64	0.71	0.70
United Arab Emirates	0.84	48	0.65	0.63	0.72	0.66	0.72	0.71	0.71	0.72
United States	0.86	50	0.74	0.69	0.77	0.64	0.70	0.66	0.73	0.72
Benchmarking Participants										
Buenos Aires, Argentina	0.86	50	0.68	0.69	0.74	0.63	0.74	0.70	0.74	0.72
Ontario, Canada	0.86	51	0.72	0.70	0.78	0.63	0.73	0.70	0.73	0.73
Quebec, Canada	0.86	50	0.75	0.65	0.74	0.62	0.71	0.69	0.74	0.75
Norway (4)	0.85	50	0.71	0.65	0.76	0.61	0.70	0.75	0.76	0.70
Abu Dhabi, UAE	0.85	48	0.65	0.63	0.70	0.68	0.72	0.72	0.71	0.73
Dubai, UAE	0.85	48	0.68	0.65	0.73	0.65	0.72	0.70	0.71	0.70
Florida, US	0.86	51	0.72	0.68	0.77	0.66	0.71	0.67	0.76	0.72

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Student Bullying Scale, Fourth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.16	0.13	0.03	0.02	0.03	0.02
Bahrain	0.16	0.17	0.03	0.03	0.03	0.03
Belgium (Flemish)	0.04	0.05	0.00	0.00	0.01	0.01
Bulgaria	0.19	0.20	0.03	0.04	0.04	0.04
Canada	0.12	0.13	0.01	0.02	0.03	0.03
Chile	0.16	0.16	0.02	0.02	0.04	0.04
Chinese Taipei	0.07	0.06	0.00	0.00	0.01	0.01
Croatia	0.09	0.07	0.01	0.00	0.01	0.01
Cyprus	0.13	0.15	0.02	0.02	0.03	0.03
Czech Republic	0.11	0.09	0.01	0.01	0.02	0.01
Denmark	0.09	0.06	0.01	0.00	0.02	0.01
England	0.08	0.09	0.01	0.01	0.02	0.02
Finland	0.08	0.07	0.01	0.01	0.02	0.01
France	0.06	0.08	0.00	0.01	0.01	0.01
Georgia	0.19	0.16	0.04	0.03	0.05	0.03
Germany	0.09	0.13	0.01	0.02	0.02	0.03
Hong Kong SAR	0.08	0.06	0.01	0.00	0.01	0.00
Hungary	0.15	0.18	0.02	0.03	0.03	0.04
Indonesia	0.03	0.02	0.00	0.00	0.01	0.00
Iran, Islamic Rep. of	0.04	0.06	0.00	0.00	0.00	0.01
Ireland	0.15	0.12	0.02	0.01	0.04	0.03
Italy	0.07	0.05	0.00	0.00	0.01	0.01
Japan	0.09	0.06	0.01	0.00	0.02	0.01
Jordan	0.23	-	0.06	-	0.07	-
Kazakhstan	0.10	0.08	0.01	0.01	0.01	0.01
Korea, Rep. of	-0.02	-0.06	0.00	0.00	0.00	0.00
Kuwait	0.05	0.07	0.00	0.01	0.01	0.01
Lithuania	0.17	0.20	0.03	0.04	0.05	0.06
Morocco	0.16	0.14	0.03	0.02	0.03	0.03
Netherlands	0.05	0.10	0.00	0.01	0.01	0.02
New Zealand	0.13	0.12	0.02	0.01	0.03	0.02
Northern Ireland	0.12	0.06	0.01	0.00	0.03	0.01
Norway (5)	0.08	0.06	0.01	0.00	0.02	0.01
Oman	0.11	0.12	0.01	0.01	0.01	0.02
Poland	0.11	0.10	0.01	0.01	0.02	0.02
Portugal	0.07	0.05	0.00	0.00	0.01	0.01
Qatar	0.17	0.19	0.03	0.04	0.05	0.06
Russian Federation	0.12	0.09	0.01	0.01	0.02	0.01
Saudi Arabia	0.23	0.25	0.05	0.06	0.05	0.06
Serbia	0.05	0.06	0.00	0.00	0.01	0.02
Singapore	0.17	0.16	0.03	0.03	0.04	0.04
Slovak Republic	0.12	0.13	0.02	0.02	0.02	0.02
Slovenia	0.08	0.09	0.01	0.01	0.02	0.02
South Africa (5)	0.26	-	0.07	-	0.08	-
Spain	0.10	0.10	0.01	0.01	0.01	0.01
Sweden	0.11	0.12	0.01	0.01	0.03	0.03
Turkey	0.22	0.22	0.05	0.05	0.07	0.06
United Arab Emirates	0.16	0.19	0.02	0.04	0.04	0.05
United States	0.12	0.12	0.01	0.01	0.03	0.03
International Median	0.11	0.10	0.01	0.01	0.02	0.02
Benchmarking Participants						
Buenos Aires, Argentina	0.10	0.06	0.01	0.00	0.03	0.01
Ontario, Canada	0.12	0.13	0.01	0.02	0.02	0.02
Quebec, Canada	0.07	0.10	0.01	0.01	0.02	0.03
Norway (4)	0.10	0.11	0.01	0.01	0.02	0.02
Abu Dhabi, UAE	0.15	0.19	0.02	0.04	0.04	0.06
Dubai, UAE	0.12	0.15	0.01	0.02	0.03	0.04
Florida, US	0.14	0.17	0.02	0.03	0.04	0.04

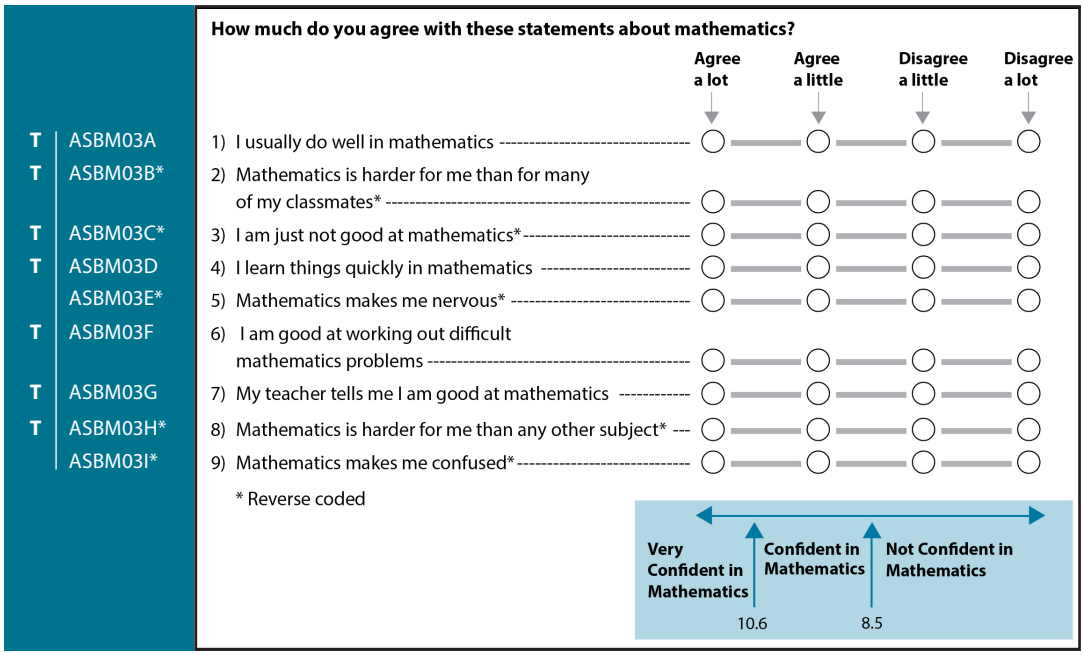
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students Confident in Mathematics Scale, Fourth Grade

The Students Confident in Mathematics (SCM) scale was created based on students' degree of agreement with the nine statements described below.

Items in the TIMSS 2015 Students Confident in Mathematics Scale, Fourth Grade



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Students Confident in Mathematics Scale, Fourth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
ASBM03A	-0.54541	-0.55281	-0.58064	1.13345	0.92
ASBM03B*	0.28031	-0.54709	0.20931	0.33778	1.03
ASBM03C*	0.03294	-0.35764	0.16685	0.19079	0.94
ASBM03D	-0.29218	-0.62562	-0.32950	0.95512	0.98
ASBM03E*	0.11800	-0.33518	0.20115	0.13403	1.14
ASBM03F	0.23717	-0.75825	-0.29418	1.05243	1.08
ASBM03G	-0.08982	-0.68948	-0.31756	1.00704	1.18
ASBM03H*	0.17797	-0.19045	0.15607	0.03438	0.92
ASBM03I*	0.08102	-0.31116	0.17313	0.13803	0.96

*Reverse coded

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Students Confident in Mathematics Scale, Fourth Grade

Scale Transformation Constants	
A = 8.5562	Transformed Scale Score = 8.5562 + 1.599041 • Logit Scale Score
B = 1.599041	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students Confident in Mathematics Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.07742	
1	4.72829	
2	5.49394	
3	6.01123	
4	6.41043	
5	6.74273	
6	7.03006	
7	7.28571	
8	7.51692	
9	7.73253	
10	7.93452	
11	8.12606	
12	8.30992	
13	8.48862	8.5
14	8.66452	
15	8.83997	
16	9.01741	
17	9.19961	
18	9.38976	
19	9.59180	
20	9.81049	
21	10.04927	
22	10.32220	
23	10.64456	10.6
24	11.04413	
25	11.57999	
26	12.39959	
27	14.17323	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students Confident in Mathematics Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item								
			ASBM03A	ASBM03B*	ASBM03C*	ASBM03D	ASBM03E*	ASBM03F	ASBM03G	ASBM03H*	ASBM03I*
Australia	0.87	50	0.74	0.71	0.78	0.71	0.65	0.74	0.42	0.78	0.74
Bahrain	0.76	35	0.18	0.72	0.74	0.38	0.73	0.34	0.33	0.79	0.74
Belgium (Flemish)	0.88	52	0.81	0.76	0.82	0.70	0.50	0.71	0.60	0.80	0.72
Bulgaria	0.87	49	0.73	0.70	0.73	0.71	0.62	0.70	0.66	0.74	0.73
Canada	0.86	48	0.73	0.75	0.77	0.70	0.63	0.69	0.38	0.78	0.74
Chile	0.82	41	0.65	0.60	0.70	0.64	0.64	0.61	0.44	0.72	0.75
Chinese Taipei	0.86	48	0.74	0.68	0.65	0.74	0.57	0.70	0.62	0.75	0.76
Croatia	0.89	53	0.75	0.73	0.71	0.76	0.69	0.70	0.67	0.77	0.78
Cyprus	0.86	47	0.71	0.68	0.71	0.68	0.61	0.70	0.59	0.73	0.74
Czech Republic	0.88	51	0.74	0.74	0.80	0.75	0.64	0.59	0.61	0.78	0.73
Denmark	0.87	50	0.78	0.75	0.80	0.74	0.58	0.63	0.54	0.75	0.74
England	0.87	49	0.73	0.70	0.78	0.71	0.64	0.72	0.36	0.79	0.76
Finland	0.86	49	0.78	0.73	0.81	0.74	0.64	0.70	0.52	0.77	0.53
France	0.87	50	0.75	0.72	0.77	0.74	0.64	0.61	0.54	0.76	0.77
Georgia	0.76	35	0.38	0.71	0.73	0.44	0.65	0.32	0.39	0.75	0.70
Germany	0.89	53	0.76	0.76	0.80	0.74	0.66	0.70	0.63	0.77	0.73
Hong Kong SAR	0.86	48	0.72	0.68	0.81	0.71	0.56	0.71	0.60	0.77	0.63
Hungary	0.88	52	0.78	0.72	0.78	0.76	0.56	0.74	0.72	0.74	0.68
Indonesia	0.75	34	0.37	0.70	0.73	0.41	0.70	0.16	0.32	0.75	0.76
Iran, Islamic Rep. of	0.76	34	0.50	0.56	0.50	0.52	0.68	0.52	0.49	0.72	0.72
Ireland	0.85	48	0.73	0.75	0.77	0.70	0.63	0.69	0.29	0.78	0.74
Italy	0.85	45	0.69	0.70	0.64	0.71	0.66	0.59	0.60	0.75	0.71
Japan	0.88	50	0.71	0.67	0.83	0.72	0.66	0.77	0.46	0.75	0.75
Jordan	0.75	35	0.09	0.73	0.76	0.26	0.78	0.17	0.25	0.80	0.77
Kazakhstan	0.85	45	0.68	0.69	0.72	0.66	0.62	0.66	0.65	0.72	0.64
Korea, Rep. of	0.88	53	0.82	0.78	0.78	0.73	0.43	0.79	0.56	0.80	0.76
Kuwait	0.75	33	0.22	0.68	0.70	0.40	0.71	0.36	0.39	0.75	0.70
Lithuania	0.84	45	0.75	0.70	0.75	0.66	0.48	0.69	0.62	0.72	0.59
Morocco	0.74	32	0.39	0.66	0.71	0.35	0.71	0.27	0.32	0.72	0.70
Netherlands	0.89	54	0.80	0.77	0.82	0.74	0.46	0.77	0.53	0.80	0.82
New Zealand	0.83	42	0.70	0.66	0.74	0.66	0.54	0.67	0.42	0.72	0.67
Northern Ireland	0.87	49	0.77	0.74	0.79	0.70	0.66	0.71	0.31	0.76	0.76
Norway (5)	0.87	49	0.76	0.72	0.75	0.75	0.57	0.75	0.50	0.76	0.70
Oman	0.69	30	0.07	0.73	0.62	0.21	0.74	0.08	0.15	0.78	0.76
Poland	0.88	52	0.75	0.74	0.73	0.76	0.60	0.74	0.65	0.79	0.74
Portugal	0.86	49	0.72	0.64	0.77	0.67	0.65	0.72	0.66	0.69	0.75
Qatar	0.80	38	0.34	0.75	0.76	0.43	0.72	0.40	0.39	0.79	0.73
Russian Federation	0.89	54	0.75	0.75	0.78	0.77	0.69	0.71	0.62	0.76	0.76
Saudi Arabia	0.75	35	0.04	0.74	0.74	0.24	0.79	0.18	0.24	0.81	0.77
Serbia	0.88	51	0.71	0.72	0.75	0.68	0.68	0.68	0.66	0.76	0.75
Singapore	0.87	49	0.77	0.73	0.76	0.69	0.61	0.69	0.52	0.78	0.75
Slovak Republic	0.87	48	0.72	0.68	0.75	0.70	0.67	0.67	0.58	0.74	0.74
Slovenia	0.88	52	0.76	0.70	0.72	0.69	0.66	0.74	0.66	0.78	0.75
South Africa (5)	0.69	29	0.12	0.72	0.73	0.11	0.68	0.05	0.06	0.76	0.71
Spain	0.85	45	0.68	0.71	0.74	0.61	0.65	0.61	0.58	0.73	0.73
Sweden	0.87	49	0.75	0.73	0.74	0.74	0.60	0.71	0.47	0.79	0.72
Turkey	0.82	42	0.63	0.70	0.74	0.55	0.61	0.58	0.59	0.70	0.70
United Arab Emirates	0.79	37	0.46	0.67	0.71	0.51	0.65	0.48	0.44	0.73	0.70
United States	0.86	48	0.70	0.75	0.77	0.68	0.64	0.68	0.39	0.79	0.75
Benchmarking Participants											
Buenos Aires, Argentina	0.81	40	0.64	0.62	0.69	0.55	0.66	0.55	0.41	0.74	0.75
Ontario, Canada	0.86	49	0.73	0.76	0.78	0.69	0.61	0.70	0.39	0.78	0.74
Quebec, Canada	0.87	50	0.77	0.75	0.76	0.77	0.66	0.69	0.39	0.75	0.72
Norway (4)	0.84	45	0.71	0.67	0.72	0.73	0.49	0.74	0.47	0.72	0.68
Abu Dhabi, UAE	0.77	35	0.37	0.67	0.71	0.45	0.69	0.40	0.37	0.72	0.73
Dubai, UAE	0.83	42	0.62	0.69	0.70	0.60	0.63	0.60	0.54	0.73	0.69
Florida, US	0.87	50	0.71	0.78	0.76	0.68	0.68	0.67	0.47	0.81	0.75

*Reverse coded

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students Confident in Mathematics Scale, Fourth Grade, and TIMSS 2015 Mathematics Achievement

Country	Pearson's Correlation with Mathematics Achievement		Variance in Mathematics Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.44	0.19	0.18
Bahrain	0.37	0.14	0.13
Belgium (Flemish)	0.39	0.15	0.14
Bulgaria	0.40	0.16	0.16
Canada	0.44	0.19	0.19
Chile	0.41	0.17	0.17
Chinese Taipei	0.44	0.19	0.20
Croatia	0.45	0.20	0.19
Cyprus	0.44	0.19	0.18
Czech Republic	0.42	0.18	0.18
Denmark	0.42	0.17	0.17
England	0.32	0.10	0.12
Finland	0.43	0.19	0.17
France	0.40	0.16	0.16
Georgia	0.36	0.13	0.15
Germany	0.42	0.18	0.18
Hong Kong SAR	0.41	0.17	0.18
Hungary	0.49	0.24	0.25
Indonesia	0.29	0.09	0.09
Iran, Islamic Rep. of	0.30	0.09	0.10
Ireland	0.43	0.18	0.18
Italy	0.32	0.10	0.10
Japan	0.44	0.19	0.19
Jordan	0.38	0.14	0.15
Kazakhstan	0.22	0.05	0.05
Korea, Rep. of	0.54	0.29	0.27
Kuwait	0.26	0.07	0.07
Lithuania	0.46	0.21	0.21
Morocco	0.32	0.10	0.10
Netherlands	0.52	0.27	0.28
New Zealand	0.37	0.14	0.13
Northern Ireland	0.40	0.16	0.17
Norway (5)	0.42	0.18	0.16
Oman	0.31	0.10	0.10
Poland	0.47	0.22	0.22
Portugal	0.49	0.24	0.25
Qatar	0.28	0.08	0.10
Russian Federation	0.39	0.15	0.16
Saudi Arabia	0.28	0.08	0.09
Serbia	0.44	0.19	0.19
Singapore	0.47	0.22	0.22
Slovak Republic	0.40	0.16	0.15
Slovenia	0.46	0.21	0.21
South Africa (5)	0.38	0.15	0.15
Spain	0.44	0.19	0.21
Sweden	0.38	0.14	0.13
Turkey	0.47	0.22	0.20
United Arab Emirates	0.32	0.11	0.11
United States	0.43	0.18	0.19
International Median	0.41	0.17	0.17
Benchmarking Participants			
Buenos Aires, Argentina	0.33	0.11	0.12
Ontario, Canada	0.45	0.20	0.20
Quebec, Canada	0.43	0.19	0.17
Norway (4)	0.39	0.15	0.14
Abu Dhabi, UAE	0.37	0.14	0.14
Dubai, UAE	0.30	0.09	0.10
Florida, US	0.43	0.18	0.20

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students Confident in Science Scale, Fourth Grade

The Students Confident in Science (SCS) scale was created based on students' degree of agreement with the seven statements described below.

Items in the TIMSS 2015 Students Confident in Science Scale, Fourth Grade

T	ASBS06A
T	ASBS06B*
T	ASBS06C*
T	ASBS06D
	ASBS06E
T	ASBS06F*
	ASBS06G*

How much do you agree with these statements about science?

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
1) I usually do well in science	○	○	○	○
2) Science is harder for me than for many of my classmates*	○	○	○	○
3) I am just not good at science*	○	○	○	○
4) I learn things quickly in science	○	○	○	○
5) My teacher tells me I am good at science	○	○	○	○
6) Science is harder for me than any other subject*	○	○	○	○
7) Science makes me confused*	○	○	○	○

* Reverse coded

T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Students Confident in Science Scale, Fourth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
ASBS06A	-0.39055	-0.49625	-0.66696	1.16321	1.02
ASBS06B*	0.20690	-0.51673	0.11786	0.39887	0.99
ASBS06C*	0.09646	-0.33652	0.05023	0.28629	0.95
ASBS06D	-0.24028	-0.68647	-0.30807	0.99454	1.03
ASBS06E	0.14669	-0.81490	-0.26498	1.07988	1.27
ASBS06F*	0.12712	-0.23193	0.04516	0.18677	0.93
ASBS06G*	0.05366	-0.19671	0.12470	0.07201	0.99

*Reverse coded

Scale Transformation Constants for the TIMSS 2015 Students Confident in Science Scale, Fourth Grade

Scale Transformation Constants	
A = 8.285794	Transformed Scale Score = 8.285794 + 1.489538 • Logit Scale Score
B = 1.489538	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students Confident in Science Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.59707	
1	5.10277	
2	5.80866	
3	6.29097	
4	6.67014	
5	6.98812	
6	7.26571	
7	7.51852	
8	7.75142	
9	7.97047	
10	8.18083	8.2
11	8.38716	
12	8.59408	
13	8.80664	
14	9.03080	
15	9.27412	
16	9.54624	
17	9.85727	
18	10.24189	10.2
19	10.75225	
20	11.53013	
21	13.20458	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students Confident in Science Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item						
			ASBS06A	ASBS06B*	ASBS06C*	ASBS06D	ASBS06E	ASBS06F*	ASBS06G*
Australia	0.84	51	0.72	0.77	0.79	0.71	0.50	0.75	0.73
Bahrain	0.72	39	0.08	0.81	0.79	0.35	0.26	0.85	0.76
Belgium (Flemish)	0.85	52	0.77	0.75	0.80	0.67	0.54	0.78	0.73
Bulgaria	0.82	48	0.60	0.76	0.77	0.64	0.53	0.77	0.75
Canada	0.83	51	0.70	0.78	0.77	0.71	0.45	0.79	0.74
Chile	0.76	42	0.51	0.74	0.72	0.53	0.31	0.79	0.77
Chinese Taipei	0.83	50	0.68	0.75	0.68	0.71	0.55	0.78	0.78
Croatia	0.87	57	0.75	0.79	0.75	0.74	0.66	0.81	0.77
Cyprus	0.85	52	0.73	0.72	0.75	0.72	0.65	0.72	0.75
Czech Republic	0.87	57	0.75	0.76	0.81	0.75	0.62	0.81	0.74
Denmark	0.86	55	0.78	0.73	0.79	0.79	0.61	0.75	0.73
England	0.85	54	0.75	0.77	0.82	0.73	0.46	0.79	0.76
Finland	0.82	49	0.76	0.76	0.81	0.75	0.53	0.76	0.47
France	0.85	54	0.75	0.72	0.76	0.74	0.58	0.78	0.78
Georgia	0.74	40	0.29	0.80	0.80	0.31	0.21	0.82	0.78
Germany	0.84	52	0.69	0.77	0.78	0.71	0.56	0.79	0.72
Hong Kong SAR	0.81	47	0.65	0.72	0.81	0.65	0.49	0.79	0.65
Hungary	0.86	55	0.77	0.77	0.80	0.72	0.68	0.78	0.66
Indonesia	0.73	39	0.29	0.77	0.78	0.38	0.21	0.79	0.78
Iran, Islamic Rep. of	0.76	41	0.32	0.69	0.80	0.44	0.36	0.83	0.80
Ireland	0.82	49	0.71	0.77	0.77	0.69	0.38	0.77	0.73
Italy	0.78	44	0.67	0.68	0.57	0.70	0.57	0.75	0.68
Japan	0.83	51	0.70	0.73	0.83	0.70	0.46	0.77	0.74
Jordan	0.72	40	-0.02	0.82	0.82	0.21	0.22	0.85	0.80
Kazakhstan	0.82	48	0.60	0.76	0.76	0.63	0.58	0.77	0.71
Korea, Rep. of	0.86	55	0.80	0.77	0.80	0.69	0.57	0.78	0.76
Kuwait	0.72	39	0.17	0.78	0.76	0.40	0.34	0.81	0.75
Lithuania	0.81	48	0.69	0.75	0.79	0.60	0.51	0.78	0.66
Morocco	0.72	37	0.31	0.75	0.75	0.40	0.30	0.77	0.74
Netherlands	0.84	52	0.70	0.75	0.80	0.67	0.44	0.79	0.81
New Zealand	0.77	43	0.63	0.69	0.75	0.61	0.41	0.75	0.69
Northern Ireland	0.84	52	0.71	0.73	0.80	0.72	0.47	0.79	0.75
Norway (5)	0.82	48	0.72	0.75	0.75	0.71	0.49	0.74	0.67
Oman	0.70	37	0.11	0.78	0.72	0.33	0.25	0.82	0.77
Poland	0.83	50	0.72	0.77	0.66	0.73	0.58	0.76	0.72
Portugal	0.76	42	0.64	0.65	0.73	0.67	0.54	0.59	0.72
Qatar	0.77	43	0.30	0.82	0.77	0.42	0.37	0.84	0.78
Russian Federation	0.87	57	0.73	0.79	0.82	0.76	0.63	0.79	0.76
Saudi Arabia	0.72	40	0.00	0.81	0.81	0.24	0.20	0.85	0.80
Serbia	0.82	49	0.63	0.74	0.75	0.65	0.59	0.76	0.74
Singapore	0.86	55	0.74	0.80	0.79	0.70	0.55	0.80	0.75
Slovak Republic	0.85	53	0.73	0.73	0.79	0.71	0.57	0.79	0.74
Slovenia	0.86	54	0.74	0.75	0.73	0.73	0.64	0.79	0.74
South Africa (5)	-	-	-	-	-	-	-	-	-
Spain	0.82	49	0.67	0.75	0.75	0.64	0.58	0.76	0.72
Sweden	0.81	48	0.69	0.71	0.76	0.71	0.47	0.77	0.70
Turkey	0.77	43	0.50	0.75	0.79	0.49	0.41	0.79	0.73
United Arab Emirates	0.77	42	0.39	0.77	0.75	0.50	0.40	0.81	0.74
United States	0.82	49	0.67	0.78	0.77	0.64	0.43	0.80	0.74
Benchmarking Participants									
Buenos Aires, Argentina	0.74	40	0.54	0.70	0.74	0.50	0.38	0.72	0.73
Ontario, Canada	0.84	52	0.70	0.79	0.80	0.69	0.44	0.80	0.75
Quebec, Canada	0.83	50	0.74	0.75	0.70	0.75	0.47	0.78	0.73
Norway (4)	0.81	48	0.70	0.74	0.75	0.71	0.51	0.74	0.65
Abu Dhabi, UAE	0.74	40	0.27	0.78	0.76	0.41	0.33	0.82	0.75
Dubai, UAE	0.81	47	0.58	0.78	0.75	0.60	0.50	0.79	0.73
Florida, US	0.84	52	0.67	0.77	0.79	0.68	0.49	0.80	0.77

*Reverse coded

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students Confident in Science Scale, Fourth Grade, and TIMSS 2015 Science Achievement

Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η2)
	(r)	(r^2)	
Australia	0.20	0.04	0.05
Bahrain	0.38	0.15	0.15
Belgium (Flemish)	0.25	0.06	0.08
Bulgaria	0.42	0.18	0.20
Canada	0.24	0.06	0.07
Chile	0.29	0.08	0.09
Chinese Taipei	0.31	0.10	0.10
Croatia	0.25	0.06	0.07
Cyprus	0.21	0.04	0.05
Czech Republic	0.20	0.04	0.06
Denmark	0.18	0.03	0.04
England	0.22	0.05	0.06
Finland	0.25	0.06	0.07
France	0.23	0.05	0.07
Georgia	0.29	0.09	0.10
Germany	0.24	0.06	0.06
Hong Kong SAR	0.30	0.09	0.11
Hungary	0.33	0.11	0.11
Indonesia	0.29	0.08	0.10
Iran, Islamic Rep. of	0.35	0.12	0.13
Ireland	0.23	0.05	0.07
Italy	0.20	0.04	0.05
Japan	0.22	0.05	0.05
Jordan	-	-	-
Kazakhstan	0.21	0.05	0.05
Korea, Rep. of	0.36	0.13	0.12
Kuwait	0.27	0.07	0.09
Lithuania	0.33	0.11	0.12
Morocco	0.35	0.12	0.13
Netherlands	0.28	0.08	0.09
New Zealand	0.26	0.07	0.08
Northern Ireland	0.18	0.03	0.05
Norway (5)	0.22	0.05	0.06
Oman	0.33	0.11	0.12
Poland	0.24	0.06	0.07
Portugal	0.26	0.07	0.08
Qatar	0.34	0.11	0.14
Russian Federation	0.20	0.04	0.04
Saudi Arabia	0.32	0.11	0.12
Serbia	0.27	0.07	0.08
Singapore	0.26	0.07	0.08
Slovak Republic	0.28	0.08	0.09
Slovenia	0.31	0.10	0.12
South Africa (5)	-	-	-
Spain	0.34	0.12	0.13
Sweden	0.22	0.05	0.06
Turkey	0.43	0.19	0.19
United Arab Emirates	0.37	0.14	0.15
United States	0.26	0.07	0.08
International Median	0.26	0.07	0.08
Benchmarking Participants			
Buenos Aires, Argentina	0.24	0.06	0.05
Ontario, Canada	0.23	0.05	0.06
Quebec, Canada	0.22	0.05	0.06
Norway (4)	0.24	0.06	0.07
Abu Dhabi, UAE	0.42	0.18	0.17
Dubai, UAE	0.28	0.08	0.10
Florida, US	0.27	0.07	0.08

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

A dash (–) indicates comparable data not available.

Students Like Learning Mathematics Scale, Fourth Grade

The Students Like Learning Mathematics (SLM) scale was created based on students' degree of agreement with the nine statements described below.

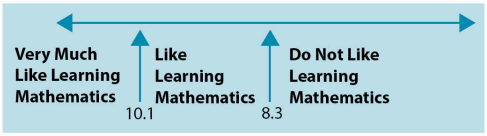
Items in the TIMSS 2015 Students Like Learning Mathematics Scale, Fourth Grade

T	ASBM01A
T	ASBM01B*
T	ASBM01C*
T	ASBM01D
T	ASBM01E
	ASBM01F
	ASBM01G
	ASBM01H
	ASBM01I

How much do you agree with these statements about learning mathematics?

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
1) I enjoy learning mathematics	○	○	○	○
2) I wish I did not have to study mathematics*	○	○	○	○
3) Mathematics is boring*	○	○	○	○
4) I learn many interesting things in mathematics	○	○	○	○
5) I like mathematics	○	○	○	○
6) I like any schoolwork that involves numbers	○	○	○	○
7) I like to solve mathematics problems	○	○	○	○
8) I look forward to mathematics lessons	○	○	○	○
9) Mathematics is one of my favorite subjects	○	○	○	○

* Reverse coded



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Students Like Learning Mathematics Scale, Fourth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
ASBM01A	-0.36154	-0.78229	-0.58169	1.36398	0.78
ASBM01B*	0.16159	-0.46676	-0.01626	0.48302	1.72
ASBM01C*	0.12982	-0.82103	0.11530	0.70573	1.39
ASBM01D	-0.81796	-0.82855	-0.37351	1.20206	1.18
ASBM01E	-0.19078	-0.58243	-0.43159	1.01402	0.65
ASBM01F	0.03849	-1.25798	-0.21189	1.46987	1.05
ASBM01G	0.15055	-0.96095	-0.26596	1.22691	1.06
ASBM01H	0.41364	-1.10049	-0.23780	1.33829	0.84
ASBM01I	0.47619	-0.62831	-0.10305	0.73136	0.91

*Reverse coded

Scale Transformation Constants for the TIMSS 2015 Students Like Learning Mathematics Scale, Fourth Grade

Scale Transformation Constants	
A = 8.402636	Transformed Scale Score = 8.402636 + 1.047479 • Logit Scale Score
B = 1.047479	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students Like Learning Mathematics Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	4.40782	
1	5.53183	
2	6.06393	
3	6.42611	
4	6.71073	
5	6.94947	
6	7.15899	
7	7.34756	
8	7.52392	
9	7.68976	
10	7.84785	
11	8.00037	
12	8.14916	
13	8.29582	8.3
14	8.44192	
15	8.58902	
16	8.73889	
17	8.89348	
18	9.05518	
19	9.22676	
20	9.41034	
21	9.61310	
22	9.84154	
23	10.10678	10.1
24	10.42683	
25	10.83982	
26	11.43903	
27	12.65794	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students Like Learning Mathematics Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item								
			ASBM01A	ASBM01B*	ASBM01C*	ASBM01D	ASBM01E	ASBM01F	ASBM01G	ASBM01H	ASBM01I
Australia	0.93	66	0.88	0.67	0.77	0.70	0.91	0.76	0.82	0.89	0.86
Bahrain	0.89	55	0.79	0.47	0.52	0.76	0.87	0.69	0.80	0.82	0.83
Belgium (Flemish)	0.93	65	0.89	0.78	0.82	0.64	0.92	0.78	0.70	0.82	0.86
Bulgaria	0.92	63	0.86	0.52	0.68	0.74	0.89	0.83	0.88	0.84	0.85
Canada	0.93	64	0.87	0.63	0.74	0.70	0.91	0.77	0.81	0.87	0.85
Chile	0.91	59	0.84	0.58	0.68	0.69	0.88	0.71	0.83	0.84	0.83
Chinese Taipei	0.95	70	0.88	0.75	0.74	0.79	0.92	0.84	0.85	0.88	0.87
Croatia	0.93	66	0.89	0.71	0.82	0.68	0.92	0.82	0.61	0.92	0.86
Cyprus	0.93	64	0.86	0.70	0.70	0.73	0.89	0.77	0.79	0.87	0.85
Czech Republic	0.93	66	0.90	0.65	0.79	0.63	0.92	0.81	0.73	0.91	0.89
Denmark	0.94	67	0.86	0.70	0.81	0.77	0.90	0.76	0.85	0.87	0.82
England	0.93	66	0.87	0.72	0.80	0.68	0.91	0.77	0.77	0.90	0.85
Finland	0.93	65	0.86	0.68	0.82	0.78	0.91	0.81	0.67	0.86	0.85
France	0.91	59	0.87	0.65	0.76	0.68	0.89	0.70	0.67	0.83	0.84
Georgia	0.84	47	0.78	0.36	0.37	0.69	0.85	0.70	0.75	0.71	0.74
Germany	0.93	66	0.88	0.73	0.73	0.71	0.92	0.81	0.76	0.90	0.87
Hong Kong SAR	0.94	67	0.86	0.65	0.74	0.79	0.91	0.83	0.84	0.86	0.86
Hungary	0.93	63	0.87	0.65	0.72	0.69	0.90	0.81	0.74	0.88	0.84
Indonesia	0.75	40	0.72	0.31	0.39	0.66	0.81	0.69	0.43	0.70	0.74
Iran, Islamic Rep. of	0.83	46	0.77	0.47	0.44	0.63	0.83	0.53	0.79	0.72	0.80
Ireland	0.92	63	0.87	0.66	0.75	0.67	0.91	0.78	0.76	0.88	0.83
Italy	0.93	63	0.88	0.73	0.79	0.63	0.90	0.77	0.68	0.88	0.86
Japan	0.94	67	0.89	0.60	0.73	0.76	0.91	0.82	0.85	0.89	0.85
Jordan	0.83	50	0.71	0.30	0.36	0.75	0.86	0.74	0.80	0.82	0.77
Kazakhstan	0.83	47	0.62	0.36	0.56	0.63	0.80	0.71	0.77	0.80	0.78
Korea, Rep. of	0.94	67	0.86	0.63	0.80	0.77	0.91	0.85	0.86	0.83	0.85
Kuwait	0.87	54	0.80	0.30	0.46	0.76	0.87	0.74	0.82	0.84	0.80
Lithuania	0.92	61	0.85	0.66	0.67	0.59	0.89	0.81	0.86	0.85	0.80
Morocco	0.75	41	0.66	0.27	0.31	0.68	0.79	0.70	0.70	0.76	0.66
Netherlands	0.93	63	0.85	0.71	0.78	0.65	0.90	0.76	0.82	0.85	0.81
New Zealand	0.93	66	0.88	0.70	0.75	0.71	0.90	0.79	0.84	0.87	0.85
Northern Ireland	0.92	62	0.87	0.65	0.75	0.66	0.90	0.79	0.74	0.88	0.83
Norway (5)	0.94	68	0.86	0.66	0.82	0.75	0.91	0.81	0.86	0.87	0.85
Oman	0.77	41	0.69	0.33	0.39	0.62	0.79	0.64	0.76	0.65	0.75
Poland	0.93	65	0.88	0.71	0.78	0.73	0.91	0.78	0.87	0.72	0.85
Portugal	0.92	63	0.87	0.72	0.75	0.66	0.90	0.76	0.79	0.85	0.83
Qatar	0.89	55	0.80	0.44	0.52	0.77	0.87	0.74	0.79	0.80	0.82
Russian Federation	0.89	56	0.84	0.45	0.70	0.67	0.87	0.75	0.73	0.84	0.82
Saudi Arabia	0.87	54	0.78	0.34	0.40	0.79	0.87	0.75	0.83	0.85	0.80
Serbia	0.93	65	0.86	0.65	0.75	0.71	0.91	0.79	0.79	0.90	0.83
Singapore	0.93	64	0.86	0.75	0.75	0.72	0.89	0.73	0.81	0.84	0.85
Slovak Republic	0.92	62	0.87	0.65	0.73	0.58	0.89	0.75	0.82	0.90	0.85
Slovenia	0.93	66	0.86	0.65	0.78	0.76	0.91	0.77	0.81	0.91	0.84
South Africa (5)	0.77	39	0.70	0.26	0.33	0.60	0.79	0.67	0.67	0.67	0.72
Spain	0.91	59	0.83	0.59	0.74	0.64	0.88	0.70	0.77	0.85	0.84
Sweden	0.93	67	0.85	0.68	0.85	0.72	0.91	0.83	0.77	0.87	0.83
Turkey	0.84	48	0.78	0.54	0.65	0.40	0.83	0.62	0.74	0.77	0.79
United Arab Emirates	0.89	56	0.80	0.52	0.65	0.74	0.86	0.69	0.79	0.79	0.81
United States	0.93	65	0.88	0.66	0.75	0.71	0.91	0.76	0.86	0.87	0.85
Benchmarking Participants											
Buenos Aires, Argentina	0.91	60	0.84	0.54	0.64	0.68	0.89	0.78	0.81	0.85	0.85
Ontario, Canada	0.93	65	0.88	0.66	0.74	0.70	0.91	0.76	0.83	0.88	0.85
Quebec, Canada	0.91	60	0.84	0.56	0.76	0.69	0.89	0.74	0.73	0.87	0.82
Norway (4)	0.93	66	0.87	0.60	0.79	0.74	0.91	0.79	0.86	0.89	0.83
Abu Dhabi, UAE	0.89	55	0.79	0.48	0.60	0.75	0.85	0.71	0.80	0.80	0.80
Dubai, UAE	0.91	58	0.84	0.60	0.71	0.71	0.87	0.68	0.78	0.79	0.84
Florida, US	0.93	65	0.87	0.65	0.74	0.70	0.90	0.77	0.88	0.86	0.83

*Reverse coded

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students Like Learning Mathematics Scale, Fourth Grade, and TIMSS 2015 Mathematics Achievement

Country	Pearson's Correlation with Mathematics Achievement		Variance in Mathematics Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.19	0.04	0.03
Bahrain	0.21	0.04	0.05
Belgium (Flemish)	0.10	0.01	0.01
Bulgaria	0.22	0.05	0.04
Canada	0.21	0.04	0.04
Chile	0.19	0.04	0.04
Chinese Taipei	0.21	0.05	0.04
Croatia	0.14	0.02	0.02
Cyprus	0.18	0.03	0.04
Czech Republic	0.17	0.03	0.02
Denmark	0.17	0.03	0.03
England	0.12	0.02	0.02
Finland	0.20	0.04	0.03
France	0.19	0.04	0.03
Georgia	0.22	0.05	0.04
Germany	0.16	0.03	0.03
Hong Kong SAR	0.22	0.05	0.04
Hungary	0.20	0.04	0.03
Indonesia	0.24	0.06	0.06
Iran, Islamic Rep. of	0.23	0.05	0.05
Ireland	0.17	0.03	0.03
Italy	0.13	0.02	0.01
Japan	0.30	0.09	0.09
Jordan	0.25	0.06	0.06
Kazakhstan	0.15	0.02	0.02
Korea, Rep. of	0.33	0.11	0.10
Kuwait	0.18	0.03	0.04
Lithuania	0.16	0.02	0.02
Morocco	0.29	0.09	0.08
Netherlands	0.18	0.03	0.03
New Zealand	0.05	0.00	0.00
Northern Ireland	0.18	0.03	0.03
Norway (5)	0.10	0.01	0.02
Oman	0.26	0.07	0.06
Poland	0.13	0.02	0.02
Portugal	0.28	0.08	0.07
Qatar	0.21	0.04	0.05
Russian Federation	0.22	0.05	0.04
Saudi Arabia	0.21	0.04	0.05
Serbia	0.10	0.01	0.01
Singapore	0.23	0.05	0.05
Slovak Republic	0.07	0.01	0.00
Slovenia	0.19	0.03	0.03
South Africa (5)	0.32	0.10	0.12
Spain	0.13	0.02	0.02
Sweden	0.07	0.00	0.00
Turkey	0.26	0.07	0.06
United Arab Emirates	0.19	0.03	0.04
United States	0.16	0.02	0.02
International Median	0.19	0.04	0.03
Benchmarking Participants			
Buenos Aires, Argentina	0.06	0.00	0.01
Ontario, Canada	0.21	0.04	0.04
Quebec, Canada	0.18	0.03	0.03
Norway (4)	0.17	0.03	0.03
Abu Dhabi, UAE	0.21	0.04	0.05
Dubai, UAE	0.16	0.02	0.02
Florida, US	0.19	0.04	0.04

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students Like Learning Science Scale, Fourth Grade

The Students Like Learning Science (SLS) scale was created based on students' degree of agreement with the nine statements described below.

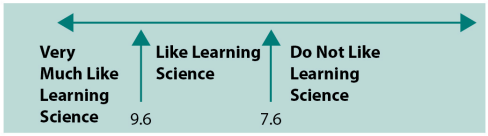
Items in the TIMSS 2015 Students Like Learning Science Scale, Fourth Grade

T	ASBS04A
T	ASBS04B*
T	ASBS04C*
T	ASBS04D
T	ASBS04E
	ASBS04F
	ASBS04G
	ASBS04H
	ASBS04I

How much do you agree with these statements about learning science?

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
1) I enjoy learning science	○	○	○	○
2) I wish I did not have to study science*	○	○	○	○
3) Science is boring*	○	○	○	○
4) I learn many interesting things in science	○	○	○	○
5) I like science	○	○	○	○
6) I look forward to learning science in school	○	○	○	○
7) Science teaches me how things in the world work	○	○	○	○
8) I like to do science experiments	○	○	○	○
9) Science is one of my favorite subjects	○	○	○	○

* Reverse coded



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Students Like Learning Science Scale, Fourth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
ASBS04A	-0.03177	-0.48837	-0.55624	1.04461	0.81
ASBS04B*	0.54508	-0.31578	-0.16722	0.48300	1.53
ASBS04C*	0.36011	-0.48672	-0.06029	0.54701	1.28
ASBS04D	-0.49710	-0.28238	-0.48794	0.77032	0.95
ASBS04E	-0.00762	-0.45509	-0.40061	0.85570	0.65
ASBS04F	0.32089	-0.78932	-0.22311	1.01243	0.85
ASBS04G	-0.63912	-0.42807	-0.58269	1.01076	1.21
ASBS04H	-0.63548	-0.16495	-0.39717	0.56212	1.38
ASBS04I	0.58501	-0.73823	-0.18404	0.92227	0.93

*Reverse coded

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Students Like Learning Science Scale, Fourth Grade

Scale Transformation Constants	
A = 7.692952	Transformed Scale Score = 7.692952 + 1.31277 • Logit Scale Score
B = 1.31277	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students Like Learning Science Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.23946	
1	4.51118	
2	5.09266	
3	5.48363	
4	5.78856	
5	6.04394	
6	6.26730	
7	6.47373	
8	6.66589	
9	6.84816	
10	7.02381	
11	7.19528	
12	7.36446	
13	7.53286	7.6
14	7.70219	
15	7.87285	
16	8.04737	
17	8.22734	
18	8.41513	
19	8.61378	
20	8.82516	
21	9.05834	
22	9.32098	
23	9.62700	9.6
24	9.99920	
25	10.48630	
26	11.20666	
27	12.70534	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students Like Learning Science Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item								
			ASBS04A	ASBS04B*	ASBS04C*	ASBS04D	ASBS04E	ASBS04F	ASBS04G	ASBS04H	ASBS04I
Australia	0.92	62	0.86	0.69	0.74	0.79	0.90	0.90	0.66	0.62	0.84
Bahrain	0.86	52	0.76	0.43	0.47	0.79	0.87	0.81	0.74	0.70	0.81
Belgium (Flemish)	0.91	59	0.88	0.78	0.83	0.70	0.91	0.83	0.58	0.46	0.84
Bulgaria	0.86	52	0.81	0.43	0.56	0.78	0.88	0.77	0.73	0.59	0.80
Canada	0.91	59	0.87	0.64	0.74	0.77	0.91	0.88	0.60	0.57	0.84
Chile	0.86	51	0.81	0.40	0.56	0.76	0.89	0.83	0.63	0.58	0.82
Chinese Taipei	0.92	62	0.87	0.66	0.60	0.81	0.91	0.87	0.75	0.72	0.85
Croatia	0.90	58	0.86	0.67	0.78	0.78	0.90	0.89	0.56	0.42	0.84
Cyprus	0.91	59	0.86	0.70	0.71	0.78	0.91	0.87	0.64	0.48	0.86
Czech Republic	0.92	61	0.88	0.63	0.77	0.71	0.92	0.90	0.63	0.58	0.88
Denmark	0.93	65	0.87	0.74	0.81	0.84	0.91	0.90	0.67	0.59	0.84
England	0.93	64	0.88	0.74	0.79	0.75	0.92	0.90	0.65	0.64	0.85
Finland	0.93	63	0.86	0.73	0.82	0.80	0.91	0.85	0.67	0.66	0.82
France	0.92	61	0.88	0.70	0.78	0.78	0.91	0.86	0.62	0.60	0.82
Georgia	0.82	45	0.77	0.36	0.37	0.75	0.85	0.65	0.71	0.72	0.66
Germany	0.91	60	0.82	0.77	0.76	0.77	0.90	0.90	0.65	0.46	0.84
Hong Kong SAR	0.92	61	0.84	0.58	0.65	0.79	0.91	0.88	0.75	0.71	0.85
Hungary	0.89	54	0.87	0.59	0.71	0.72	0.90	0.88	0.53	0.42	0.83
Indonesia	0.74	37	0.66	0.29	0.36	0.68	0.78	0.65	0.58	0.61	0.71
Iran, Islamic Rep. of	0.79	43	0.74	0.39	0.41	0.68	0.82	0.66	0.62	0.67	0.78
Ireland	0.91	59	0.86	0.65	0.74	0.73	0.90	0.89	0.64	0.63	0.82
Italy	0.85	47	0.84	0.67	0.70	0.74	0.86	0.56	0.41	0.46	0.81
Japan	0.92	63	0.87	0.65	0.69	0.79	0.91	0.90	0.70	0.72	0.84
Jordan	0.82	48	0.70	0.34	0.37	0.78	0.85	0.79	0.75	0.74	0.75
Kazakhstan	0.83	46	0.68	0.34	0.62	0.68	0.80	0.77	0.69	0.64	0.76
Korea, Rep. of	0.93	63	0.86	0.71	0.79	0.81	0.90	0.86	0.69	0.65	0.83
Kuwait	0.82	46	0.69	0.38	0.46	0.72	0.84	0.77	0.67	0.69	0.72
Lithuania	0.89	55	0.82	0.65	0.65	0.76	0.87	0.83	0.65	0.62	0.77
Morocco	0.77	41	0.61	0.38	0.42	0.69	0.78	0.73	0.66	0.69	0.65
Netherlands	0.90	57	0.84	0.65	0.78	0.74	0.90	0.86	0.58	0.54	0.81
New Zealand	0.91	59	0.84	0.63	0.66	0.77	0.90	0.87	0.69	0.70	0.82
Northern Ireland	0.90	57	0.85	0.65	0.72	0.72	0.89	0.87	0.62	0.59	0.80
Norway (5)	0.91	59	0.87	0.67	0.79	0.77	0.91	0.88	0.61	0.48	0.82
Oman	0.75	41	0.67	0.35	0.41	0.62	0.78	0.65	0.69	0.70	0.73
Poland	0.90	57	0.85	0.63	0.66	0.81	0.89	0.71	0.72	0.65	0.82
Portugal	0.87	52	0.82	0.62	0.64	0.72	0.88	0.81	0.59	0.59	0.77
Qatar	0.86	52	0.74	0.44	0.48	0.80	0.87	0.81	0.75	0.70	0.79
Russian Federation	0.88	53	0.83	0.57	0.72	0.71	0.86	0.83	0.62	0.49	0.80
Saudi Arabia	0.85	51	0.73	0.33	0.39	0.79	0.87	0.84	0.73	0.74	0.80
Serbia	0.88	54	0.85	0.47	0.64	0.75	0.89	0.88	0.58	0.57	0.83
Singapore	0.92	60	0.86	0.72	0.73	0.78	0.90	0.87	0.66	0.58	0.85
Slovak Republic	0.90	57	0.86	0.65	0.73	0.64	0.90	0.88	0.62	0.58	0.84
Slovenia	0.91	59	0.85	0.66	0.76	0.80	0.91	0.90	0.57	0.48	0.82
South Africa (5)	-	-	-	-	-	-	-	-	-	-	-
Spain	0.88	53	0.83	0.58	0.72	0.73	0.89	0.86	0.52	0.37	0.84
Sweden	0.92	62	0.86	0.70	0.81	0.80	0.91	0.88	0.66	0.61	0.82
Turkey	0.76	38	0.70	0.53	0.58	0.45	0.78	0.68	0.49	0.53	0.73
United Arab Emirates	0.88	53	0.77	0.51	0.63	0.78	0.86	0.80	0.70	0.65	0.80
United States	0.91	60	0.87	0.63	0.71	0.78	0.91	0.88	0.67	0.61	0.84
Benchmarking Participants											
Buenos Aires, Argentina	0.87	52	0.84	0.48	0.56	0.75	0.90	0.86	0.60	0.51	0.84
Ontario, Canada	0.91	59	0.87	0.66	0.75	0.76	0.91	0.88	0.63	0.53	0.85
Quebec, Canada	0.90	58	0.88	0.60	0.76	0.78	0.92	0.90	0.50	0.57	0.83
Norway (4)	0.91	59	0.87	0.64	0.77	0.77	0.91	0.90	0.57	0.57	0.82
Abu Dhabi, UAE	0.88	52	0.74	0.50	0.60	0.79	0.86	0.81	0.71	0.64	0.78
Dubai, UAE	0.88	54	0.82	0.58	0.70	0.74	0.86	0.79	0.66	0.57	0.82
Florida, US	0.92	60	0.88	0.65	0.72	0.79	0.92	0.88	0.66	0.59	0.84

*Reverse coded

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students Like Learning Science Scale, Fourth Grade, and TIMSS 2015 Science Achievement

Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.10	0.01	0.01
Bahrain	0.38	0.14	0.13
Belgium (Flemish)	0.12	0.02	0.02
Bulgaria	0.28	0.08	0.08
Canada	0.11	0.01	0.01
Chile	0.14	0.02	0.02
Chinese Taipei	0.16	0.03	0.02
Croatia	0.10	0.01	0.01
Cyprus	0.10	0.01	0.01
Czech Republic	0.06	0.00	0.00
Denmark	0.07	0.00	0.01
England	0.10	0.01	0.01
Finland	0.08	0.01	0.01
France	0.11	0.01	0.01
Georgia	0.20	0.04	0.04
Germany	0.09	0.01	0.01
Hong Kong SAR	0.22	0.05	0.04
Hungary	0.15	0.02	0.02
Indonesia	0.29	0.09	0.10
Iran, Islamic Rep. of	0.28	0.08	0.07
Ireland	0.19	0.04	0.03
Italy	0.10	0.01	0.01
Japan	0.17	0.03	0.02
Jordan	-	-	-
Kazakhstan	0.16	0.03	0.02
Korea, Rep. of	0.26	0.07	0.05
Kuwait	0.27	0.03	0.06
Lithuania	0.18	0.11	0.03
Morocco	0.34	0.02	0.10
Netherlands	0.15	0.01	0.02
New Zealand	0.12	0.02	0.02
Northern Ireland	0.14	0.01	0.01
Norway (5)	0.10	0.12	0.01
Oman	0.34	0.00	0.10
Poland	0.07	0.02	0.01
Portugal	0.14	0.12	0.02
Qatar	0.34	0.00	0.11
Russian Federation	0.06	0.08	0.00
Saudi Arabia	0.28	0.00	0.09
Serbia	0.02	0.02	0.00
Singapore	0.14	0.00	0.02
Slovak Republic	0.06	0.02	0.00
Slovenia	0.13	0.02	0.01
South Africa (5)	-	-	-
Spain	0.13	0.02	0.02
Sweden	-0.02	0.00	0.00
Turkey	0.34	0.12	0.11
United Arab Emirates	0.35	0.12	0.11
United States	0.13	0.02	0.02
International Median	0.14	0.02	0.02
Benchmarking Participants			
Buenos Aires, Argentina	0.08	0.01	0.01
Ontario, Canada	0.11	0.01	0.01
Quebec, Canada	0.12	0.01	0.01
Norway (4)	0.11	0.01	0.01
Abu Dhabi, UAE	0.35	0.13	0.13
Dubai, UAE	0.27	0.07	0.06
Florida, US	0.16	0.02	0.02

A dash (–) indicates comparable data not available.

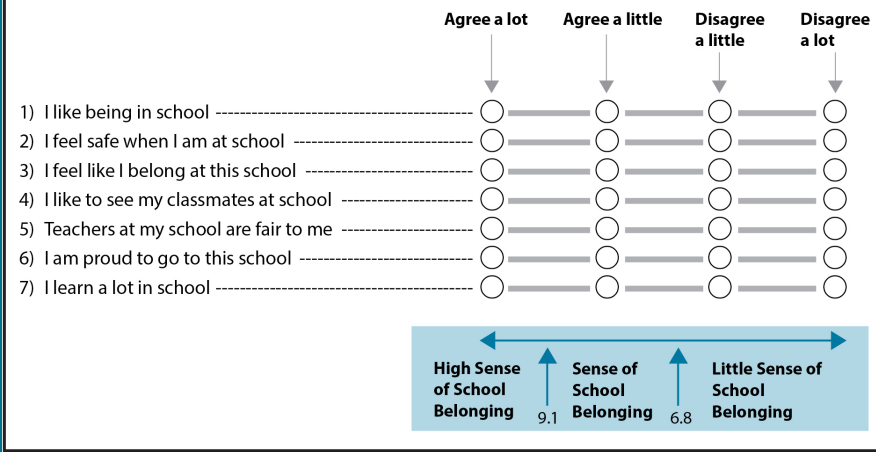
SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students' Sense of School Belonging Scale, Fourth Grade

The Students' Sense of School Belonging (SSB) scale was created based on students' degree of agreement with the seven statements described below.

Items in the TIMSS 2015 Students' Sense of School Belonging, Fourth Grade

What do you think about your school? Tell how much you agree with these statements.



Item Parameters for the TIMSS 2015 Students' Sense of School Belonging Scale, Fourth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
ASBG11A	0.56254	-0.33789	-0.81923	1.15712	1.06
ASBG11B	0.18287	-0.43736	-0.56824	1.00560	1.01
ASBG11C	0.30843	-0.24942	-0.47527	0.72469	1.02
ASBG11D	-0.64754	0.09352	-0.52319	0.42967	1.13
ASBG11E	0.05958	-0.20049	-0.59003	0.79052	1.10
ASBG11F	0.13972	-0.12324	-0.60389	0.72713	0.94
ASBG11G	-0.60560	-0.08268	-0.71676	0.79944	1.00

Scale Transformation Constants for the TIMSS 2015 Students' Sense of School Belonging Scale, Fourth Grade

Scale Transformation Constants	
A = 7.050578	Transformed Scale Score = 7.050578 + 1.530558 • Logit Scale Score
B = 1.530558	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students' Sense of School Belonging Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	2.69267	
1	3.96448	
2	4.56327	
3	4.97987	
4	5.31312	
5	5.59808	
6	5.85633	
7	6.09696	
8	6.32653	
9	6.55299	
10	6.77277	6.8
11	6.99462	
12	7.22296	
13	7.46316	
14	7.72193	
15	8.00589	
16	8.33009	
17	8.71486	
18	9.19396	9.1
19	9.83052	
20	10.76714	
21	12.63595	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students' Sense of School Belonging Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item						
			ASBG11A	ASBG11B	ASBG11C	ASBG11D	ASBG11E	ASBG11F	ASBG11G
Australia	0.82	49	0.70	0.73	0.74	0.51	0.69	0.82	0.66
Bahrain	0.80	46	0.69	0.70	0.73	0.59	0.59	0.76	0.65
Belgium (Flemish)	0.77	43	0.71	0.67	0.74	0.53	0.64	0.75	0.51
Bulgaria	0.79	45	0.65	0.69	0.72	0.54	0.63	0.78	0.68
Canada	0.82	48	0.70	0.71	0.73	0.60	0.68	0.80	0.63
Chile	0.81	48	0.69	0.71	0.73	0.61	0.65	0.80	0.64
Chinese Taipei	0.78	44	0.72	0.69	0.69	0.57	0.65	0.65	0.68
Croatia	0.78	45	0.67	0.72	0.67	0.48	0.65	0.77	0.68
Cyprus	0.81	48	0.71	0.67	0.73	0.48	0.70	0.81	0.69
Czech Republic	0.77	43	0.64	0.66	0.61	0.53	0.69	0.78	0.66
Denmark	0.83	49	0.73	0.76	0.77	0.60	0.63	0.78	0.63
England	0.82	48	0.72	0.71	0.75	0.45	0.69	0.81	0.69
Finland	0.82	49	0.76	0.74	0.69	0.57	0.65	0.77	0.69
France	0.68	36	0.63	0.61	0.66	0.48	0.44	0.78	0.57
Georgia	0.77	45	0.57	0.58	0.46	0.79	0.65	0.80	0.79
Germany	0.80	46	0.70	0.72	0.73	0.59	0.63	0.78	0.60
Hong Kong SAR	0.85	52	0.76	0.79	0.81	0.59	0.67	0.75	0.69
Hungary	0.76	42	0.64	0.67	0.73	0.50	0.66	0.77	0.53
Indonesia	0.79	45	0.62	0.60	0.70	0.72	0.66	0.69	0.70
Iran, Islamic Rep. of	0.66	38	0.66	0.67	0.68	0.64	0.66	0.35	0.61
Ireland	0.79	46	0.66	0.74	0.74	0.50	0.67	0.79	0.62
Italy	0.77	43	0.68	0.66	0.69	0.49	0.67	0.78	0.59
Japan	0.83	50	0.76	0.74	0.69	0.64	0.67	0.79	0.67
Jordan	0.80	46	0.68	0.65	0.72	0.64	0.61	0.74	0.68
Kazakhstan	0.75	42	0.62	0.56	0.67	0.59	0.65	0.73	0.67
Korea, Rep. of	0.83	50	0.75	0.72	0.64	0.66	0.65	0.79	0.70
Kuwait	0.77	42	0.67	0.66	0.69	0.56	0.57	0.74	0.63
Lithuania	0.77	43	0.68	0.65	0.68	0.57	0.66	0.76	0.55
Morocco	0.75	42	0.62	0.62	0.63	0.61	0.63	0.72	0.69
Netherlands	0.80	47	0.74	0.69	0.73	0.61	0.66	0.77	0.58
New Zealand	0.82	48	0.71	0.71	0.76	0.52	0.65	0.81	0.67
Northern Ireland	0.79	47	0.66	0.73	0.73	0.50	0.71	0.77	0.64
Norway (5)	0.81	48	0.65	0.73	0.78	0.57	0.63	0.79	0.64
Oman	0.80	46	0.64	0.64	0.68	0.65	0.65	0.75	0.71
Poland	0.79	45	0.74	0.68	0.71	0.42	0.64	0.80	0.63
Portugal	0.75	42	0.72	0.65	0.70	0.47	0.50	0.81	0.62
Qatar	0.84	50	0.75	0.72	0.76	0.58	0.67	0.80	0.65
Russian Federation	0.75	41	0.72	0.61	0.69	0.47	0.62	0.75	0.59
Saudi Arabia	0.80	46	0.67	0.68	0.71	0.60	0.68	0.75	0.65
Serbia	0.76	42	0.70	0.66	0.72	0.51	0.62	0.79	0.48
Singapore	0.81	47	0.75	0.70	0.76	0.51	0.65	0.80	0.61
Slovak Republic	0.79	44	0.67	0.68	0.74	0.41	0.68	0.78	0.60
Slovenia	0.81	48	0.70	0.69	0.74	0.45	0.69	0.81	0.69
South Africa (5)	0.75	41	0.63	0.66	0.67	0.65	0.48	0.70	0.69
Spain	0.77	43	0.66	0.67	0.66	0.52	0.65	0.76	0.66
Sweden	0.81	47	0.68	0.69	0.76	0.60	0.58	0.80	0.66
Turkey	0.60	34	0.59	0.64	0.64	0.60	0.34	0.62	0.58
United Arab Emirates	0.81	47	0.67	0.69	0.72	0.59	0.66	0.77	0.67
United States	0.82	49	0.69	0.72	0.76	0.57	0.69	0.82	0.63
Benchmarking Participants									
Buenos Aires, Argentina	0.76	43	0.69	0.67	0.64	0.49	0.66	0.77	0.62
Ontario, Canada	0.81	48	0.70	0.70	0.74	0.57	0.68	0.81	0.63
Quebec, Canada	0.80	46	0.70	0.70	0.72	0.58	0.66	0.78	0.58
Norway (4)	0.78	45	0.66	0.67	0.76	0.52	0.60	0.80	0.65
Abu Dhabi, UAE	0.80	46	0.64	0.69	0.72	0.62	0.65	0.75	0.67
Dubai, UAE	0.81	47	0.70	0.69	0.71	0.55	0.67	0.80	0.64
Florida, US	0.82	49	0.70	0.72	0.76	0.59	0.66	0.83	0.59

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students' Sense of School Belonging Scale, Fourth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement (r)		Pearson's Correlation with Achievement (r^2)		Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.11	0.10	0.01	0.01	0.01	0.01
Bahrain	0.10	0.12	0.01	0.01	0.01	0.02
Belgium (Flemish)	0.08	0.10	0.01	0.01	0.01	0.02
Bulgaria	0.02	-0.01	0.00	0.00	0.01	0.01
Canada	0.07	0.08	0.01	0.01	0.01	0.01
Chile	0.16	0.12	0.02	0.02	0.02	0.01
Chinese Taipei	0.11	0.08	0.01	0.01	0.01	0.01
Croatia	0.05	0.03	0.00	0.00	0.00	0.00
Cyprus	0.02	0.03	0.00	0.00	0.00	0.00
Czech Republic	-0.03	-0.05	0.00	0.00	0.01	0.00
Denmark	0.14	0.12	0.02	0.01	0.02	0.01
England	0.12	0.12	0.01	0.01	0.01	0.01
Finland	0.08	0.07	0.01	0.01	0.01	0.01
France	0.04	0.07	0.00	0.01	0.01	0.01
Georgia	0.09	0.04	0.01	0.00	0.02	0.01
Germany	0.07	0.06	0.00	0.00	0.01	0.00
Hong Kong SAR	0.16	0.13	0.03	0.02	0.02	0.01
Hungary	0.09	0.05	0.01	0.00	0.01	0.00
Indonesia	0.09	0.08	0.01	0.01	0.02	0.02
Iran, Islamic Rep. of	-0.12	-0.12	0.01	0.02	0.01	0.02
Ireland	0.10	0.06	0.01	0.00	0.01	0.01
Italy	0.06	0.03	0.00	0.00	0.01	0.01
Japan	0.16	0.13	0.03	0.02	0.03	0.02
Jordan	0.06	-	0.00	-	0.01	-
Kazakhstan	0.11	0.16	0.01	0.02	0.01	0.02
Korea, Rep. of	0.13	0.06	0.02	0.00	0.01	0.00
Kuwait	-0.01	0.07	0.00	0.00	0.00	0.01
Lithuania	0.07	0.06	0.00	0.00	0.01	0.01
Morocco	0.14	0.19	0.02	0.04	0.02	0.05
Netherlands	0.09	0.13	0.01	0.02	0.01	0.02
New Zealand	0.03	0.02	0.00	0.00	0.01	0.00
Northern Ireland	0.10	0.06	0.01	0.00	0.02	0.01
Norway (5)	0.09	0.05	0.01	0.00	0.01	0.01
Oman	0.11	0.13	0.01	0.02	0.02	0.02
Poland	-0.05	-0.06	0.00	0.00	0.00	0.00
Portugal	0.11	0.05	0.01	0.00	0.01	0.00
Qatar	0.13	0.16	0.02	0.02	0.02	0.03
Russian Federation	0.08	0.01	0.01	0.00	0.01	0.00
Saudi Arabia	0.16	0.17	0.03	0.03	0.03	0.03
Serbia	-0.04	-0.08	0.00	0.01	0.00	0.00
Singapore	0.08	0.05	0.01	0.00	0.01	0.00
Slovak Republic	-0.08	-0.08	0.01	0.01	0.01	0.01
Slovenia	-0.03	-0.02	0.00	0.00	0.00	0.00
South Africa (5)	0.16	-	0.03	-	0.04	-
Spain	0.03	0.04	0.00	0.00	0.00	0.01
Sweden	0.07	0.08	0.00	0.01	0.01	0.01
Turkey	0.22	0.20	0.05	0.04	0.04	0.04
United Arab Emirates	0.13	0.16	0.02	0.03	0.02	0.03
United States	0.14	0.13	0.02	0.02	0.02	0.02
International Median	0.09	0.07	0.01	0.01	0.01	0.01
Benchmarking Participants						
Buenos Aires, Argentina	-0.01	-0.01	0.00	0.00	0.00	0.00
Ontario, Canada	0.10	0.09	0.01	0.01	0.01	0.01
Quebec, Canada	0.04	0.04	0.00	0.00	0.00	0.00
Norway (4)	0.12	0.13	0.02	0.02	0.01	0.01
Abu Dhabi, UAE	0.11	0.13	0.01	0.02	0.02	0.02
Dubai, UAE	0.15	0.18	0.02	0.03	0.03	0.04
Florida, US	0.18	0.17	0.03	0.03	0.03	0.03

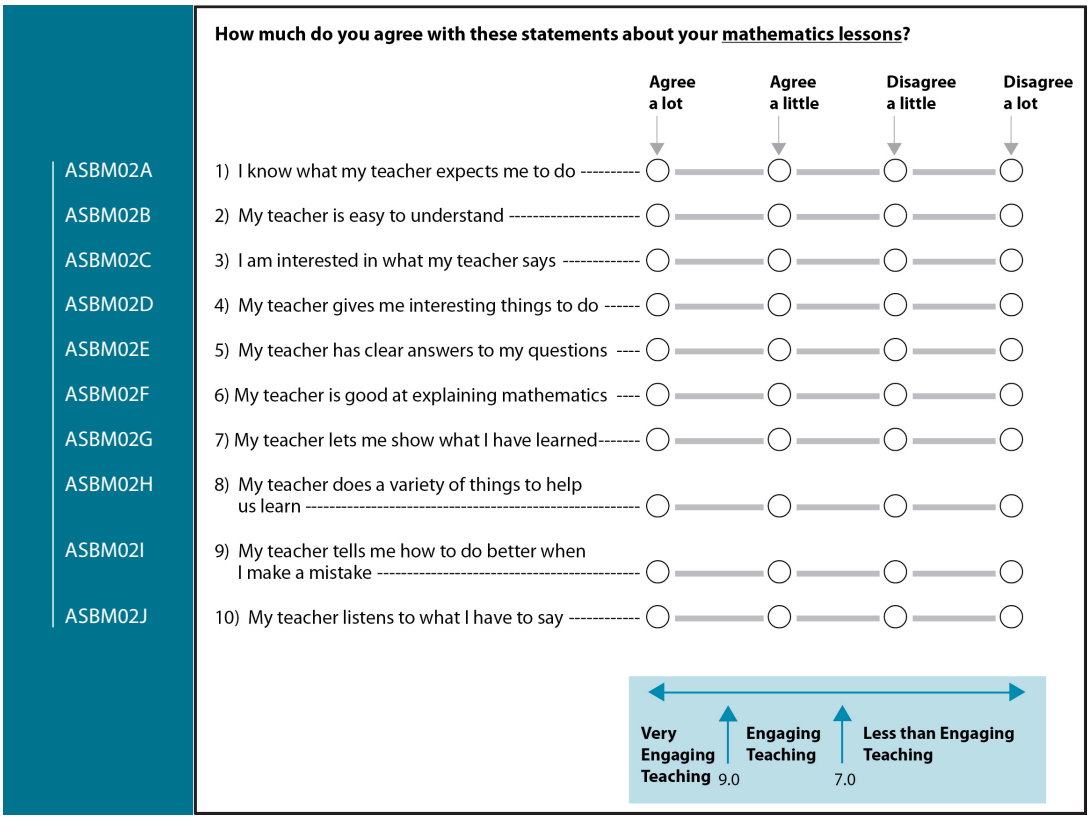
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students' Views on Engaging Teaching in Mathematics Lessons Scale, Fourth Grade

The Students' Views on Engaging Teaching in Mathematics Lessons (EML) scale was created based on students' degree of agreement with the ten statements described below.

Items in the TIMSS 2015 Students' Views on Engaging Teaching in Mathematics Lessons Scale, Fourth Grade



Item Parameters for the TIMSS 2015 Students' Views on Engaging Teaching in Mathematics Lessons Scale, Fourth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
ASBM02A	0.38419	-0.45928	-0.74716	1.20644	1.45
ASBM02B	0.03877	-0.72151	-0.67326	1.39477	1.09
ASBM02C	0.12130	-0.75604	-0.46634	1.22238	0.99
ASBM02D	0.40625	-0.83775	-0.35861	1.19636	0.99
ASBM02E	-0.14411	-0.72485	-0.45891	1.18376	0.90
ASBM02F	-0.48092	-0.43600	-0.50640	0.94240	0.86
ASBM02G	0.35273	-0.79575	-0.43071	1.22646	1.10
ASBM02H	-0.39195	-0.38697	-0.55457	0.94154	0.95
ASBM02I	-0.20522	-0.43958	-0.49368	0.93326	1.01
ASBM02J	-0.08104	-0.40846	-0.52440	0.93286	1.01

Scale Transformation Constants for the TIMSS 2015 Students' Views on Engaging Teaching in Mathematics Lessons Scale, Fourth Grade

Scale Transformation Constants	
A = 7.092835	Transformed Scale Score = 7.092835 + 1.336512 • Logit Scale Score
B = 1.336512	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students' Views on Engaging Teaching in Mathematics Lessons Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	2.28692	
1	3.63188	
2	4.24280	
3	4.64797	
4	4.95849	
5	5.21283	
6	5.43698	
7	5.63375	
8	5.81602	
9	5.98702	
10	6.15013	
11	6.30793	
12	6.46248	
13	6.61730	
14	6.76989	
15	6.92442	7.0
16	7.08212	
17	7.24591	
18	7.41643	
19	7.59618	
20	7.78743	
21	7.99236	
22	8.21605	
23	8.46252	
24	8.73772	
25	9.04989	9.0
26	9.41158	
27	9.84507	
28	10.39553	
29	11.17927	
30	12.74909	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students' Views on Engaging Teaching in Mathematics Lessons Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item									
			ASBM02A	ASBM02B	ASBM02C	ASBM02D	ASBM02E	ASBM02F	ASBM02G	ASBM02H	ASBM02I	ASBM02J
Australia	0.88	49	0.52	0.73	0.75	0.75	0.74	0.76	0.65	0.71	0.68	0.68
Bahrain	0.88	49	0.45	0.63	0.71	0.76	0.76	0.74	0.73	0.75	0.70	0.68
Belgium (Flemish)	0.83	41	0.52	0.65	0.66	0.63	0.70	0.72	0.57	0.65	0.61	0.65
Bulgaria	0.86	47	0.50	0.65	0.70	0.69	0.76	0.71	0.73	0.66	0.70	0.71
Canada	0.88	48	0.54	0.70	0.73	0.73	0.75	0.75	0.64	0.69	0.67	0.68
Chile	0.87	48	0.49	0.63	0.71	0.69	0.74	0.76	0.65	0.72	0.72	0.75
Chinese Taipei	0.90	54	0.70	0.71	0.77	0.71	0.76	0.75	0.75	0.77	0.74	0.66
Croatia	0.87	48	0.54	0.68	0.61	0.67	0.79	0.77	0.70	0.71	0.73	0.72
Cyprus	0.89	51	0.54	0.62	0.76	0.75	0.76	0.77	0.72	0.77	0.68	0.73
Czech Republic	0.88	50	0.54	0.76	0.69	0.66	0.77	0.77	0.57	0.77	0.72	0.74
Denmark	0.88	50	0.49	0.75	0.73	0.73	0.73	0.79	0.67	0.72	0.67	0.73
England	0.87	48	0.51	0.72	0.73	0.73	0.74	0.76	0.60	0.70	0.67	0.71
Finland	0.86	46	0.41	0.72	0.68	0.68	0.66	0.78	0.67	0.74	0.70	0.72
France	0.84	42	0.45	0.66	0.71	0.69	0.68	0.72	0.64	0.63	0.64	0.65
Georgia	0.87	53	0.38	0.74	0.48	0.79	0.80	0.87	0.76	0.83	0.66	0.79
Germany	0.85	44	0.46	0.74	0.69	0.71	0.74	0.73	0.65	0.63	0.63	0.63
Hong Kong SAR	0.91	56	0.67	0.76	0.78	0.78	0.79	0.75	0.74	0.75	0.72	0.73
Hungary	0.87	47	0.51	0.63	0.73	0.71	0.73	0.75	0.62	0.70	0.70	0.72
Indonesia	0.79	36	0.43	0.55	0.63	0.64	0.57	0.62	0.64	0.67	0.64	0.56
Iran, Islamic Rep. of	0.85	45	0.36	0.62	0.71	0.66	0.75	0.76	0.70	0.68	0.64	0.73
Ireland	0.87	47	0.48	0.71	0.73	0.73	0.75	0.75	0.62	0.69	0.68	0.71
Italy	0.82	41	0.36	0.54	0.70	0.69	0.72	0.71	0.67	0.60	0.60	0.69
Japan	0.90	53	0.57	0.79	0.77	0.73	0.77	0.79	0.55	0.76	0.76	0.75
Jordan	0.84	46	0.35	0.60	0.75	0.73	0.76	0.76	0.65	0.71	0.71	0.66
Kazakhstan	0.83	43	0.41	0.52	0.72	0.75	0.72	0.73	0.75	0.60	0.66	0.63
Korea, Rep. of	0.90	54	0.53	0.70	0.78	0.76	0.78	0.78	0.59	0.81	0.78	0.78
Kuwait	0.85	45	0.44	0.66	0.67	0.72	0.75	0.75	0.65	0.69	0.66	0.65
Lithuania	0.83	42	0.47	0.60	0.60	0.70	0.70	0.71	0.63	0.64	0.66	0.70
Morocco	0.78	37	0.37	0.53	0.67	0.64	0.66	0.69	0.55	0.69	0.65	0.62
Netherlands	0.82	40	0.54	0.66	0.64	0.63	0.72	0.70	0.56	0.60	0.60	0.67
New Zealand	0.87	48	0.53	0.69	0.73	0.72	0.75	0.75	0.63	0.70	0.65	0.69
Northern Ireland	0.86	45	0.49	0.70	0.73	0.70	0.75	0.72	0.57	0.66	0.63	0.71
Norway (5)	0.87	48	0.51	0.72	0.69	0.70	0.74	0.74	0.67	0.70	0.70	0.71
Oman	0.81	41	0.35	0.59	0.69	0.64	0.69	0.71	0.68	0.68	0.68	0.65
Poland	0.91	55	0.61	0.70	0.73	0.77	0.81	0.81	0.72	0.78	0.72	0.76
Portugal	0.79	38	0.37	0.51	0.64	0.71	0.67	0.67	0.63	0.57	0.63	0.67
Qatar	0.90	53	0.53	0.73	0.76	0.78	0.78	0.78	0.69	0.78	0.71	0.70
Russian Federation	0.82	42	0.43	0.64	0.68	0.69	0.69	0.69	0.62	0.67	0.64	0.68
Saudi Arabia	0.87	48	0.40	0.68	0.74	0.72	0.77	0.77	0.63	0.77	0.69	0.69
Serbia	0.85	44	0.46	0.67	0.70	0.68	0.73	0.72	0.72	0.61	0.64	0.65
Singapore	0.88	49	0.56	0.72	0.75	0.74	0.74	0.73	0.64	0.72	0.71	0.68
Slovak Republic	0.88	49	0.56	0.70	0.69	0.69	0.73	0.76	0.69	0.73	0.74	0.72
Slovenia	0.88	49	0.55	0.59	0.68	0.76	0.74	0.79	0.71	0.74	0.71	0.68
South Africa (5)	0.85	42	0.52	0.63	0.67	0.69	0.63	0.68	0.64	0.66	0.67	0.64
Spain	0.84	44	0.39	0.58	0.69	0.72	0.72	0.67	0.65	0.70	0.71	0.72
Sweden	0.86	46	0.44	0.70	0.68	0.68	0.73	0.73	0.68	0.73	0.67	0.70
Turkey	0.73	34	0.39	0.53	0.61	0.40	0.65	0.63	0.60	0.58	0.64	0.68
United Arab Emirates	0.88	48	0.48	0.70	0.72	0.74	0.76	0.75	0.67	0.71	0.69	0.68
United States	0.88	49	0.54	0.73	0.74	0.72	0.75	0.75	0.63	0.71	0.71	0.72
Benchmarking Participants												
Buenos Aires, Argentina	0.84	43	0.41	0.56	0.72	0.70	0.72	0.72	0.61	0.67	0.67	0.71
Ontario, Canada	0.88	48	0.53	0.71	0.73	0.74	0.74	0.75	0.62	0.70	0.67	0.68
Quebec, Canada	0.87	46	0.49	0.68	0.73	0.72	0.74	0.74	0.67	0.67	0.67	0.65
Norway (4)	0.85	44	0.52	0.64	0.69	0.70	0.70	0.73	0.63	0.69	0.66	0.67
Abu Dhabi, UAE	0.87	46	0.47	0.69	0.72	0.74	0.74	0.74	0.65	0.70	0.67	0.65
Dubai, UAE	0.88	49	0.53	0.70	0.71	0.74	0.75	0.75	0.67	0.71	0.70	0.69
Florida, US	0.87	47	0.57	0.72	0.74	0.72	0.72	0.73	0.65	0.65	0.66	0.71

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students' Views on Engaging Teaching in Mathematics Lessons Scale, Fourth Grade, and TIMSS 2015 Mathematics Achievement

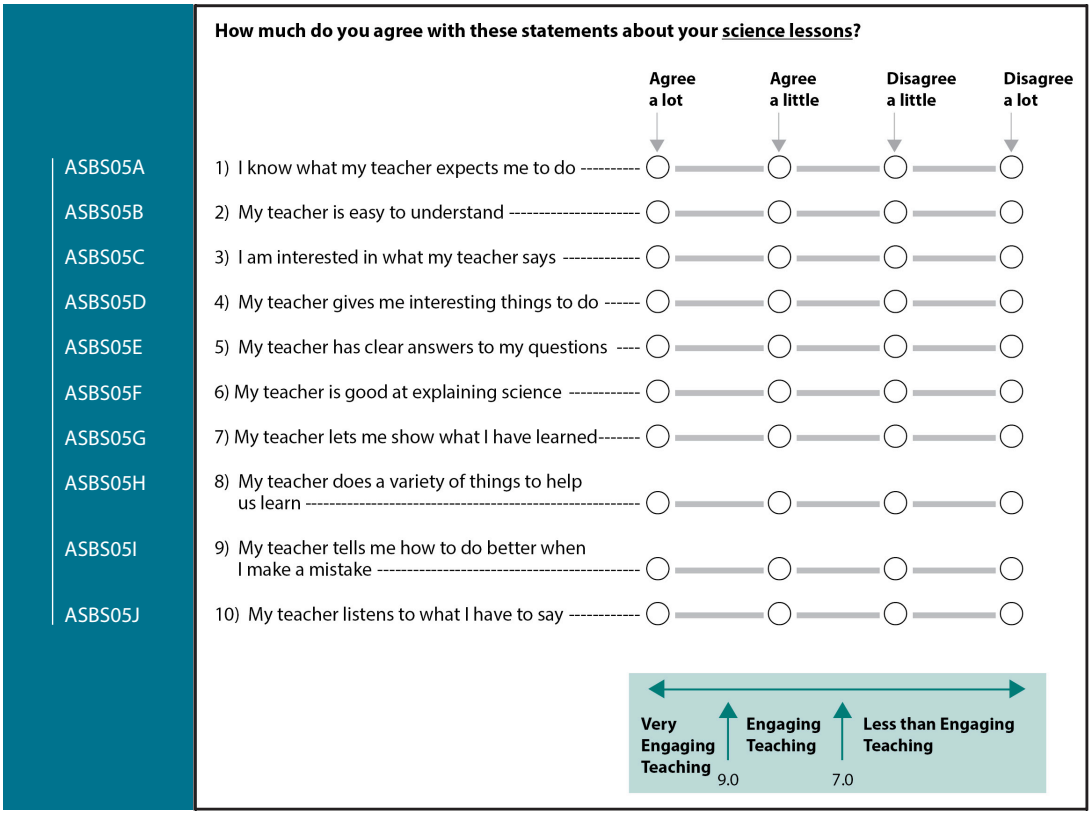
Country	Pearson's Correlation with Mathematics Achievement		Variance in Mathematics Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.03	0.00	0.01
Bahrain	0.13	0.02	0.02
Belgium (Flemish)	-0.06	0.00	0.00
Bulgaria	0.09	0.01	0.02
Canada	0.02	0.00	0.00
Chile	0.12	0.01	0.02
Chinese Taipei	0.10	0.01	0.01
Croatia	0.08	0.01	0.00
Cyprus	0.05	0.00	0.00
Czech Republic	-0.05	0.00	0.00
Denmark	0.11	0.01	0.01
England	0.01	0.00	0.00
Finland	0.08	0.01	0.01
France	0.01	0.00	0.00
Georgia	0.13	0.02	0.03
Germany	-0.01	0.00	0.00
Hong Kong SAR	0.12	0.02	0.02
Hungary	0.05	0.00	0.00
Indonesia	0.07	0.00	0.02
Iran, Islamic Rep. of	0.04	0.00	0.01
Ireland	-0.01	0.00	0.00
Italy	0.07	0.00	0.01
Japan	0.05	0.00	0.01
Jordan	0.14	0.02	0.03
Kazakhstan	0.10	0.01	0.02
Korea, Rep. of	0.11	0.01	0.01
Kuwait	0.06	0.00	0.01
Lithuania	0.03	0.00	0.00
Morocco	0.13	0.02	0.03
Netherlands	0.04	0.00	0.01
New Zealand	-0.06	0.00	0.00
Northern Ireland	-0.03	0.00	0.00
Norway (5)	0.05	0.00	0.00
Oman	0.15	0.02	0.04
Poland	0.02	0.00	0.00
Portugal	0.08	0.01	0.00
Qatar	0.13	0.02	0.04
Russian Federation	0.04	0.00	0.00
Saudi Arabia	0.11	0.01	0.03
Serbia	-0.01	0.00	0.00
Singapore	0.10	0.01	0.01
Slovak Republic	-0.08	0.01	0.00
Slovenia	0.05	0.00	0.00
South Africa (5)	0.23	0.05	0.07
Spain	-0.01	0.00	0.00
Sweden	-0.02	0.00	0.00
Turkey	0.24	0.06	0.06
United Arab Emirates	0.17	0.03	0.03
United States	0.07	0.01	0.01
International Median	0.06	0.00	0.01
Benchmarking Participants			
Buenos Aires, Argentina	-0.01	0.00	0.00
Ontario, Canada	0.03	0.00	0.01
Quebec, Canada	-0.01	0.00	0.00
Norway (4)	0.05	0.00	0.00
Abu Dhabi, UAE	0.17	0.03	0.04
Dubai, UAE	0.12	0.01	0.02
Florida, US	0.10	0.01	0.02

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students' Views on Engaging Teaching in Science Lessons Scale, Fourth Grade

The Students' Views on Engaging Teaching in Science Lessons (ESL) scale was created based on students' degree of agreement with the ten statements described below.

Items in the TIMSS 2015 Students' Views on Engaging Teaching in Science Lessons Scale, Fourth Grade



Item Parameters for the TIMSS 2015 Students' Views on Engaging Teaching in Science Lessons Scale, Fourth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
ASBS05A	0.50888	-0.81715	-0.58879	1.40594	1.50
ASBS05B	-0.03751	-0.82603	-0.63735	1.46338	1.09
ASBS05C	-0.04871	-0.88128	-0.35960	1.24088	1.02
ASBS05D	0.22876	-0.99483	-0.27841	1.27324	1.02
ASBS05E	-0.21612	-0.95060	-0.40396	1.35456	0.90
ASBS05F	-0.47098	-0.74576	-0.49669	1.24245	0.91
ASBS05G	0.45511	-1.06157	-0.35018	1.41175	1.15
ASBS05H	-0.31307	-0.72648	-0.49092	1.21740	1.02
ASBS05I	-0.05738	-0.77774	-0.42703	1.20477	1.04
ASBS05J	-0.04898	-0.67414	-0.50076	1.17490	1.05

Scale Transformation Constants for the TIMSS 2015 Students' Views on Engaging Teaching in Science Lessons Scale, Fourth Grade

Scale Transformation Constants	
A = 7.078772	Transformed Scale Score = 7.078772 + 1.209047 • Logit Scale Score
B = 1.209047	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students' Views on Engaging Teaching in Science Lessons Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	2.40628	
1	3.68357	
2	4.27493	
3	4.67030	
4	4.97489	
5	5.22528	
6	5.44624	
7	5.64160	
8	5.82255	
9	5.99269	
10	6.15531	
11	6.31297	
12	6.46770	
13	6.62249	
14	6.77592	
15	6.93146	7.0
16	7.09103	
17	7.25510	
18	7.42646	
19	7.60651	
20	7.79674	
21	8.00038	
22	8.22000	
23	8.45923	
24	8.72285	
25	9.01785	9.0
26	9.35467	
27	9.75424	
28	10.25748	
29	10.97053	
30	12.39384	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students' Views on Engaging Teaching in Science Lessons Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item									
			ASBS05A	ASBS05B	ASBS05C	ASBS05D	ASBS05E	ASBS05F	ASBS05G	ASBS05H	ASBS05I	ASBS05J
Australia	0.91	56	0.63	0.78	0.79	0.78	0.80	0.76	0.69	0.77	0.72	0.72
Bahrain	0.90	54	0.49	0.71	0.77	0.79	0.81	0.76	0.75	0.78	0.74	0.71
Belgium (Flemish)	0.87	48	0.62	0.74	0.71	0.69	0.75	0.72	0.58	0.70	0.69	0.69
Bulgaria	0.88	50	0.54	0.66	0.71	0.71	0.78	0.74	0.75	0.71	0.74	0.74
Canada	0.90	53	0.60	0.76	0.76	0.76	0.78	0.76	0.68	0.74	0.71	0.71
Chile	0.90	53	0.56	0.68	0.75	0.75	0.78	0.78	0.68	0.76	0.75	0.75
Chinese Taipei	0.92	59	0.76	0.79	0.81	0.77	0.79	0.77	0.75	0.80	0.74	0.69
Croatia	0.90	55	0.59	0.77	0.66	0.72	0.82	0.82	0.76	0.73	0.76	0.78
Cyprus	0.93	60	0.63	0.70	0.81	0.80	0.83	0.82	0.78	0.82	0.77	0.79
Czech Republic	0.90	55	0.65	0.80	0.74	0.68	0.79	0.80	0.62	0.79	0.75	0.75
Denmark	0.92	60	0.62	0.80	0.80	0.78	0.79	0.81	0.74	0.80	0.77	0.77
England	0.91	55	0.62	0.78	0.77	0.77	0.80	0.79	0.65	0.74	0.73	0.73
Finland	0.89	52	0.52	0.79	0.73	0.72	0.72	0.80	0.72	0.74	0.72	0.73
France	0.89	52	0.55	0.74	0.74	0.75	0.76	0.77	0.73	0.73	0.69	0.72
Georgia	0.89	57	0.39	0.78	0.54	0.82	0.84	0.86	0.82	0.83	0.70	0.82
Germany	0.89	51	0.52	0.78	0.74	0.76	0.79	0.78	0.67	0.66	0.71	0.71
Hong Kong SAR	0.94	65	0.77	0.81	0.83	0.84	0.85	0.81	0.78	0.82	0.78	0.78
Hungary	0.90	54	0.63	0.71	0.76	0.74	0.78	0.79	0.68	0.74	0.74	0.76
Indonesia	0.81	38	0.47	0.56	0.61	0.69	0.59	0.62	0.68	0.65	0.66	0.60
Iran, Islamic Rep. of	0.85	46	0.37	0.66	0.75	0.65	0.74	0.77	0.72	0.71	0.65	0.70
Ireland	0.90	53	0.56	0.76	0.76	0.75	0.79	0.76	0.67	0.74	0.72	0.74
Italy	0.85	45	0.45	0.57	0.72	0.73	0.75	0.71	0.69	0.63	0.67	0.71
Japan	0.92	58	0.62	0.80	0.82	0.76	0.81	0.79	0.59	0.79	0.80	0.78
Jordan	0.87	49	0.37	0.66	0.77	0.76	0.77	0.78	0.64	0.79	0.73	0.66
Kazakhstan	0.84	45	0.44	0.60	0.71	0.76	0.70	0.74	0.73	0.64	0.68	0.66
Korea, Rep. of	0.92	59	0.63	0.77	0.81	0.81	0.81	0.80	0.63	0.82	0.80	0.79
Kuwait	0.84	44	0.39	0.65	0.71	0.73	0.75	0.74	0.63	0.71	0.64	0.64
Lithuania	0.87	48	0.54	0.65	0.65	0.73	0.77	0.75	0.64	0.68	0.70	0.77
Morocco	0.79	38	0.34	0.47	0.67	0.69	0.69	0.71	0.52	0.71	0.63	0.66
Netherlands	0.86	45	0.60	0.71	0.67	0.64	0.75	0.70	0.62	0.65	0.64	0.73
New Zealand	0.92	57	0.65	0.76	0.78	0.80	0.81	0.78	0.72	0.78	0.75	0.75
Northern Ireland	0.90	53	0.59	0.75	0.74	0.77	0.77	0.71	0.67	0.74	0.73	0.74
Norway (5)	0.90	53	0.60	0.75	0.71	0.74	0.76	0.77	0.70	0.73	0.75	0.72
Oman	0.82	42	0.34	0.65	0.73	0.69	0.69	0.70	0.67	0.67	0.64	0.65
Poland	0.93	62	0.71	0.77	0.79	0.80	0.84	0.83	0.79	0.79	0.76	0.79
Portugal	0.84	44	0.53	0.55	0.67	0.74	0.69	0.69	0.66	0.67	0.68	0.72
Qatar	0.91	56	0.55	0.76	0.79	0.80	0.80	0.80	0.71	0.79	0.74	0.72
Russian Federation	0.86	48	0.51	0.67	0.73	0.74	0.75	0.73	0.69	0.69	0.67	0.70
Saudi Arabia	0.89	51	0.47	0.72	0.77	0.74	0.78	0.78	0.68	0.75	0.69	0.73
Serbia	0.87	48	0.52	0.74	0.72	0.68	0.78	0.73	0.74	0.58	0.70	0.68
Singapore	0.91	56	0.66	0.78	0.79	0.79	0.79	0.78	0.68	0.76	0.76	0.69
Slovak Republic	0.90	55	0.65	0.75	0.73	0.71	0.78	0.77	0.70	0.77	0.76	0.75
Slovenia	0.91	56	0.64	0.70	0.71	0.78	0.79	0.83	0.74	0.78	0.77	0.74
South Africa (5)	-	-	-	-	-	-	-	-	-	-	-	-
Spain	0.88	51	0.47	0.68	0.74	0.74	0.78	0.69	0.71	0.76	0.77	0.77
Sweden	0.89	52	0.53	0.75	0.71	0.73	0.78	0.78	0.69	0.74	0.70	0.73
Turkey	0.77	37	0.39	0.55	0.61	0.45	0.70	0.66	0.66	0.57	0.68	0.70
United Arab Emirates	0.90	54	0.54	0.75	0.77	0.77	0.79	0.79	0.71	0.74	0.73	0.71
United States	0.91	56	0.64	0.78	0.78	0.76	0.79	0.78	0.69	0.76	0.73	0.76
Benchmarking Participants												
Buenos Aires, Argentina	0.87	49	0.49	0.63	0.75	0.73	0.78	0.75	0.65	0.74	0.73	0.71
Ontario, Canada	0.90	53	0.62	0.76	0.77	0.76	0.77	0.76	0.67	0.74	0.72	0.71
Quebec, Canada	0.89	52	0.52	0.76	0.75	0.76	0.78	0.73	0.72	0.74	0.69	0.70
Norway (4)	0.89	52	0.61	0.71	0.72	0.75	0.77	0.76	0.72	0.74	0.74	0.70
Abu Dhabi, UAE	0.89	52	0.51	0.74	0.75	0.77	0.79	0.77	0.70	0.73	0.71	0.70
Dubai, UAE	0.90	53	0.59	0.74	0.75	0.76	0.78	0.77	0.70	0.74	0.72	0.71
Florida, US	0.91	57	0.66	0.77	0.77	0.76	0.79	0.78	0.73	0.73	0.75	0.77

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students' Views on Engaging Teaching in Science Lessons Scale, Fourth Grade, and TIMSS 2015 Science Achievement

Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	-0.02	0.00	0.00
Bahrain	0.22	0.05	0.04
Belgium (Flemish)	-0.08	0.01	0.01
Bulgaria	0.11	0.01	0.02
Canada	0.02	0.00	0.00
Chile	0.09	0.01	0.01
Chinese Taipei	0.07	0.01	0.01
Croatia	0.06	0.00	0.01
Cyprus	0.03	0.00	0.00
Czech Republic	-0.06	0.00	0.00
Denmark	0.02	0.00	0.00
England	-0.05	0.00	0.00
Finland	0.07	0.00	0.01
France	-0.02	0.00	0.00
Georgia	0.10	0.01	0.02
Germany	-0.02	0.00	0.00
Hong Kong SAR	0.07	0.00	0.01
Hungary	0.04	0.00	0.00
Indonesia	0.16	0.02	0.04
Iran, Islamic Rep. of	0.08	0.01	0.02
Ireland	-0.05	0.00	0.00
Italy	0.04	0.00	0.01
Japan	0.04	0.00	0.00
Jordan	-	-	-
Kazakhstan	0.12	0.01	0.02
Korea, Rep. of	0.09	0.01	0.01
Kuwait	0.13	0.02	0.03
Lithuania	0.07	0.00	0.01
Morocco	0.17	0.03	0.03
Netherlands	-0.01	0.00	0.00
New Zealand	-0.05	0.00	0.00
Northern Ireland	-0.06	0.00	0.00
Norway (5)	-0.01	0.00	0.00
Oman	0.17	0.03	0.04
Poland	-0.02	0.00	0.00
Portugal	0.07	0.01	0.00
Qatar	0.19	0.04	0.04
Russian Federation	-0.01	0.00	0.00
Saudi Arabia	0.12	0.01	0.02
Serbia	-0.02	0.00	0.00
Singapore	0.07	0.00	0.00
Slovak Republic	-0.07	0.00	0.00
Slovenia	0.06	0.00	0.01
South Africa (5)	-	-	-
Spain	0.03	0.00	0.00
Sweden	-0.06	0.00	0.01
Turkey	0.28	0.08	0.07
United Arab Emirates	0.20	0.04	0.04
United States	0.06	0.00	0.01
International Median	0.06	0.00	0.01
Benchmarking Participants			
Buenos Aires, Argentina	0.01	0.00	0.00
Ontario, Canada	0.02	0.00	0.00
Quebec, Canada	-0.01	0.00	0.00
Norway (4)	0.03	0.00	0.00
Abu Dhabi, UAE	0.18	0.03	0.03
Dubai, UAE	0.16	0.03	0.03
Florida, US	0.15	0.02	0.03

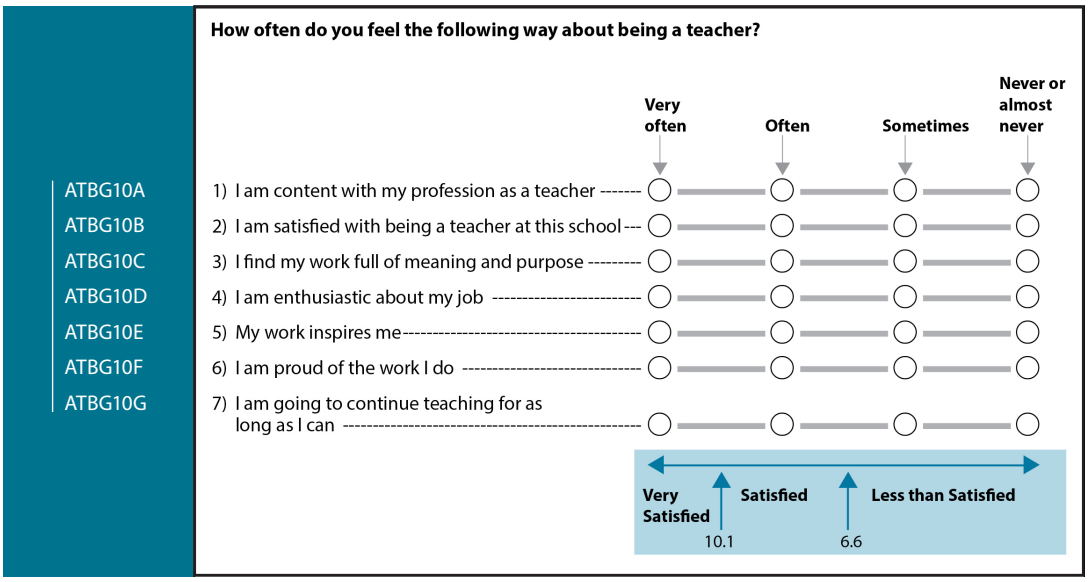
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Teacher Job Satisfaction Scale, Fourth Grade

The Teacher Job Satisfaction (TJS) scale was created based on how often teachers responded positively to the seven statements described below.

Items in the TIMSS 2015 Teacher Job Satisfaction Scale, Fourth Grade[1]



1 For the purpose of scaling, categories in which there were very few respondents were combined. The categories "Sometimes" and "Never or almost never" were combined for all variables. The scale statistics that are reported herein reflect analysis of the items following collapsing.

Item Parameters for the TIMSS 2015 Teacher Job Satisfaction Scale, Fourth Grade

Item	delta	tau_1	tau_2	Infit
ATBG10A	0.18167	-1.87034	1.87034	0.92
ATBG10B	0.10394	-1.66322	1.66322	1.28
ATBG10C	-0.65803	-1.81035	1.81035	0.97
ATBG10D	-0.08795	-1.84973	1.84973	0.79
ATBG10E	0.26732	-1.76637	1.76637	0.84
ATBG10F	-0.20476	-1.60751	1.60751	1.00
ATBG10G	0.39781	-1.29161	1.29161	1.19

Scale Transformation Constants for the TIMSS 2015 Teacher Job Satisfaction Scale, Fourth Grade

Scale Transformation Constants	
A = 8.377535	Transformed Scale Score = 8.377535 + 0.905788 • Logit Scale Score
B = 0.905788	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Teacher Job Satisfaction Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	4.30095	
1	5.44546	
2	6.07197	
3	6.56411	6.6
4	7.00941	
5	7.44953	
6	7.91110	
7	8.39763	
8	8.88012	
9	9.32868	
10	9.75567	
11	10.18696	10.1
12	10.66453	
13	11.27347	
14	12.40375	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Teacher Job Satisfaction Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item						
			ATBG10A	ATBG10B	ATBG10C	ATBG10D	ATBG10E	ATBG10F	ATBG10G
Australia	0.91	65	0.84	0.70	0.85	0.87	0.88	0.74	0.74
Bahrain	0.90	63	0.84	0.73	0.71	0.87	0.86	0.77	0.76
Belgium (Flemish)	0.90	63	0.80	0.65	0.75	0.89	0.85	0.84	0.74
Bulgaria	0.89	61	0.73	0.74	0.76	0.86	0.81	0.84	0.69
Canada	0.90	63	0.83	0.70	0.78	0.88	0.85	0.79	0.73
Chile	0.87	58	0.70	0.65	0.66	0.81	0.87	0.85	0.76
Chinese Taipei	0.94	75	0.89	0.79	0.89	0.91	0.88	0.92	0.80
Croatia	0.91	65	0.82	0.72	0.74	0.87	0.87	0.86	0.76
Cyprus	0.91	66	0.82	0.60	0.86	0.87	0.89	0.81	0.80
Czech Republic	0.91	66	0.80	0.65	0.86	0.89	0.89	0.80	0.77
Denmark	0.92	67	0.87	0.78	0.76	0.88	0.86	0.76	0.80
England	0.93	73	0.85	0.76	0.85	0.91	0.92	0.86	0.80
Finland	0.93	69	0.86	0.73	0.79	0.89	0.87	0.85	0.83
France	0.88	58	0.78	0.59	0.66	0.88	0.87	0.78	0.75
Georgia	0.85	54	0.69	0.67	0.58	0.79	0.77	0.82	0.79
Germany	0.87	58	0.77	0.61	0.77	0.86	0.83	0.74	0.71
Hong Kong SAR	0.93	70	0.86	0.81	0.86	0.86	0.85	0.83	0.77
Hungary	0.89	63	0.78	0.67	0.79	0.88	0.86	0.77	0.80
Indonesia	0.87	58	0.74	0.81	0.84	0.82	0.78	0.67	0.66
Iran, Islamic Rep. of	0.82	51	0.73	0.59	0.74	0.80	0.76	0.59	0.76
Ireland	0.91	67	0.83	0.63	0.87	0.86	0.87	0.80	0.84
Italy	0.90	62	0.80	0.73	0.74	0.87	0.83	0.83	0.69
Japan	0.92	67	0.84	0.76	0.84	0.83	0.89	0.84	0.73
Jordan	0.91	66	0.83	0.70	0.73	0.87	0.83	0.88	0.83
Kazakhstan	0.89	61	0.69	0.76	0.77	0.78	0.82	0.83	0.79
Korea, Rep. of	0.93	72	0.81	0.71	0.89	0.92	0.93	0.88	0.78
Kuwait	0.92	68	0.83	0.77	0.79	0.89	0.86	0.83	0.81
Lithuania	0.90	63	0.78	0.74	0.75	0.85	0.85	0.79	0.77
Morocco	0.89	62	0.81	0.71	0.76	0.85	0.87	0.79	0.69
Netherlands	0.87	57	0.75	0.65	0.71	0.83	0.87	0.72	0.73
New Zealand	0.92	67	0.83	0.76	0.84	0.88	0.86	0.75	0.81
Northern Ireland	0.92	68	0.88	0.72	0.88	0.87	0.87	0.75	0.78
Norway (5)	0.92	67	0.82	0.73	0.81	0.87	0.86	0.82	0.82
Oman	0.85	55	0.79	0.67	0.62	0.85	0.81	0.76	0.65
Poland	0.91	66	0.85	0.73	0.82	0.86	0.84	0.83	0.73
Portugal	0.86	54	0.77	0.63	0.71	0.85	0.78	0.69	0.70
Qatar	0.90	64	0.80	0.77	0.78	0.84	0.85	0.80	0.75
Russian Federation	0.89	61	0.86	0.78	0.63	0.84	0.85	0.79	0.68
Saudi Arabia	0.88	60	0.79	0.72	0.71	0.84	0.80	0.81	0.76
Serbia	0.88	59	0.81	0.66	0.70	0.83	0.82	0.78	0.76
Singapore	0.95	79	0.88	0.81	0.89	0.93	0.93	0.91	0.86
Slovak Republic	0.92	68	0.83	0.69	0.84	0.89	0.86	0.85	0.80
Slovenia	0.87	57	0.76	0.67	0.80	0.82	0.74	0.76	0.72
South Africa (5)	0.90	63	0.76	0.75	0.83	0.83	0.83	0.79	0.76
Spain	0.88	60	0.79	0.73	0.80	0.80	0.84	0.76	0.66
Sweden	0.85	55	0.80	0.56	0.69	0.85	0.85	0.69	0.69
Turkey	0.84	53	0.73	0.59	0.65	0.83	0.83	0.75	0.65
United Arab Emirates	0.90	63	0.79	0.74	0.74	0.86	0.84	0.81	0.75
United States	0.92	69	0.83	0.75	0.85	0.91	0.87	0.78	0.82
Benchmarking Participants									
Buenos Aires, Argentina	0.87	57	0.68	0.60	0.77	0.84	0.76	0.82	0.81
Ontario, Canada	0.91	65	0.84	0.70	0.85	0.87	0.86	0.79	0.73
Quebec, Canada	0.90	62	0.81	0.65	0.64	0.90	0.84	0.82	0.80
Norway (4)	0.92	68	0.86	0.66	0.78	0.90	0.88	0.88	0.78
Abu Dhabi, UAE	0.91	65	0.84	0.77	0.81	0.85	0.85	0.83	0.65
Dubai, UAE	0.89	62	0.75	0.78	0.75	0.87	0.82	0.77	0.77
Florida, US	0.91	67	0.78	0.77	0.88	0.85	0.86	0.72	0.84

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Teacher Job Satisfaction Scale, Fourth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.04	0.03	0.00	0.00	0.00	0.00
Bahrain	0.10	0.02	0.01	0.00	0.01	0.00
Belgium (Flemish)	0.01	0.02	0.00	0.00	0.00	0.00
Bulgaria	0.05	0.05	0.00	0.00	0.00	0.01
Canada	-0.02	-0.02	0.00	0.00	0.00	0.00
Chile	0.13	0.09	0.02	0.01	0.02	0.01
Chinese Taipei	-0.02	0.03	0.00	0.00	0.00	0.00
Croatia	0.02	0.01	0.00	0.00	0.00	0.00
Cyprus	0.03	0.02	0.00	0.00	0.00	0.00
Czech Republic	0.04	0.05	0.00	0.00	0.00	0.00
Denmark	-0.04	-0.01	0.00	0.00	0.01	0.00
England	0.07	0.04	0.01	0.00	0.00	0.00
Finland	0.01	0.01	0.00	0.00	0.00	0.00
France	0.06	0.06	0.00	0.00	0.01	0.01
Georgia	0.01	0.03	0.00	0.00	0.00	0.00
Germany	0.03	0.02	0.00	0.00	0.00	0.00
Hong Kong SAR	0.06	0.15	0.00	0.02	0.01	0.02
Hungary	0.06	0.03	0.00	0.00	0.02	0.00
Indonesia	0.01	0.04	0.00	0.00	0.00	0.01
Iran, Islamic Rep. of	-0.01	-0.02	0.00	0.00	0.00	0.00
Ireland	0.02	0.05	0.00	0.00	0.00	0.00
Italy	0.00	0.01	0.00	0.00	0.00	0.00
Japan	0.02	0.02	0.00	0.00	0.00	0.00
Jordan	0.10	-	0.01	-	0.01	-
Kazakhstan	0.06	0.05	0.00	0.00	0.00	0.00
Korea, Rep. of	0.05	0.04	0.00	0.00	0.01	0.00
Kuwait	0.04	0.06	0.00	0.00	0.00	0.01
Lithuania	0.03	0.04	0.00	0.00	0.01	0.00
Morocco	0.12	0.07	0.02	0.00	0.01	0.01
Netherlands	-0.04	-0.04	0.00	0.00	0.00	0.00
New Zealand	0.07	0.07	0.00	0.00	0.00	0.00
Northern Ireland	0.04	0.03	0.00	0.00	0.00	0.00
Norway (5)	0.05	0.03	0.00	0.00	0.00	0.00
Oman	0.05	0.03	0.00	0.00	0.00	0.00
Poland	0.02	0.02	0.00	0.00	0.00	0.00
Portugal	0.12	0.10	0.01	0.01	0.01	0.01
Qatar	-0.07	-0.03	0.00	0.00	0.00	0.00
Russian Federation	-0.04	-0.04	0.00	0.00	0.00	0.00
Saudi Arabia	0.10	0.15	0.01	0.02	0.02	0.02
Serbia	0.01	0.01	0.00	0.00	0.00	0.00
Singapore	0.05	0.03	0.00	0.00	0.01	0.01
Slovak Republic	0.06	0.06	0.00	0.00	0.00	0.00
Slovenia	0.01	0.03	0.00	0.00	0.00	0.00
South Africa (5)	0.02	-	0.00	-	0.00	-
Spain	0.09	0.09	0.01	0.01	0.01	0.01
Sweden	0.08	0.10	0.01	0.01	0.01	0.01
Turkey	0.12	0.11	0.01	0.01	0.01	0.01
United Arab Emirates	0.14	0.14	0.02	0.02	0.02	0.01
United States	0.06	0.04	0.00	0.00	0.00	0.00
International Median	0.04	0.03	0.00	0.00	0.00	0.00
Benchmarking Participants						
Buenos Aires, Argentina	0.17	0.19	0.03	0.04	0.03	0.04
Ontario, Canada	-0.01	-0.03	0.00	0.00	0.00	0.00
Quebec, Canada	0.03	0.01	0.00	0.00	0.00	0.00
Norway (4)	0.04	0.07	0.00	0.01	0.00	0.01
Abu Dhabi, UAE	0.20	0.12	0.04	0.02	0.04	0.01
Dubai, UAE	0.07	0.07	0.00	0.01	0.01	0.01
Florida, US	0.17	0.15	0.03	0.02	0.03	0.03

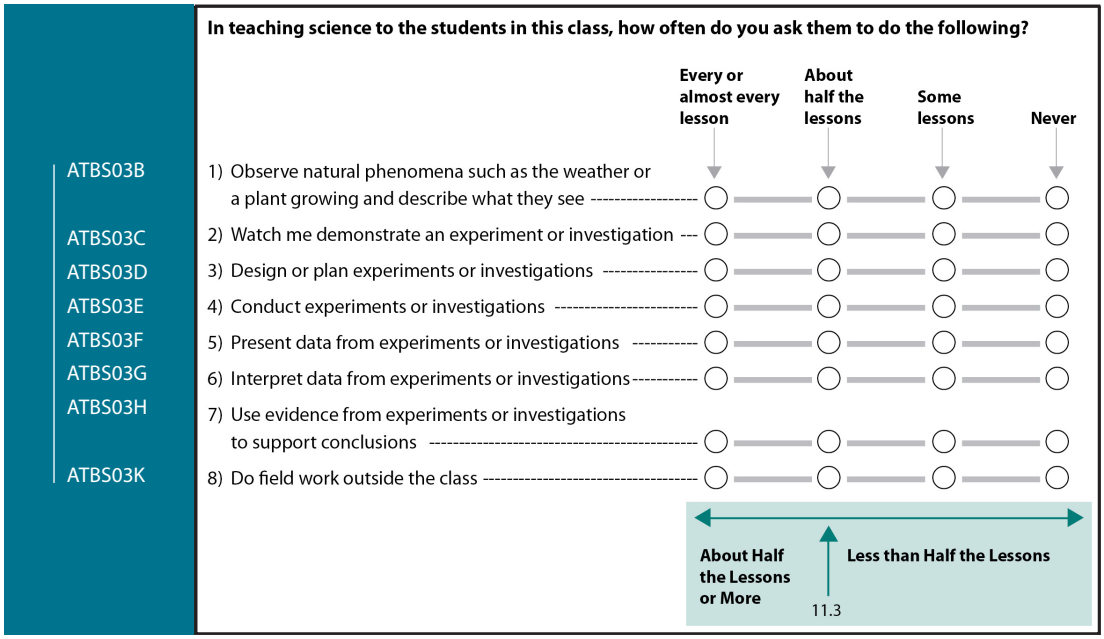
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Teachers Emphasize Science Investigation Scale, Fourth Grade

The Teachers Emphasize Science Investigation (ESI) scale was created based on teachers' responses to how often they used the eight instructional activities described below.

Items in the TIMSS 2015 Teachers Emphasize Science Investigation Scale, Fourth Grade[1]



1 For the purpose of scaling, categories in which there were very few respondents were combined. The categories "Some Lessons" and "Never" were combined for all variables. The scale statistics that are reported herein reflect analysis of the items following collapsing.

Item Parameters for the TIMSS 2015 Teachers Emphasize Science Investigation Scale, Fourth Grade

Item	delta	tau_1	tau_2	Infit
ATBS03B	-0.97859	-1.00917	1.00917	1.54
ATBS03C	-0.43524	-0.63501	0.63501	1.34
ATBS03D	0.08764	-0.94529	0.94529	0.86
ATBS03E	-0.19774	-0.99274	0.99274	0.81
ATBS03F	0.14498	-0.92496	0.92496	0.72
ATBS03G	0.00719	-0.96463	0.96463	0.73
ATBS03H	-0.34379	-0.92870	0.92870	0.92
ATBS03K	1.71555	-0.79925	0.79925	1.40

Scale Transformation Constants for the TIMSS 2015 Teachers Emphasize Science Investigation Scale, Fourth Grade

Scale Transformation Constants	
A = 11.370579	Transformed Scale Score = 11.370579 + 1.031391 • Logit Scale Score
B = 1.031391	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Teachers Emphasize Science Investigation Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	7.29951	
1	8.55692	
2	9.20866	
3	9.68367	
4	10.07397	
5	10.42134	
6	10.74105	
7	11.04610	
8	11.34471	11.3
9	11.64792	
10	11.95987	
11	12.29081	
12	12.65106	
13	13.06204	
14	13.56297	
15	14.24746	
16	15.54731	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Teachers Emphasize Science Investigation Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item							
			ATBSI03B	ATBSI03C	ATBSI03D	ATBSI03E	ATBSI03F	ATBSI03G	ATBSI03H	ATBSI03K
Australia	0.89	58	0.63	0.58	0.83	0.86	0.88	0.88	0.75	0.64
Bahrain	0.83	47	0.46	0.42	0.75	0.80	0.83	0.83	0.80	0.43
Belgium (Flemish)	0.90	64	0.58	0.70	0.90	0.93	0.93	0.91	0.88	0.41
Bulgaria	0.85	53	0.64	0.63	0.80	0.87	0.85	0.81	0.55	0.62
Canada	0.85	49	0.56	0.44	0.72	0.80	0.84	0.86	0.82	0.40
Chile	0.90	62	0.56	0.76	0.83	0.89	0.87	0.83	0.75	0.74
Chinese Taipei	0.89	57	0.59	0.60	0.78	0.84	0.89	0.90	0.88	0.40
Croatia	0.90	62	0.67	0.66	0.84	0.91	0.92	0.91	0.64	0.64
Cyprus	0.81	48	0.32	0.25	0.83	0.85	0.86	0.88	0.85	0.22
Czech Republic	0.87	57	0.54	0.65	0.84	0.88	0.90	0.87	0.79	0.40
Denmark	0.84	50	0.39	0.53	0.73	0.72	0.82	0.85	0.80	0.71
England	0.86	53	0.43	0.55	0.81	0.85	0.88	0.86	0.88	0.31
Finland	0.82	52	0.48	0.55	0.78	0.87	0.88	0.87	0.73	0.45
France	0.85	50	0.53	0.26	0.78	0.89	0.88	0.89	0.84	0.14
Georgia	0.86	56	0.50	0.68	0.87	0.89	0.90	0.86	0.61	0.53
Germany	0.88	55	0.65	0.51	0.78	0.88	0.87	0.88	0.84	0.37
Hong Kong SAR	0.89	58	0.66	0.77	0.87	0.79	0.87	0.85	0.81	0.30
Hungary	0.76	46	0.53	0.41	0.81	0.81	0.84	0.73	0.70	0.40
Indonesia	0.92	63	0.68	0.78	0.80	0.86	0.87	0.86	0.80	0.64
Iran, Islamic Rep. of	0.87	53	0.52	0.62	0.79	0.84	0.84	0.84	0.76	0.56
Ireland	0.81	45	0.37	0.41	0.69	0.75	0.81	0.84	0.85	0.41
Italy	0.91	63	0.67	0.67	0.84	0.87	0.90	0.86	0.86	0.59
Japan	0.84	49	0.64	0.59	0.65	0.76	0.80	0.83	0.82	0.45
Jordan	-	-	-	-	-	-	-	-	-	-
Kazakhstan	0.90	59	0.55	0.77	0.84	0.86	0.85	0.78	0.71	0.71
Korea, Rep. of	0.84	50	0.54	0.45	0.73	0.85	0.86	0.89	0.80	0.35
Kuwait	0.87	53	0.59	0.65	0.71	0.79	0.85	0.85	0.81	0.51
Lithuania	0.90	64	0.67	0.77	0.92	0.92	0.91	0.82	0.75	0.61
Morocco	0.85	49	0.49	0.48	0.74	0.83	0.85	0.85	0.76	0.38
Netherlands	0.82	51	0.66	0.56	0.86	0.87	0.67	0.85	0.82	-0.08
New Zealand	0.85	50	0.48	0.49	0.78	0.81	0.84	0.84	0.83	0.43
Northern Ireland	0.87	54	0.46	0.64	0.87	0.87	0.89	0.86	0.80	0.17
Norway (5)	0.85	50	0.70	0.48	0.74	0.81	0.83	0.83	0.70	0.48
Oman	0.84	48	0.44	0.59	0.77	0.80	0.80	0.81	0.79	0.37
Poland	0.92	67	0.61	0.75	0.89	0.88	0.88	0.91	0.91	0.66
Portugal	0.89	59	0.63	0.68	0.82	0.88	0.87	0.86	0.85	0.43
Qatar	0.89	58	0.49	0.58	0.82	0.86	0.89	0.87	0.87	0.61
Russian Federation	0.91	63	0.60	0.68	0.86	0.92	0.90	0.90	0.85	0.54
Saudi Arabia	0.84	47	0.45	0.40	0.71	0.76	0.88	0.85	0.76	0.54
Serbia	0.90	62	0.66	0.71	0.84	0.86	0.86	0.87	0.81	0.63
Singapore	0.86	51	0.63	0.60	0.75	0.78	0.83	0.84	0.64	0.61
Slovak Republic	0.90	61	0.57	0.70	0.86	0.90	0.91	0.90	0.77	0.52
Slovenia	0.89	59	0.57	0.61	0.80	0.91	0.93	0.90	0.79	0.49
South Africa (5)	-	-	-	-	-	-	-	-	-	-
Spain	0.87	55	0.54	0.65	0.85	0.84	0.84	0.82	0.77	0.55
Sweden	0.83	50	0.25	0.44	0.84	0.86	0.81	0.88	0.85	0.37
Turkey	0.88	57	0.64	0.59	0.82	0.82	0.90	0.88	0.83	0.41
United Arab Emirates	0.88	56	0.56	0.59	0.82	0.85	0.88	0.86	0.84	0.46
United States	0.90	60	0.73	0.66	0.79	0.88	0.90	0.89	0.78	0.52
Benchmarking Participants										
Buenos Aires, Argentina	0.91	61	0.70	0.72	0.85	0.87	0.87	0.87	0.83	0.42
Ontario, Canada	0.86	51	0.52	0.51	0.80	0.76	0.84	0.85	0.82	0.50
Quebec, Canada	0.81	45	0.47	0.51	0.61	0.81	0.84	0.87	0.78	0.16
Norway (4)	0.77	44	0.58	0.71	0.79	0.77	0.78	0.76	0.43	0.33
Abu Dhabi, UAE	0.90	60	0.65	0.65	0.85	0.86	0.89	0.83	0.84	0.57
Dubai, UAE	0.87	56	0.59	0.49	0.81	0.87	0.89	0.88	0.84	0.44
Florida, US	0.91	65	0.78	0.64	0.87	0.91	0.93	0.92	0.77	0.53

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Teachers Emphasize Science Investigation Scale, Fourth Grade, and TIMSS 2015 Science Achievement

Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.05	0.00	0.00
Bahrain	0.05	0.00	0.01
Belgium (Flemish)	-0.07	0.00	0.01
Bulgaria	-0.05	0.00	0.00
Canada	-0.04	0.00	0.00
Chile	-0.08	0.01	0.01
Chinese Taipei	0.01	0.00	0.00
Croatia	-0.01	0.00	0.00
Cyprus	-0.01	0.00	0.00
Czech Republic	0.02	0.00	0.00
Denmark	-0.04	0.00	0.01
England	0.05	0.00	0.00
Finland	-0.04	0.00	0.00
France	0.05	0.00	0.00
Georgia	0.02	0.00	0.00
Germany	0.05	0.00	0.00
Hong Kong SAR	0.05	0.00	0.01
Hungary	-0.03	0.00	0.00
Indonesia	0.07	0.00	0.00
Iran, Islamic Rep. of	0.05	0.00	0.00
Ireland	0.08	0.01	0.01
Italy	-0.01	0.00	0.00
Japan	0.02	0.00	0.00
Jordan	-	-	-
Kazakhstan	0.04	0.00	0.01
Korea, Rep. of	-0.01	0.00	0.00
Kuwait	-0.06	0.00	0.00
Lithuania	-0.04	0.00	0.00
Morocco	0.05	0.00	0.01
Netherlands	0.02	0.00	0.00
New Zealand	0.06	0.00	0.00
Northern Ireland	-0.02	0.00	0.00
Norway (5)	-0.02	0.00	0.00
Oman	0.01	0.00	0.00
Poland	-0.02	0.00	0.00
Portugal	-0.03	0.00	0.00
Qatar	-0.13	0.02	0.02
Russian Federation	-0.03	0.00	0.00
Saudi Arabia	0.12	0.02	0.01
Serbia	0.04	0.00	0.00
Singapore	0.04	0.00	0.00
Slovak Republic	0.07	0.00	0.01
Slovenia	0.01	0.00	0.00
South Africa (5)	-	-	-
Spain	0.03	0.00	0.00
Sweden	0.02	0.00	0.00
Turkey	0.09	0.01	0.01
United Arab Emirates	0.10	0.01	0.01
United States	0.01	0.00	0.00
International Median	0.02	0.00	0.00
Benchmarking Participants			
Buenos Aires, Argentina	-0.07	0.01	0.01
Ontario, Canada	-0.03	0.00	0.00
Quebec, Canada	0.02	0.00	0.00
Norway (4)	0.03	0.00	0.00
Abu Dhabi, UAE	0.09	0.01	0.01
Dubai, UAE	-0.03	0.00	0.00
Florida, US	0.02	0.00	0.00

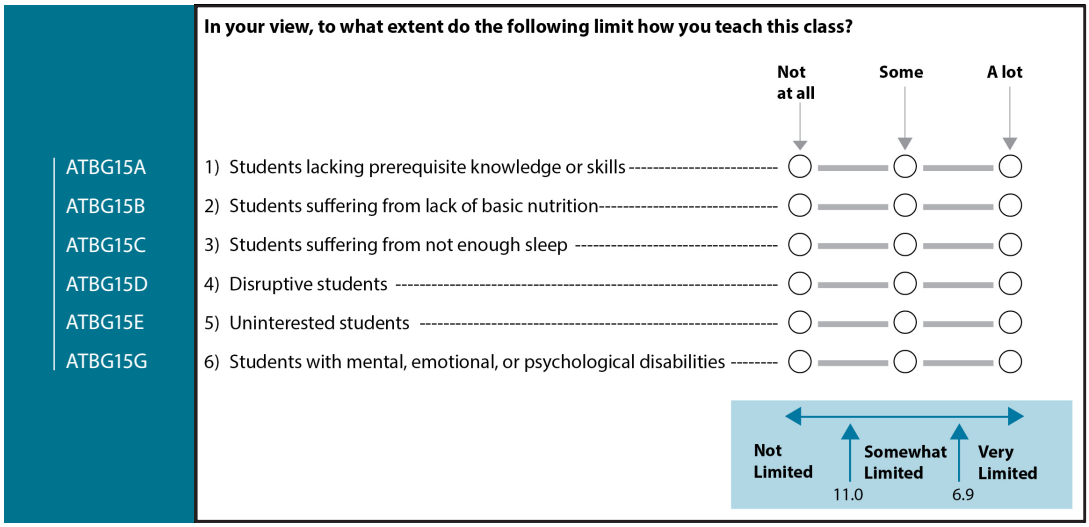
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Teaching Limited by Student Needs Scale, Fourth Grade

The Teaching Limited by Student Needs (LSN) scale was created based on teachers' responses concerning six needs described below.

Items in the TIMSS 2015 Teaching Limited by Student Needs Scale, Fourth Grade



Item Parameters for the TIMSS 2015 Teaching Limited by Student Needs Scale, Fourth Grade

Item	delta	tau_1	tau_2	Infit
ATBG15A	0.90362	-2.02080	2.02080	1.02
ATBG15B	-1.27753	-1.05996	1.05996	1.04
ATBG15C	-0.43516	-1.62325	1.62325	0.98
ATBG15D	0.58656	-1.51840	1.51840	0.97
ATBG15E	0.51242	-1.88467	1.88467	0.92
ATBG15G	-0.28991	-1.50177	1.50177	1.10

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Teaching Limited by Student Needs Scale, Fourth Grade

Scale Transformation Constants	
A = 8.964842	Transformed Scale Score = 8.964842 + 1.203519 • Logit Scale Score
B = 1.203519	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Teaching Limited by Student Needs Scale, Fourth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.80319	
1	5.34054	
2	6.20203	
3	6.88260	6.9
4	7.50773	
5	8.12884	
6	8.78577	
7	9.50093	
8	10.26124	
9	11.04392	11.0
10	11.87401	
11	12.86225	
12	14.51024	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Teaching Limited by Student Needs Scale, Fourth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item					
			ATBG15A	ATBG15B	ATBG15C	ATBG15D	ATBG15E	ATBG15G
Australia	0.78	48	0.64	0.71	0.68	0.74	0.70	0.67
Bahrain	0.77	47	0.67	0.52	0.63	0.77	0.77	0.71
Belgium (Flemish)	0.67	38	0.66	0.45	0.68	0.63	0.68	0.57
Bulgaria	0.70	41	0.59	0.52	0.66	0.68	0.77	0.58
Canada	0.73	43	0.68	0.69	0.73	0.61	0.59	0.62
Chile	0.79	49	0.60	0.77	0.73	0.63	0.77	0.67
Chinese Taipei	0.78	48	0.59	0.70	0.71	0.75	0.74	0.64
Croatia	0.75	45	0.49	0.63	0.71	0.74	0.77	0.65
Cyprus	0.77	46	0.50	0.61	0.75	0.75	0.76	0.68
Czech Republic	0.63	35	0.70	0.28	0.44	0.65	0.72	0.64
Denmark	0.77	48	0.68	0.59	0.67	0.77	0.75	0.67
England	0.79	50	0.60	0.69	0.74	0.74	0.71	0.74
Finland	0.72	42	0.67	0.48	0.58	0.74	0.72	0.66
France	0.70	40	0.59	0.48	0.71	0.73	0.67	0.59
Georgia	0.69	39	0.59	0.57	0.67	0.71	0.58	0.63
Germany	0.74	44	0.69	0.60	0.70	0.68	0.58	0.71
Hong Kong SAR	0.71	41	0.67	0.49	0.60	0.66	0.70	0.69
Hungary	0.77	47	0.72	0.68	0.75	0.66	0.67	0.63
Indonesia	0.59	34	0.43	0.61	0.71	0.56	0.69	0.40
Iran, Islamic Rep. of	0.77	46	0.52	0.68	0.66	0.79	0.66	0.74
Ireland	0.75	44	0.61	0.74	0.66	0.67	0.71	0.58
Italy	0.81	52	0.69	0.73	0.75	0.79	0.72	0.63
Japan	0.75	44	0.71	0.27	0.69	0.76	0.75	0.69
Jordan	0.68	39	0.60	0.53	0.52	0.69	0.71	0.68
Kazakhstan	0.79	48	0.62	0.75	0.75	0.76	0.71	0.56
Korea, Rep. of	0.82	53	0.61	0.64	0.76	0.76	0.77	0.79
Kuwait	0.68	40	0.60	0.50	0.65	0.75	0.76	0.44
Lithuania	0.75	44	0.70	0.50	0.56	0.79	0.72	0.70
Morocco	0.70	40	0.64	0.59	0.59	0.73	0.69	0.56
Netherlands	0.73	42	0.57	0.61	0.62	0.72	0.73	0.63
New Zealand	0.79	48	0.59	0.75	0.80	0.72	0.58	0.71
Northern Ireland	0.75	46	0.65	0.65	0.79	0.54	0.75	0.65
Norway (5)	0.76	47	0.49	0.72	0.73	0.67	0.80	0.66
Oman	0.78	47	0.65	0.69	0.70	0.78	0.70	0.59
Poland	0.71	41	0.69	0.42	0.67	0.65	0.72	0.64
Portugal	0.76	46	0.61	0.73	0.72	0.69	0.71	0.61
Qatar	0.71	41	0.59	0.60	0.69	0.68	0.80	0.44
Russian Federation	0.81	51	0.60	0.73	0.82	0.75	0.67	0.70
Saudi Arabia	0.68	39	0.54	0.61	0.59	0.72	0.74	0.49
Serbia	0.72	42	0.63	0.57	0.65	0.74	0.75	0.56
Singapore	0.77	47	0.64	0.70	0.71	0.68	0.68	0.71
Slovak Republic	0.82	54	0.70	0.56	0.73	0.85	0.78	0.74
Slovenia	0.69	40	0.45	0.57	0.65	0.72	0.76	0.56
South Africa (5)	0.76	45	0.64	0.63	0.66	0.68	0.78	0.63
Spain	0.76	45	0.70	0.47	0.68	0.74	0.75	0.66
Sweden	0.75	45	0.66	0.53	0.67	0.76	0.71	0.65
Turkey	0.73	43	0.66	0.65	0.66	0.70	0.73	0.51
United Arab Emirates	0.76	45	0.66	0.62	0.67	0.75	0.75	0.56
United States	0.78	48	0.69	0.70	0.72	0.72	0.74	0.60
Benchmarking Participants								
Buenos Aires, Argentina	0.81	51	0.60	0.78	0.73	0.70	0.72	0.72
Ontario, Canada	0.74	43	0.67	0.65	0.69	0.62	0.69	0.64
Quebec, Canada	0.58	34	0.67	0.70	0.77	0.49	0.20	0.46
Norway (4)	0.75	45	0.66	0.69	0.71	0.74	0.69	0.51
Abu Dhabi, UAE	0.76	46	0.68	0.52	0.66	0.76	0.74	0.67
Dubai, UAE	0.71	41	0.63	0.68	0.60	0.74	0.68	0.47
Florida, US	0.80	50	0.73	0.67	0.70	0.75	0.82	0.54

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Teaching Limited by Student Needs Scale, Fourth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement (r)		Pearson's Correlation with Achievement (r^2)		Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.28	0.23	0.08	0.05	0.07	0.04
Bahrain	0.09	0.07	0.01	0.00	0.01	0.01
Belgium (Flemish)	0.16	0.18	0.02	0.03	0.02	0.02
Bulgaria	0.19	0.21	0.03	0.05	0.01	0.02
Canada	0.24	0.20	0.06	0.04	0.06	0.04
Chile	0.23	0.27	0.05	0.07	0.06	0.07
Chinese Taipei	0.08	0.02	0.01	0.00	0.01	0.00
Croatia	0.01	0.01	0.00	0.00	0.00	0.00
Cyprus	0.10	0.07	0.01	0.00	0.01	0.00
Czech Republic	0.09	0.09	0.01	0.01	0.01	0.01
Denmark	0.14	0.13	0.02	0.02	0.02	0.01
England	0.26	0.19	0.07	0.04	0.04	0.03
Finland	0.15	0.17	0.02	0.03	0.02	0.02
France	0.19	0.20	0.04	0.04	0.01	0.02
Georgia	0.14	0.14	0.02	0.02	0.02	0.02
Germany	0.18	0.20	0.03	0.04	0.03	0.04
Hong Kong SAR	0.22	0.17	0.05	0.03	0.04	0.02
Hungary	0.21	0.22	0.04	0.05	0.03	0.04
Indonesia	0.14	0.08	0.02	0.01	0.01	0.01
Iran, Islamic Rep. of	0.16	0.17	0.03	0.03	0.02	0.02
Ireland	0.19	0.21	0.04	0.04	0.03	0.03
Italy	0.08	0.05	0.01	0.00	0.01	0.00
Japan	0.09	0.06	0.01	0.00	0.00	0.00
Jordan	0.11	-	0.01	-	0.01	-
Kazakhstan	0.17	0.17	0.03	0.03	0.02	0.02
Korea, Rep. of	0.06	0.05	0.00	0.00	0.01	0.00
Kuwait	0.18	0.16	0.03	0.03	0.03	0.02
Lithuania	0.11	0.09	0.01	0.01	0.01	0.01
Morocco	0.14	0.18	0.02	0.03	0.01	0.03
Netherlands	0.14	0.16	0.02	0.03	0.02	0.03
New Zealand	0.27	0.26	0.07	0.07	0.07	0.06
Northern Ireland	0.22	0.20	0.05	0.04	0.04	0.03
Norway (5)	0.12	0.13	0.01	0.02	0.01	0.01
Oman	-0.04	-0.02	0.00	0.00	0.00	0.00
Poland	0.16	0.09	0.03	0.01	0.01	0.00
Portugal	0.14	0.11	0.02	0.01	0.02	0.01
Qatar	0.24	0.23	0.06	0.05	0.03	0.03
Russian Federation	0.12	0.13	0.01	0.02	0.02	0.02
Saudi Arabia	0.16	0.11	0.03	0.01	0.03	0.02
Serbia	0.05	0.04	0.00	0.00	0.00	0.00
Singapore	0.40	0.34	0.16	0.12	0.12	0.08
Slovak Republic	0.21	0.25	0.04	0.06	0.03	0.04
Slovenia	0.01	0.02	0.00	0.00	0.00	0.00
South Africa (5)	0.08	-	0.01	-	0.01	-
Spain	0.24	0.23	0.06	0.05	0.03	0.03
Sweden	0.18	0.20	0.03	0.04	0.04	0.04
Turkey	0.14	0.14	0.02	0.02	0.02	0.02
United Arab Emirates	0.33	0.34	0.11	0.11	0.09	0.09
United States	0.21	0.22	0.04	0.05	0.04	0.05
International Median	0.16	0.17	0.02	0.03	0.02	0.02
Benchmarking Participants						
Buenos Aires, Argentina	0.21	0.19	0.04	0.04	0.06	0.07
Ontario, Canada	0.16	0.14	0.03	0.02	0.02	0.02
Quebec, Canada	0.21	0.19	0.04	0.04	0.04	0.03
Norway (4)	0.09	0.10	0.01	0.01	0.01	0.01
Abu Dhabi, UAE	0.32	0.34	0.10	0.11	0.08	0.07
Dubai, UAE	0.28	0.26	0.08	0.07	0.08	0.05
Florida, US	0.31	0.28	0.09	0.08	0.04	0.03

A dash (–) indicates comparable data not available.

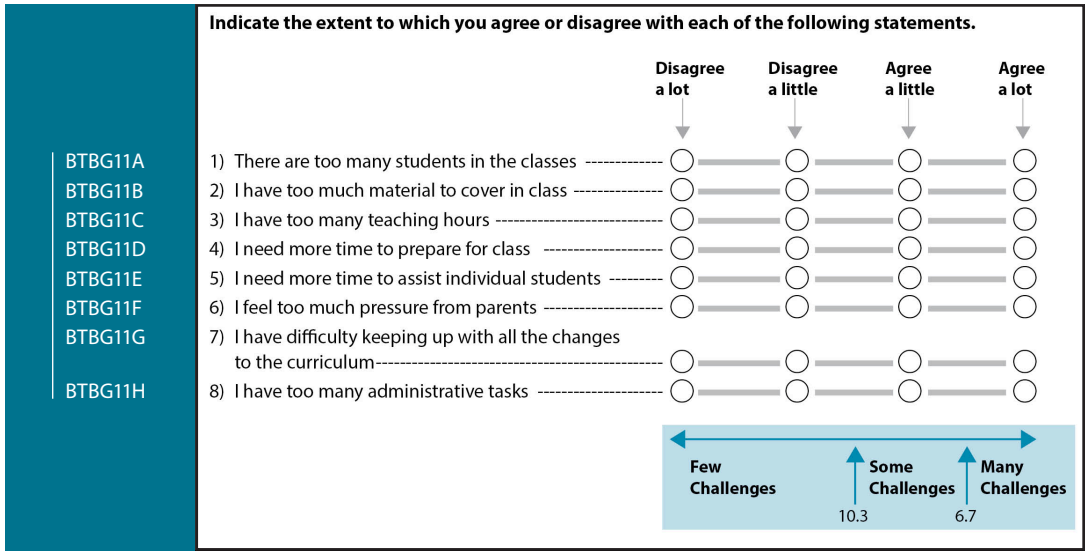
SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Appendix 15B: TIMSS 2015 Context Questionnaire Scales, Eighth Grade

Challenges Facing Teachers Scale, Eighth Grade

The Challenges Facing Teachers (CFT) scale was created based on teachers' degree of agreement with the eight statements described below.

Items in the TIMSS 2015 Challenges Facing Teachers Scale, Eighth Grade



Item Parameters for the TIMSS 2015 Challenges Facing Teachers Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BTBG11A	0.26540	-0.81039	0.24920	0.56119	1.11
BTBG11B	0.52937	-1.30760	0.16072	1.14688	1.02
BTBG11C	-0.28947	-0.97083	-0.04654	1.01737	0.99
BTBG11D	0.28900	-1.29421	0.29118	1.00303	0.92
BTBG11E	1.32631	-1.39494	0.63027	0.76467	0.97
BTBG11F	-0.97546	-1.30536	-0.17929	1.48465	1.08
BTBG11G	-0.91502	-1.36767	0.12377	1.24390	1.02
BTBG11H	-0.23013	-0.80736	0.14004	0.66732	1.04

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Challenges Facing Teachers Scale, Eighth Grade

Scale Transformation Constants	
A = 10.279046	Transformed Scale Score = 10.279046 + 2.114581 • Logit Scale Score
B = 2.114581	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Challenges Facing Teachers Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	1.29542	
1	3.81029	
2	5.08204	
3	5.97972	
4	6.69800	6.7
5	7.30575	
6	7.84015	
7	8.32300	
8	8.76809	
9	9.18765	
10	9.58747	
11	9.97417	
12	10.35346	10.3
13	10.73076	
14	11.11149	
15	11.50149	
16	11.90744	
17	12.33708	
18	12.79739	
19	13.30313	
20	13.87094	
21	14.52876	
22	15.32951	
23	16.43759	
24	18.66344	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Challenges Facing Teachers Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item							
			BTBG11A	BTBG11B	BTBG11C	BTBG11D	BTBG11E	BTBG11F	BTBG11G	BTBG11H
Australia	0.81	44	0.56	0.66	0.72	0.78	0.70	0.57	0.61	0.66
Bahrain	0.74	36	0.64	0.70	0.73	0.76	0.48	0.37	0.45	0.58
Botswana (9)	0.50	24	0.56	0.54	0.41	0.69	0.59	0.09	0.37	0.44
Canada	0.75	37	0.52	0.62	0.60	0.72	0.63	0.50	0.57	0.66
Chile	0.68	34	0.42	0.56	0.67	0.78	0.75	0.38	0.29	0.65
Chinese Taipei	0.73	36	0.62	0.66	0.67	0.69	0.58	0.67	0.42	0.40
Egypt	0.64	29	0.60	0.61	0.71	0.57	0.44	0.44	0.48	0.38
England	0.80	43	0.58	0.70	0.74	0.79	0.72	0.43	0.60	0.63
Georgia	0.66	31	0.45	0.62	0.51	0.69	0.55	0.49	0.56	0.51
Hong Kong SAR	0.69	33	0.60	0.68	0.32	0.70	0.62	0.56	0.47	0.56
Hungary	0.76	39	0.43	0.63	0.63	0.75	0.74	0.63	0.54	0.61
Iran, Islamic Rep. of	0.62	28	0.44	0.42	0.42	0.63	0.56	0.48	0.64	0.56
Ireland	0.80	42	0.59	0.68	0.71	0.75	0.67	0.51	0.58	0.68
Israel	0.72	34	0.51	0.52	0.52	0.72	0.57	0.66	0.57	0.58
Italy	0.71	34	0.56	0.75	0.32	0.68	0.47	0.46	0.70	0.57
Japan	0.76	38	0.53	0.49	0.60	0.69	0.66	0.63	0.62	0.69
Jordan	0.74	36	0.54	0.58	0.73	0.70	0.54	0.62	0.53	0.53
Kazakhstan	0.67	31	0.43	0.31	0.57	0.63	0.50	0.64	0.66	0.62
Korea, Rep. of	0.82	45	0.65	0.72	0.76	0.78	0.71	0.48	0.59	0.63
Kuwait	0.74	36	0.53	0.54	0.66	0.72	0.59	0.65	0.59	0.49
Lebanon	0.81	42	0.62	0.68	0.67	0.77	0.71	0.47	0.60	0.62
Lithuania	0.66	30	0.46	0.57	0.43	0.65	0.57	0.56	0.58	0.52
Malaysia	0.59	27	0.36	0.21	0.60	0.71	0.44	0.53	0.49	0.66
Malta	0.77	39	0.57	0.59	0.67	0.68	0.65	0.54	0.63	0.65
Morocco	0.66	30	0.58	0.66	0.76	0.61	0.49	0.38	0.42	0.34
New Zealand	0.78	40	0.50	0.56	0.70	0.79	0.72	0.54	0.51	0.68
Norway (9)	0.78	40	0.61	0.63	0.68	0.77	0.62	0.48	0.50	0.70
Oman	0.73	35	0.61	0.65	0.67	0.66	0.56	0.53	0.50	0.52
Qatar	0.74	36	0.54	0.54	0.66	0.69	0.61	0.66	0.56	0.48
Russian Federation	0.66	30	0.49	0.57	0.64	0.69	0.55	0.45	0.59	0.35
Saudi Arabia	0.71	33	0.60	0.58	0.65	0.71	0.55	0.48	0.52	0.46
Singapore	-	-	-	-	-	-	-	-	-	-
Slovenia	0.72	34	0.48	0.63	0.66	0.73	0.58	0.55	0.53	0.50
South Africa (9)	0.70	34	0.49	0.46	0.58	0.72	0.66	0.51	0.59	0.58
Sweden	0.72	35	0.47	0.53	0.73	0.77	0.63	0.52	0.42	0.55
Thailand	0.74	37	0.46	0.63	0.73	0.68	0.54	0.62	0.59	0.56
Turkey	0.72	35	0.49	0.81	0.78	0.70	0.64	0.33	0.42	0.35
United Arab Emirates	0.82	45	0.61	0.71	0.74	0.78	0.69	0.65	0.53	0.64
United States	0.80	42	0.60	0.66	0.66	0.76	0.70	0.51	0.64	0.64
Benchmarking Participants										
Buenos Aires, Argentina	0.79	41	0.58	0.53	0.58	0.83	0.80	0.57	0.51	0.65
Ontario, Canada	0.73	36	0.42	0.61	0.61	0.70	0.60	0.57	0.56	0.68
Quebec, Canada	0.71	34	0.44	0.53	0.64	0.73	0.67	0.38	0.55	0.63
Norway (8)	0.78	40	0.61	0.66	0.67	0.75	0.62	0.54	0.56	0.61
Abu Dhabi, UAE	0.78	41	0.62	0.64	0.72	0.78	0.70	0.55	0.48	0.62
Dubai, UAE	0.84	48	0.51	0.71	0.78	0.79	0.68	0.73	0.64	0.64
Florida, US	0.79	42	0.48	0.64	0.69	0.75	0.76	0.51	0.69	0.64

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Challenges Facing Teachers Scale, Eighth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.03	0.03	0.00	0.00	0.00	0.00
Bahrain	0.08	0.09	0.01	0.01	0.01	0.00
Botswana (9)	0.02	0.09	0.00	0.01	0.00	0.01
Canada	0.02	0.06	0.00	0.00	0.00	0.00
Chile	0.05	0.04	0.00	0.00	0.00	0.02
Chinese Taipei	-0.02	-0.05	0.00	0.00	0.00	0.01
Egypt	0.10	0.09	0.01	0.01	0.01	0.02
England	0.09	0.12	0.01	0.01	0.01	0.02
Georgia	-0.01	0.04	0.00	0.00	0.00	0.00
Hong Kong SAR	-0.01	-0.01	0.00	0.00	0.01	0.01
Hungary	0.01	-0.06	0.00	0.00	0.01	0.01
Iran, Islamic Rep. of	0.01	-0.09	0.00	0.01	0.01	0.01
Ireland	-0.06	0.04	0.00	0.00	0.00	0.00
Israel	-0.01	0.01	0.00	0.00	0.01	0.00
Italy	-0.02	-0.03	0.00	0.00	0.00	0.00
Japan	0.03	0.06	0.00	0.00	0.00	0.00
Jordan	0.03	0.08	0.00	0.01	0.00	0.00
Kazakhstan	0.14	0.09	0.02	0.01	0.01	0.00
Korea, Rep. of	-0.02	-0.03	0.00	0.00	0.00	0.00
Kuwait	0.05	0.07	0.00	0.00	0.01	0.00
Lebanon	0.11	0.07	0.01	0.00	0.01	0.00
Lithuania	-0.12	-0.06	0.02	0.00	0.00	0.00
Malaysia	0.04	0.03	0.00	0.00	0.01	0.01
Malta	-0.13	0.12	0.02	0.01	0.01	0.01
Morocco	0.06	0.09	0.00	0.01	0.00	0.01
New Zealand	-0.07	-0.03	0.01	0.00	0.02	0.00
Norway (9)	-0.01	-0.05	0.00	0.00	0.00	0.00
Oman	0.02	0.03	0.00	0.00	0.00	0.00
Qatar	0.08	-0.01	0.01	0.00	0.00	0.01
Russian Federation	0.06	0.02	0.00	0.00	0.00	0.00
Saudi Arabia	0.15	-0.01	0.02	0.00	0.01	0.00
Singapore	-	-	-	-	-	-
Slovenia	0.04	0.02	0.00	0.00	0.00	0.00
South Africa (9)	0.28	0.23	0.08	0.05	0.11	0.03
Sweden	-0.05	-0.06	0.00	0.00	0.00	0.00
Thailand	0.04	0.04	0.00	0.00	0.01	0.01
Turkey	0.04	0.01	0.00	0.00	0.00	0.01
United Arab Emirates	0.17	0.17	0.03	0.03	0.01	0.01
United States	-0.02	0.01	0.00	0.00	0.01	0.00
International Median	0.03	0.00	0.00	0.00	0.00	0.00
Benchmarking Participants						
Buenos Aires, Argentina	0.14	-0.08	0.02	0.01	0.04	0.01
Ontario, Canada	0.01	0.00	0.00	0.00	0.00	0.00
Quebec, Canada	0.03	0.11	0.00	0.01	0.01	0.01
Norway (8)	-0.04	-0.09	0.00	0.01	0.00	0.01
Abu Dhabi, UAE	0.16	0.16	0.03	0.03	0.00	0.01
Dubai, UAE	0.20	0.13	0.04	0.02	0.02	0.01
Florida, US	0.04	0.02	0.00	0.00	0.01	0.01

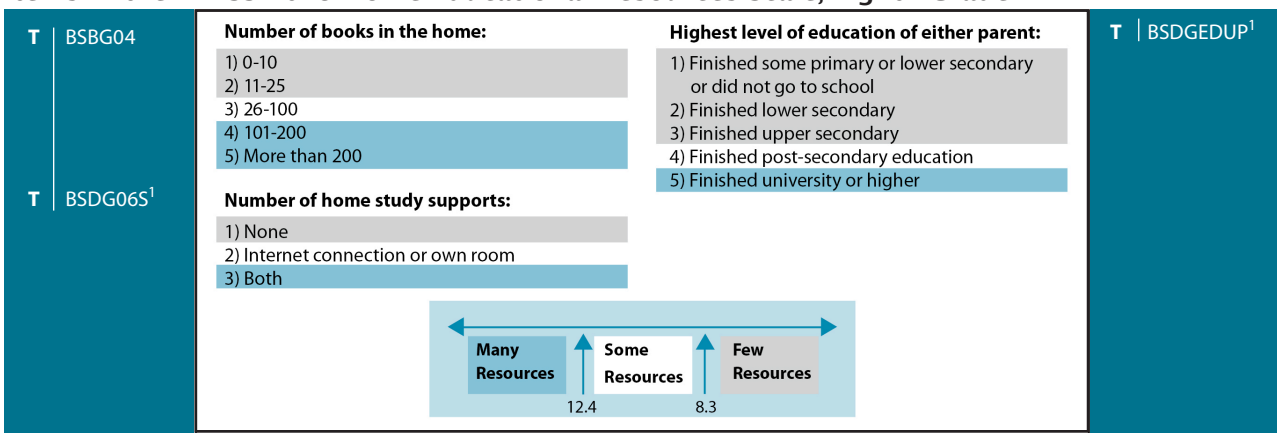
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Home Educational Resources Scale, Eighth Grade

The Home Educational Resources (HER) scale was created based on students' responses concerning the availability of three resources described below.

Items in the TIMSS 2015 Home Educational Resources Scale, Eighth Grade



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.
1 Derived variable. For more details, see Supplement 3 of the User Guide for the TIMSS 2015 International Database.

Item Parameters for the TIMSS 2015 Home Educational Resources Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	tau_4	Infit
BSBG04	0.83301	-1.03371	-0.22069	0.78431	0.47009	1.00
BSDG06S	-0.73962	-0.64211	0.64211			0.97
BSDGEDUP	-0.09339	-0.73961	-0.50760	0.77465	0.47256	0.97

Scale Transformation Constants for the TIMSS 2015 Home Educational Resources Scale, Eighth Grade

Scale Transformation Constants	
A = 9.211881	Transformed Scale Score = 9.211881 + 1.80992 • Logit Scale Score
B = 1.80992	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Home Educational Resources Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	4.23163	
1	6.35011	
2	7.44587	
3	8.27061	8.3
4	8.97690	
5	9.62284	
6	10.26361	
7	10.91820	
8	11.62210	
9	12.45383	12.4
10	13.88377	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Home Educational Resources Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Factor Loadings for Each Item		
			BSBG04	BSDG06S	BSDGEDUP
Australia	0.40	46	0.77	0.42	0.78
Bahrain	0.40	46	0.70	0.52	0.79
Botswana (9)	0.47	50	0.63	0.71	0.77
Canada	0.35	44	0.77	0.38	0.77
Chile	0.44	48	0.69	0.57	0.79
Chinese Taipei	0.46	48	0.81	0.34	0.82
Egypt	0.39	46	0.57	0.70	0.75
England	0.44	47	0.80	0.37	0.80
Georgia	0.54	53	0.79	0.58	0.79
Hong Kong SAR	0.50	51	0.75	0.56	0.80
Hungary	0.56	54	0.87	0.33	0.87
Iran, Islamic Rep. of	0.63	59	0.75	0.71	0.83
Ireland	0.42	47	0.80	0.30	0.82
Israel	0.51	68	0.82	-	0.82
Italy	0.46	48	0.80	0.37	0.82
Japan	0.34	44	0.73	0.45	0.76
Jordan	0.46	49	0.64	0.67	0.77
Kazakhstan	0.50	51	0.76	0.68	0.70
Korea, Rep. of	0.41	47	0.74	0.54	0.75
Kuwait	0.27	40	0.71	0.36	0.76
Lebanon	0.37	44	0.71	0.48	0.77
Lithuania	0.45	49	0.78	0.48	0.78
Malaysia	0.52	51	0.71	0.66	0.78
Malta	0.37	45	0.80	0.16	0.82
Morocco	0.55	54	0.73	0.69	0.77
New Zealand	0.43	48	0.77	0.57	0.73
Norway (9)	0.38	47	0.77	0.44	0.78
Oman	0.44	48	0.63	0.65	0.78
Qatar	0.34	43	0.71	0.43	0.78
Russian Federation	0.39	45	0.78	0.36	0.78
Saudi Arabia	0.38	45	0.68	0.50	0.79
Singapore	0.44	48	0.73	0.53	0.79
Slovenia	0.43	47	0.80	0.31	0.82
South Africa (9)	0.45	48	0.61	0.71	0.75
Sweden	0.39	46	0.79	0.46	0.75
Thailand	0.49	50	0.73	0.60	0.78
Turkey	0.62	58	0.78	0.70	0.80
United Arab Emirates	0.35	44	0.72	0.51	0.73
United States	0.47	49	0.73	0.55	0.80
Benchmarking Participants					
Buenos Aires, Argentina	0.58	54	0.78	0.58	0.83
Ontario, Canada	0.36	45	0.76	0.44	0.76
Quebec, Canada	0.38	45	0.80	0.27	0.80
Norway (8)	0.37	46	0.76	0.41	0.78
Abu Dhabi, UAE	0.34	43	0.72	0.48	0.74
Dubai, UAE	0.38	45	0.73	0.57	0.71
Florida, US	0.43	48	0.72	0.56	0.78

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Home Educational Resources Scale, Eighth Grade, and TIMSS 2015 Achievement

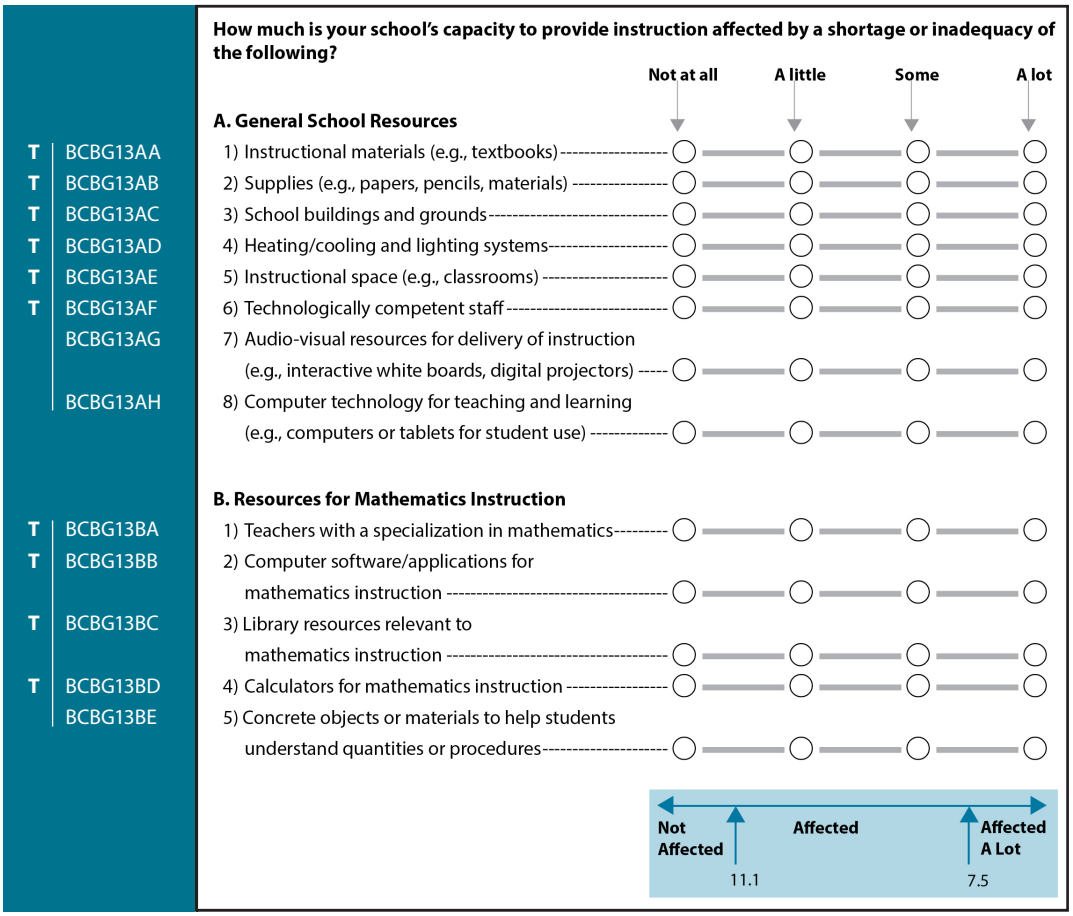
Country	Pearson's Correlation with Achievement (r)		Pearson's Correlation with Achievement (r^2)		Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.38	0.45	0.15	0.20	0.09	0.13
Bahrain	0.26	0.26	0.07	0.07	0.03	0.03
Botswana (9)	0.18	0.18	0.03	0.03	0.03	0.03
Canada	0.33	0.40	0.11	0.16	0.07	0.10
Chile	0.38	0.38	0.15	0.14	0.08	0.08
Chinese Taipei	0.44	0.47	0.19	0.22	0.14	0.15
Egypt	0.21	0.20	0.05	0.04	0.04	0.03
England	0.48	0.52	0.23	0.27	0.17	0.19
Georgia	0.35	0.36	0.12	0.13	0.07	0.09
Hong Kong SAR	0.29	0.30	0.08	0.09	0.06	0.06
Hungary	0.60	0.57	0.37	0.32	0.27	0.24
Iran, Islamic Rep. of	0.40	0.41	0.16	0.17	0.13	0.14
Ireland	0.45	0.48	0.20	0.23	0.13	0.15
Israel	0.45	0.47	0.20	0.22	0.09	0.09
Italy	0.39	0.42	0.15	0.17	0.11	0.13
Japan	0.39	0.35	0.15	0.13	0.10	0.08
Jordan	0.28	0.33	0.08	0.11	0.05	0.07
Kazakhstan	0.17	0.18	0.03	0.03	0.02	0.02
Korea, Rep. of	0.35	0.33	0.12	0.11	0.10	0.09
Kuwait	0.28	0.28	0.08	0.08	0.04	0.04
Lebanon	0.23	0.26	0.05	0.07	0.04	0.04
Lithuania	0.41	0.43	0.17	0.18	0.10	0.11
Malaysia	0.32	0.33	0.10	0.11	0.07	0.07
Malta	0.39	0.41	0.15	0.17	0.11	0.12
Morocco	0.20	0.15	0.04	0.02	0.03	0.02
New Zealand	0.47	0.50	0.22	0.25	0.13	0.15
Norway (9)	0.38	0.42	0.15	0.17	0.10	0.12
Oman	0.21	0.17	0.04	0.03	0.03	0.02
Qatar	0.40	0.37	0.16	0.14	0.09	0.08
Russian Federation	0.22	0.26	0.05	0.07	0.02	0.03
Saudi Arabia	0.23	0.25	0.05	0.06	0.03	0.03
Singapore	0.38	0.42	0.15	0.18	0.09	0.11
Slovenia	0.34	0.38	0.12	0.14	0.06	0.08
South Africa (9)	0.30	0.31	0.09	0.10	0.07	0.07
Sweden	0.42	0.45	0.17	0.21	0.11	0.15
Thailand	0.32	0.33	0.10	0.11	0.07	0.08
Turkey	0.45	0.43	0.21	0.19	0.16	0.15
United Arab Emirates	0.35	0.34	0.12	0.11	0.07	0.07
United States	0.40	0.42	0.16	0.17	0.11	0.12
International Median	0.35	0.37	0.12	0.13	0.08	0.08
Benchmarking Participants						
Buenos Aires, Argentina	0.44	0.41	0.19	0.17	0.13	0.11
Ontario, Canada	0.36	0.41	0.13	0.17	0.09	0.11
Quebec, Canada	0.36	0.42	0.13	0.17	0.07	0.10
Norway (8)	0.37	0.39	0.14	0.15	0.08	0.09
Abu Dhabi, UAE	0.35	0.34	0.12	0.11	0.08	0.07
Dubai, UAE	0.36	0.36	0.13	0.13	0.08	0.08
Florida, US	0.39	0.41	0.15	0.17	0.10	0.11

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Instruction Affected by Mathematics Resource Shortages–Principals' Reports Scale, Eighth Grade

The Instruction Affected by Mathematics Resource Shortages–Principals' Reports (MRS) scale was created based on principals' responses concerning thirteen school and classroom resources described below.

Items in the TIMSS 2015 Instruction Affected by Mathematics Resource Shortages–Principals' Reports Scale, Eighth Grade



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Instruction Affected by Mathematics Resource Shortages - Principals' Reports Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BCBG13AA	-0.04723	-0.20396	0.02271	0.18125	0.88
BCBG13AB	-0.38064	-0.32518	0.24639	0.07879	0.92
BCBG13AC	0.12618	-0.78991	0.12928	0.66063	0.98
BCBG13AD	-0.12528	-0.57654	-0.01616	0.59270	0.96
BCBG13AE	0.21910	-0.43871	-0.10609	0.54480	0.95
BCBG13AF	0.07215	-1.21154	-0.05087	1.26241	0.96
BCBG13AG	0.09524	-1.07963	-0.04438	1.12401	1.00
BCBG13AH	0.28516	-1.19894	-0.00568	1.20462	1.06
BCBG13BA	0.12677	0.02370	-0.11510	0.09140	1.11
BCBG13BB	0.12244	-1.32815	-0.01581	1.34396	1.07
BCBG13BC	-0.04954	-1.36712	0.02456	1.34256	1.15
BCBG13BD	-0.46499	-0.67455	0.07619	0.59836	1.20
BCBG13BE	0.02064	-1.30083	-0.05970	1.36053	0.92

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Instruction Affected by Mathematics Resource Shortages - Principals' Reports Scale, Eighth Grade

Scale Transformation Constants	
A = 9.262831	Transformed Scale Score = 9.262831 + 1.251401 • Logit Scale Score
B = 1.251401	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Instruction Affected by Mathematics Resource Shortages - Principals' Reports Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	4.04996	
1	5.45622	
2	6.12504	
3	6.57408	
4	6.91534	
5	7.19218	
6	7.42599	7.5
7	7.62978	
8	7.81111	
9	7.97519	
10	8.12581	
11	8.26498	
12	8.39677	
13	8.52184	
14	8.64142	
15	8.75664	
16	8.86846	
17	8.97780	
18	9.08546	
19	9.19223	
20	9.30022	
21	9.40600	
22	9.51449	
23	9.62507	
24	9.73861	
25	9.85602	
26	9.97832	
27	10.10663	
28	10.24143	
29	10.38614	
30	10.54233	
31	10.71284	
32	10.90148	
33	11.11347	11.1
34	11.35656	
35	11.64345	
36	11.99552	
37	12.45578	
38	13.13639	
39	14.55441	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Instruction Affected by Mathematics Resource Shortages - Principals' Reports Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item												
			BCBG13AA	BCBG13AB	BCBG13AC	BCBG13AD	BCBG13AE	BCBG13AF	BCBG13AG	BCBG13AH	BCBG13BA	BCBG13BB	BCBG13BC	BCBG13BD	BCBG13BE
Australia	0.92	52	0.76	0.74	0.64	0.62	0.69	0.79	0.78	0.76	0.51	0.72	0.74	0.79	0.76
Bahrain	0.96	64	0.92	0.88	0.85	0.90	0.89	0.87	0.87	0.81	0.78	0.71	0.54	0.64	0.62
Botswana (9)	0.76	31	0.46	0.07	0.50	0.53	0.53	0.25	0.81	0.80	-0.32	0.77	0.75	0.03	0.67
Canada	0.90	45	0.70	0.66	0.53	0.36	0.58	0.71	0.71	0.74	0.67	0.79	0.81	0.72	0.65
Chile	0.91	47	0.69	0.71	0.65	0.56	0.71	0.73	0.76	0.71	0.62	0.59	0.72	0.67	0.77
Chinese Taipei	0.87	41	0.60	0.66	0.62	0.66	0.68	0.64	0.63	0.64	0.55	0.68	0.67	0.55	0.68
Egypt	0.81	32	0.52	0.37	0.67	0.35	0.57	0.68	0.53	0.69	0.58	0.67	0.50	0.54	0.57
England	0.89	45	0.76	0.68	0.67	0.72	0.57	0.64	0.75	0.69	0.44	0.73	0.69	0.60	0.69
Georgia	0.88	43	0.53	0.73	0.70	0.62	0.75	0.68	0.66	0.77	0.60	0.64	0.67	0.47	0.63
Hong Kong SAR	0.94	58	0.81	0.84	0.77	0.84	0.76	0.77	0.76	0.69	0.73	0.69	0.76	0.72	0.74
Hungary	0.89	43	0.67	0.71	0.73	0.71	0.66	0.53	0.69	0.70	0.63	0.60	0.57	0.57	0.74
Iran, Islamic Rep. of	0.89	44	0.75	0.74	0.71	0.75	0.76	0.74	0.66	0.60	0.67	0.57	0.50	0.50	0.60
Ireland	0.89	44	0.67	0.70	0.60	0.63	0.63	0.62	0.77	0.62	0.57	0.76	0.50	0.70	0.79
Israel	0.93	55	0.79	0.83	0.67	0.77	0.68	0.78	0.69	0.60	0.80	0.74	0.72	0.76	0.80
Italy	0.82	34	0.57	-	0.53	0.44	0.48	0.54	0.65	0.67	0.51	0.73	0.56	0.59	0.68
Japan	0.93	54	0.82	0.79	0.80	0.77	0.86	0.65	0.69	0.72	0.80	0.60	0.72	0.54	0.76
Jordan	0.89	43	0.76	0.76	0.79	0.70	0.78	0.73	0.47	0.72	0.73	0.53	0.36	0.35	0.59
Kazakhstan	0.94	57	0.73	0.70	0.70	0.80	0.77	0.80	0.80	0.75	0.83	0.69	0.86	0.62	0.78
Korea, Rep. of	0.94	57	0.75	0.79	0.78	0.81	0.80	0.74	0.74	0.73	0.79	0.75	0.74	0.66	0.73
Kuwait	0.94	56	0.82	0.79	0.79	0.85	0.85	0.78	0.70	0.69	0.87	0.64	0.48	0.70	0.70
Lebanon	0.90	46	0.81	0.83	0.80	0.69	0.81	0.63	0.52	0.35	0.74	0.49	0.45	0.74	0.70
Lithuania	0.90	45	0.60	0.65	0.67	0.64	0.56	0.64	0.72	0.74	0.58	0.73	0.72	0.65	0.77
Malaysia	0.92	50	0.77	0.69	0.77	0.63	0.76	0.72	0.54	0.43	0.79	0.71	0.73	0.80	0.75
Malta	0.89	48	0.82	0.77	0.66	0.68	0.66	0.82	0.74	0.71	0.84	0.54	0.41	0.74	0.50
Morocco	0.69	39	-0.27	-0.14	-0.38	0.29	-0.59	0.70	0.67	0.76	-0.62	0.82	0.83	0.74	0.72
New Zealand	0.88	41	0.71	0.60	0.56	0.66	0.48	0.63	0.65	0.71	0.54	0.68	0.65	0.70	0.72
Norway (9)	0.83	35	0.63	0.53	0.72	0.62	0.62	0.60	0.51	0.47	0.57	0.62	0.58	0.60	0.56
Oman	0.92	53	0.80	0.72	0.69	0.82	0.80	0.81	0.75	0.62	0.77	0.69	0.65	0.58	0.71
Qatar	0.98	79	0.90	0.90	0.88	0.94	0.90	0.93	0.90	0.92	0.92	0.87	0.82	0.76	0.90
Russian Federation	0.88	41	0.65	0.57	0.55	0.71	0.56	0.66	0.70	0.66	0.58	0.73	0.67	0.54	0.70
Saudi Arabia	0.90	47	0.73	0.66	0.70	0.81	0.77	0.68	0.58	0.76	0.69	0.61	0.35	0.70	0.74
Singapore	0.98	80	0.93	0.87	0.87	0.89	0.91	0.86	0.87	0.90	0.91	0.89	0.89	0.92	0.91
Slovenia	0.84	35	0.53	0.60	0.49	0.54	0.54	0.51	0.73	0.72	0.11	0.68	0.68	0.58	0.72
South Africa (9)	0.84	36	0.42	0.20	0.50	0.70	0.49	0.67	0.78	0.78	0.28	0.74	0.69	0.50	0.71
Sweden	0.85	38	0.72	0.69	0.59	0.60	0.54	0.63	0.65	0.62	0.66	0.65	0.37	0.48	0.70
Thailand	0.92	52	0.78	0.80	0.73	0.70	0.73	0.74	0.64	0.80	0.67	0.66	0.72	0.62	0.74
Turkey	0.88	41	0.65	0.63	0.65	0.67	0.67	0.54	0.68	0.63	0.59	0.62	0.61	0.53	0.79
United Arab Emirates	0.96	70	0.87	0.84	0.85	0.87	0.86	0.88	0.85	0.86	0.87	0.75	0.76	0.73	0.84
United States	0.91	49	0.71	0.66	0.66	0.64	0.69	0.68	0.77	0.68	0.69	0.79	0.69	0.67	0.77
Benchmarking Participants															
Buenos Aires, Argentina	0.95	62	0.84	0.82	0.77	0.83	0.79	0.79	0.66	0.73	0.68	0.74	0.89	0.83	0.81
Ontario, Canada	0.88	43	0.63	0.65	0.59	0.22	0.56	0.67	0.69	0.77	0.54	0.76	0.82	0.70	0.70
Quebec, Canada	0.91	49	0.79	0.72	0.66	0.74	0.74	0.66	0.66	0.68	0.75	0.69	0.67	0.77	0.56
Norway (8)	0.84	36	0.66	0.61	0.72	0.63	0.62	0.62	0.56	0.47	0.58	0.57	0.54	0.63	0.57
Abu Dhabi, UAE	0.96	66	0.87	0.85	0.84	0.83	0.85	0.86	0.83	0.78	0.85	0.62	0.72	0.77	0.82
Dubai, UAE	0.97	76	0.91	0.89	0.85	0.91	0.83	0.94	0.88	0.90	0.91	0.86	0.83	0.71	0.91
Florida, US	0.89	45	0.79	0.76	0.67	0.56	0.79	0.70	0.70	0.78	0.30	0.80	0.58	0.53	0.64

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Instruction Affected by Mathematics Resource Shortages - Principals' Reports Scale, Eighth Grade, and TIMSS 2015 Mathematics Achievement

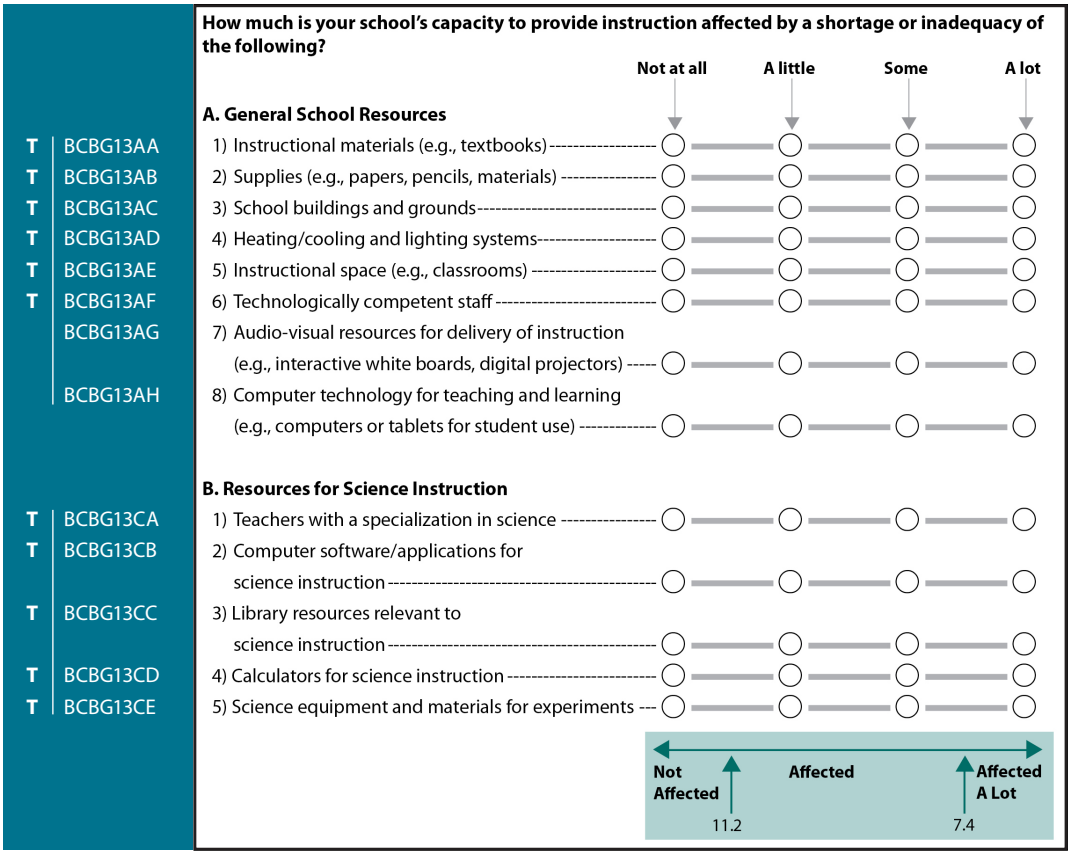
Country	Pearson's Correlation with Mathematics Achievement		Variance in Mathematics Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.22	0.05	0.02
Bahrain	0.16	0.03	0.05
Botswana (9)	0.21	0.04	0.06
Cana	0.11	0.01	0.02
Chile	0.18	0.03	0.03
Chinese Taipei	0.15	0.02	0.01
Egypt	-0.14	0.02	0.01
England	0.18	0.03	0.02
Georgia	0.05	0.00	0.00
Hong Kong SAR	0.04	0.00	0.00
Hungary	0.05	0.00	0.00
Iran, Islamic Rep. of	0.13	0.02	0.03
Ireland	0.05	0.00	0.00
Israel	0.28	0.08	0.09
Italy	0.09	0.01	0.01
Japan	0.04	0.00	0.00
Jordan	-0.14	0.02	0.04
Kazakhstan	-0.05	0.00	0.01
Korea, Rep. of	-0.06	0.00	0.00
Kuwait	0.19	0.04	0.08
Lebanon	0.08	0.01	0.03
Lithuania	-0.06	0.00	0.00
Malaysia	-0.15	0.02	0.01
Malta	0.09	0.01	0.01
Morocco	-0.12	0.01	0.03
New Zealand	0.11	0.01	0.01
Norway (9)	0.06	0.00	0.00
Oman	0.00	0.00	0.01
Qatar	0.17	0.03	0.04
Russian Federation	0.07	0.00	0.01
Saudi Arabia	-0.08	0.01	0.01
Singapore	0.02	0.00	0.00
Slovenia	-0.03	0.00	0.00
South Africa (9)	0.20	0.04	0.07
Sweden	-0.05	0.00	0.00
Thailand	0.15	0.02	0.01
Turkey	0.07	0.01	0.01
United Arab Emirates	0.24	0.06	0.08
United States	0.17	0.03	0.04
International Median	0.07	0.01	0.01
Benchmarking Participants			
Buenos Aires, Argentina	0.34	0.12	0.08
Ontario, Canada	0.05	0.00	0.00
Quebec, Canada	0.11	0.01	0.01
Norway (8)	0.03	0.00	0.00
Abu Dhabi, UAE	0.09	0.01	0.06
Dubai, UAE	0.28	0.08	0.08
Florida, US	0.11	0.01	0.02

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Instruction Affected by Science Resource Shortages–Principals' Reports Scale, Eighth Grade

The Instruction Affected by Science Resource Shortages–Principals' Reports (SRS) scale was created based on principals' responses concerning thirteen school and classroom resources described below.

Items in the TIMSS 2015 Instruction Affected by Science Resource Shortages–Principals' Reports Scale, Eighth Grade



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Instruction Affected by Science Resource Shortages - Prinicpals' Reports Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BCBG13AA	-0.07780	-0.22995	0.02106	0.20889	0.90
BCBG13AB	-0.41924	-0.35188	0.24401	0.10787	0.95
BCBG13AC	0.09925	-0.82065	0.12894	0.69171	1.01
BCBG13AD	-0.15762	-0.60587	-0.01709	0.62296	0.98
BCBG13AE	0.19292	-0.46731	-0.10673	0.57404	0.97
BCBG13AF	0.04432	-1.24596	-0.05161	1.29757	0.97
BCBG13AG	0.06683	-1.11291	-0.04548	1.15839	1.01
BCBG13AH	0.26152	-1.23259	-0.00701	1.23960	1.07
BCBG13CA	0.05892	0.12619	-0.14295	0.01676	1.07
BCBG13CB	0.17201	-1.33922	-0.06466	1.40388	1.06
BCBG13CC	-0.05514	-1.36034	0.00995	1.35039	1.06
BCBG13CD	-0.56666	-0.75165	0.04489	0.70676	1.40
BCBG13CE	0.38069	-0.81880	-0.11198	0.93078	0.85

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Instruction Affected by Science Resource Shortages - Prinicpals' Reports Scale, Eighth Grade

Scale Transformation Constants	
A = 9.315269	Transformed Scale Score = 9.315269 + 1.309226 • Logit Scale Score
B = 1.309226	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Instruction Affected by Science Resource Shortages - Prinicpals' Reports Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.88612	
1	5.35335	
2	6.04930	
3	6.51561	
4	6.86952	
5	7.15639	
6	7.39861	7.4
7	7.60979	
8	7.79773	
9	7.96788	
10	8.12416	
11	8.26869	
12	8.40566	
13	8.53569	
14	8.66008	
15	8.77999	
16	8.89646	
17	9.01042	
18	9.12273	
19	9.23419	
20	9.34677	
21	9.45769	
22	9.57129	
23	9.68719	
24	9.80631	
25	9.92960	
26	10.05811	
27	10.19300	
28	10.33482	
29	10.48712	
30	10.65148	
31	10.83088	
32	11.02928	
33	11.25210	11.2
34	11.50748	
35	11.80866	
36	12.17806	
37	12.66071	
38	13.37405	
39	14.85907	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Instruction Affected by Science Resource Shortages - Prinicpals' Reports Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item												
			BCBG13AA	BCBG13AB	BCBG13AC	BCBG13AD	BCBG13AE	BCBG13AF	BCBG13AG	BCBG13AH	BCBG13CA	BCBG13CB	BCBG13CC	BCBG13CD	BCBG13CE
Australia	0.92	52	0.74	0.73	0.64	0.61	0.68	0.78	0.77	0.78	0.61	0.74	0.76	0.79	0.74
Bahrain	0.96	68	0.92	0.88	0.85	0.90	0.89	0.87	0.87	0.80	0.85	0.75	0.70	0.50	0.85
Botswana (9)	0.76	31	0.47	0.12	0.50	0.54	0.53	0.29	0.79	0.78	-0.29	0.74	0.72	0.35	0.63
Canada	0.90	47	0.69	0.63	0.58	0.39	0.64	0.73	0.69	0.72	0.70	0.77	0.86	0.67	0.74
Chile	0.91	48	0.63	0.63	0.68	0.60	0.70	0.72	0.75	0.69	0.64	0.71	0.78	0.63	0.78
Chinese Taipei	0.87	40	0.59	0.65	0.64	0.65	0.70	0.65	0.63	0.65	0.53	0.65	0.60	0.52	0.72
Egypt	0.82	34	0.55	0.40	0.71	0.31	0.60	0.66	0.52	0.68	0.62	0.67	0.58	0.44	0.67
England	0.89	47	0.75	0.68	0.71	0.68	0.56	0.63	0.78	0.71	0.56	0.74	0.70	0.60	0.78
Georgia	0.87	41	0.55	0.72	0.68	0.64	0.75	0.69	0.66	0.77	0.64	0.60	0.65	0.30	0.57
Hong Kong SAR	0.94	58	0.81	0.83	0.74	0.84	0.74	0.77	0.75	0.70	0.76	0.69	0.77	0.67	0.81
Hungary	0.89	44	0.65	0.71	0.73	0.71	0.69	0.53	0.70	0.70	0.57	0.65	0.67	0.56	0.68
Iran, Islamic Rep. of	0.89	44	0.74	0.73	0.71	0.76	0.78	0.75	0.63	0.56	0.68	0.61	0.56	0.22	0.69
Ireland	0.89	45	0.66	0.70	0.63	0.64	0.65	0.61	0.79	0.61	0.56	0.77	0.46	0.74	0.79
Israel	0.93	54	0.79	0.82	0.69	0.78	0.68	0.78	0.69	0.60	0.73	0.78	0.75	0.67	0.76
Italy	0.82	34	0.55	-	0.57	0.47	0.55	0.54	0.65	0.66	0.51	0.72	0.66	0.50	0.60
Japan	0.93	55	0.83	0.79	0.81	0.77	0.87	0.64	0.68	0.72	0.81	0.64	0.74	0.53	0.79
Jordan	0.90	45	0.77	0.76	0.81	0.68	0.78	0.71	0.45	0.72	0.75	0.54	0.45	0.30	0.77
Kazakhstan	0.94	57	0.76	0.69	0.67	0.80	0.76	0.82	0.79	0.73	0.80	0.76	0.82	0.56	0.80
Korea, Rep. of	0.94	59	0.76	0.79	0.77	0.80	0.78	0.73	0.73	0.75	0.81	0.80	0.81	0.64	0.80
Kuwait	0.94	57	0.82	0.79	0.77	0.84	0.86	0.76	0.70	0.70	0.86	0.72	0.60	0.51	0.83
Lebanon	0.91	48	0.80	0.84	0.80	0.67	0.82	0.63	0.53	0.33	0.79	0.70	0.49	0.66	0.74
Lithuania	0.89	44	0.64	0.68	0.67	0.67	0.54	0.66	0.70	0.72	0.56	0.77	0.73	0.54	0.69
Malaysia	0.91	50	0.77	0.70	0.78	0.62	0.77	0.70	0.52	0.44	0.80	0.76	0.76	0.67	0.80
Malta	0.90	50	0.79	0.73	0.65	0.66	0.65	0.82	0.76	0.70	0.77	0.48	0.54	0.67	0.85
Morocco	0.69	35	-0.25	-0.09	-0.37	0.32	-0.59	0.69	0.71	0.76	-0.60	0.71	0.81	0.81	0.35
New Zealand	0.89	44	0.73	0.61	0.57	0.67	0.51	0.66	0.62	0.69	0.64	0.69	0.75	0.70	0.72
Norway (9)	0.83	33	0.60	0.50	0.71	0.59	0.60	0.60	0.54	0.49	0.55	0.59	0.58	0.45	0.67
Oman	0.99	60	0.81	0.74	0.68	0.81	0.78	0.81	0.77	0.66	0.81	0.76	0.73	0.49	1.10
Qatar	0.98	79	0.90	0.89	0.88	0.94	0.90	0.93	0.91	0.92	0.93	0.85	0.85	0.73	0.94
Russian Federation	0.88	43	0.64	0.58	0.53	0.69	0.55	0.66	0.71	0.69	0.63	0.76	0.70	0.55	0.76
Saudi Arabia	0.91	50	0.72	0.65	0.73	0.81	0.76	0.68	0.60	0.75	0.76	0.71	0.57	0.64	0.76
Singapore	0.98	80	0.93	0.87	0.87	0.90	0.90	0.86	0.87	0.89	0.91	0.90	0.87	0.91	0.93
Slovenia	0.83	34	0.49	0.59	0.50	0.52	0.56	0.50	0.73	0.74	0.12	0.67	0.69	0.52	0.72
South Africa (9)	0.86	40	0.38	0.18	0.50	0.69	0.48	0.66	0.77	0.75	0.51	0.78	0.73	0.66	0.77
Sweden	0.85	37	0.72	0.67	0.60	0.59	0.53	0.62	0.67	0.64	0.63	0.60	0.35	0.51	0.69
Thailand	0.92	53	0.77	0.79	0.73	0.72	0.73	0.73	0.61	0.80	0.71	0.77	0.75	0.57	0.74
Turkey	0.88	42	0.67	0.63	0.65	0.71	0.71	0.53	0.68	0.62	0.63	0.65	0.61	0.43	0.80
United Arab Emirates	0.97	71	0.87	0.85	0.85	0.88	0.86	0.88	0.84	0.85	0.88	0.78	0.80	0.73	0.89
United States	0.91	50	0.70	0.63	0.65	0.63	0.70	0.69	0.78	0.72	0.69	0.79	0.75	0.65	0.74
Benchmarking Participants															
Buenos Aires, Argentina	0.94	60	0.83	0.82	0.78	0.82	0.79	0.78	0.65	0.72	0.69	0.73	0.85	0.81	0.77
Ontario, Canada	0.88	42	0.62	0.63	0.62	0.26	0.63	0.70	0.66	0.74	0.56	0.72	0.83	0.65	0.70
Quebec, Canada	0.93	54	0.78	0.70	0.71	0.74	0.78	0.64	0.68	0.68	0.81	0.72	0.85	0.69	0.74
Norway (8)	0.84	35	0.63	0.57	0.72	0.61	0.61	0.62	0.58	0.49	0.56	0.56	0.55	0.47	0.68
Abu Dhabi, UAE	0.96	68	0.88	0.84	0.84	0.84	0.85	0.85	0.82	0.78	0.87	0.66	0.80	0.78	0.88
Dubai, UAE	0.98	78	0.91	0.89	0.85	0.91	0.85	0.93	0.88	0.91	0.92	0.88	0.88	0.72	0.94
Florida, US	0.91	49	0.75	0.73	0.75	0.51	0.81	0.66	0.65	0.77	0.52	0.78	0.65	0.61	0.80

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Instruction Affected by Science Resource Shortages - Prinicpals' Reports Scale, Eighth Grade, and TIMSS 2015 Science Achievement

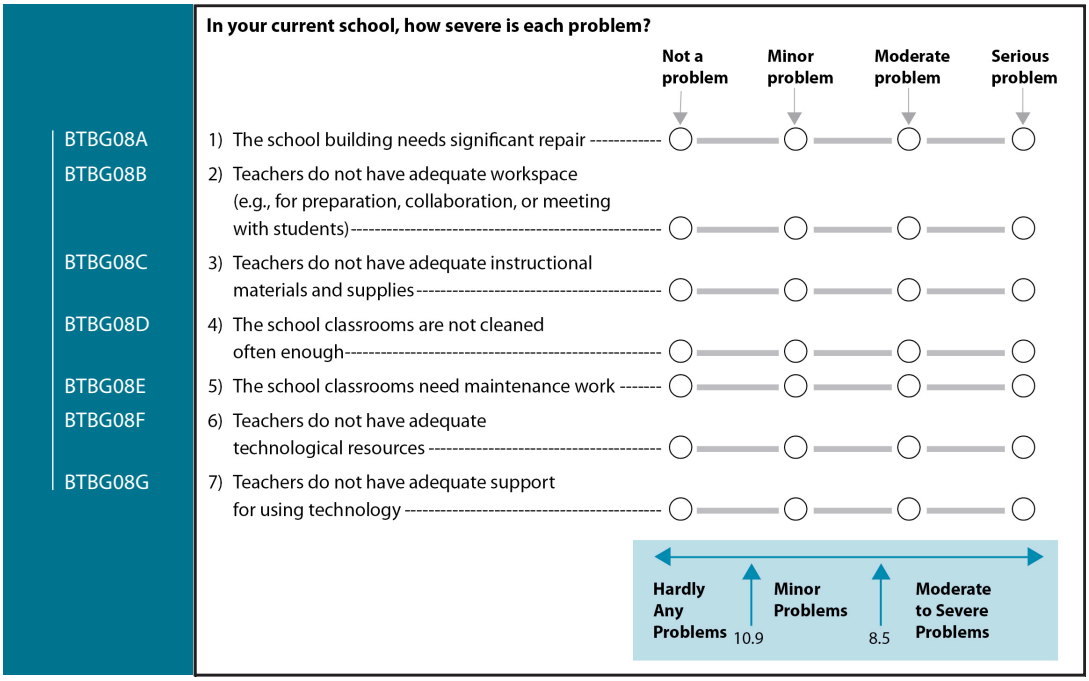
Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.19	0.04	0.01
Bahrain	0.17	0.03	0.03
Botswana (9)	0.20	0.04	0.05
Canada	0.07	0.01	0.01
Chile	0.18	0.03	0.04
Chinese Taipei	0.15	0.02	0.03
Egypt	-0.12	0.02	0.02
England	0.15	0.02	0.01
Georgia	0.07	0.01	0.01
Hong Kong SAR	0.05	0.00	0.00
Hungary	0.03	0.00	0.00
Iran, Islamic Rep. of	0.13	0.02	0.03
Ireland	0.03	0.00	0.00
Israel	0.28	0.08	0.06
Italy	0.09	0.01	0.00
Japan	0.02	0.00	0.00
Jordan	-0.13	0.02	0.04
Kazakhstan	-0.08	0.01	0.01
Korea, Rep. of	-0.04	0.00	0.00
Kuwait	0.14	0.02	0.07
Lebanon	0.09	0.01	0.05
Lithuania	-0.05	0.00	0.00
Malaysia	-0.16	0.02	0.02
Malta	0.09	0.01	0.01
Morocco	-0.08	0.01	0.02
New Zealand	0.12	0.01	0.01
Norway (9)	0.09	0.01	0.01
Oman	-0.02	0.00	0.00
Qatar	0.15	0.02	0.03
Russian Federation	0.10	0.01	0.00
Saudi Arabia	-0.07	0.00	0.02
Singapore	0.02	0.00	0.00
Slovenia	-0.02	0.00	0.00
South Africa (9)	0.17	0.03	0.07
Sweden	-0.06	0.00	0.00
Thailand	0.11	0.01	0.01
Turkey	0.06	0.00	0.01
United Arab Emirates	0.21	0.04	0.07
United States	0.17	0.03	0.02
International Median	0.09	0.01	0.01
Benchmarking Participants			
Buenos Aires, Argentina	0.30	0.09	0.08
Ontario, Canada	0.02	0.00	0.00
Quebec, Canada	0.12	0.02	0.01
Norway (8)	0.05	0.00	0.00
Abu Dhabi, UAE	0.06	0.00	0.05
Dubai, UAE	0.24	0.06	0.07
Florida, US	-0.01	0.00	0.05

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Problems with School Conditions and Resources–Teachers' Reports Scale, Eighth Grade

The Problems with School Conditions and Resources–Teachers' Reports (SCR) scale was created based on teachers' responses concerning seven conditions and resources described below.

Items in the TIMSS 2015 Problems with School Conditions and Resources–Teachers' Reports Scale, Eighth Grade



Item Parameters for the TIMSS 2015 Problems with School Conditions and Resources - Teachers' Reports Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BTBG08A	0.18329	-1.18267	-0.15059	1.33326	1.18
BTBG08B	0.10371	-1.12918	0.03675	1.09243	1.13
BTBG08C	0.06452	-1.43644	-0.01153	1.44797	0.91
BTBG08D	-0.83481	-1.03008	-0.01533	1.04541	1.16
BTBG08E	0.01912	-1.27930	-0.26537	1.54467	0.94
BTBG08F	0.31141	-1.20361	-0.08650	1.29011	0.89
BTBG08G	0.15276	-1.24345	-0.12380	1.36725	0.97

Scale Transformation Constants for the TIMSS 2015 Problems with School Conditions and Resources - Teachers' Reports Scale, Eighth Grade

Scale Transformation Constants	
A = 8.583007	Transformed Scale Score = 8.583007 + 1.253975 • Logit Scale Score
B = 1.253975	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Problems with School Conditions and Resources - Teachers' Reports Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.65135	
1	5.09647	
2	5.80756	
3	6.30783	
4	6.70551	
5	7.04380	
6	7.34972	
7	7.63174	
8	7.89851	
9	8.15652	
10	8.41086	8.5
11	8.66588	
12	8.92566	
13	9.19445	
14	9.47709	
15	9.77810	
16	10.10696	
17	10.47588	
18	10.90666	10.9
19	11.44067	
20	12.19170	
21	13.67660	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Problems with School Conditions and Resources - Teachers' Reports Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item						
			BTBG08A	BTBG08B	BTBG08C	BTBG08D	BTBG08E	BTBG08F	BTBG08G
Australia	0.84	52	0.74	0.64	0.77	0.53	0.80	0.77	0.73
Bahrain	0.87	57	0.66	0.80	0.80	0.75	0.78	0.79	0.71
Botswana (9)	0.78	43	0.73	0.70	0.65	0.59	0.71	0.66	0.53
Canada	0.84	51	0.66	0.62	0.76	0.69	0.79	0.78	0.72
Chile	0.88	58	0.70	0.76	0.83	0.63	0.77	0.83	0.81
Chinese Taipei	0.85	54	0.60	0.72	0.76	0.62	0.79	0.81	0.81
Egypt	0.86	55	0.64	0.75	0.80	0.66	0.73	0.76	0.81
England	0.82	48	0.74	0.59	0.73	0.56	0.75	0.73	0.71
Georgia	0.85	52	0.73	0.70	0.75	0.62	0.77	0.79	0.69
Hong Kong SAR	0.85	54	0.59	0.73	0.76	0.73	0.75	0.80	0.75
Hungary	0.85	54	0.72	0.75	0.81	0.51	0.79	0.81	0.69
Iran, Islamic Rep. of	0.86	55	0.72	0.75	0.79	0.56	0.78	0.81	0.76
Ireland	0.83	51	0.74	0.69	0.81	0.60	0.79	0.67	0.66
Israel	0.87	56	0.70	0.71	0.80	0.67	0.78	0.79	0.79
Italy	0.85	53	0.72	0.63	0.79	0.66	0.72	0.76	0.77
Japan	0.80	46	0.69	0.69	0.72	0.47	0.72	0.73	0.71
Jordan	0.90	62	0.74	0.78	0.81	0.70	0.81	0.84	0.83
Kazakhstan	0.88	58	0.72	0.79	0.81	0.63	0.81	0.81	0.76
Korea, Rep. of	0.87	57	0.72	0.73	0.78	0.60	0.78	0.83	0.82
Kuwait	0.90	62	0.70	0.78	0.81	0.77	0.79	0.85	0.80
Lebanon	0.87	58	0.67	0.80	0.82	0.65	0.74	0.81	0.80
Lithuania	0.81	48	0.60	0.65	0.81	0.48	0.70	0.80	0.74
Malaysia	0.85	53	0.67	0.68	0.75	0.66	0.76	0.79	0.76
Malta	0.84	52	0.73	0.62	0.79	0.65	0.82	0.69	0.72
Morocco	0.83	50	0.65	0.71	0.74	0.57	0.74	0.77	0.74
New Zealand	0.84	51	0.68	0.68	0.75	0.63	0.77	0.77	0.70
Norway (9)	0.83	50	0.80	0.63	0.75	0.56	0.80	0.72	0.63
Oman	0.86	55	0.68	0.69	0.79	0.66	0.74	0.81	0.79
Qatar	0.88	58	0.62	0.67	0.76	0.75	0.82	0.84	0.85
Russian Federation	0.86	54	0.67	0.72	0.83	0.53	0.73	0.83	0.80
Saudi Arabia	0.90	62	0.74	0.76	0.79	0.72	0.82	0.85	0.83
Singapore	0.85	54	0.70	0.73	0.75	0.65	0.78	0.77	0.74
Slovenia	0.86	55	0.69	0.72	0.83	0.60	0.76	0.82	0.76
South Africa (9)	0.91	66	0.82	0.80	0.80	0.72	0.87	0.84	0.81
Sweden	0.82	49	0.68	0.67	0.72	0.61	0.78	0.75	0.68
Thailand	0.87	56	0.67	0.70	0.83	0.69	0.79	0.81	0.75
Turkey	0.88	59	0.69	0.76	0.82	0.59	0.81	0.85	0.82
United Arab Emirates	0.88	58	0.75	0.72	0.80	0.69	0.78	0.79	0.79
United States	0.84	51	0.72	0.69	0.74	0.64	0.79	0.71	0.72
Benchmarking Participants									
Buenos Aires, Argentina	0.91	65	0.77	0.82	0.74	0.73	0.87	0.84	0.86
Ontario, Canada	0.83	50	0.65	0.56	0.76	0.66	0.80	0.80	0.71
Quebec, Canada	0.86	54	0.70	0.63	0.80	0.74	0.82	0.75	0.71
Norway (8)	0.82	48	0.72	0.72	0.74	0.60	0.77	0.71	0.59
Abu Dhabi, UAE	0.87	58	0.73	0.72	0.80	0.67	0.78	0.82	0.81
Dubai, UAE	0.85	53	0.79	0.69	0.79	0.56	0.74	0.72	0.75
Florida, US	0.83	51	0.60	0.64	0.72	0.71	0.80	0.78	0.74

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Problems with School Conditions and Resources - Teachers' Reports Scale, Eighth Grade, and TIMSS 2015 Achievement

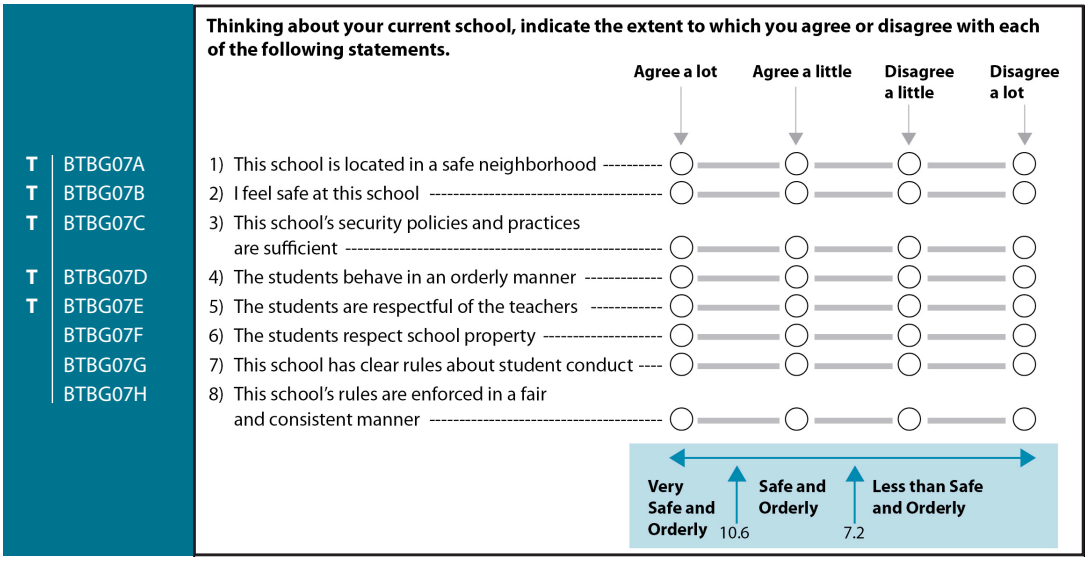
Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.17	0.10	0.03	0.01	0.02	0.01
Bahrain	0.07	0.11	0.00	0.01	0.01	0.01
Botswana (9)	0.13	0.13	0.02	0.02	0.01	0.03
Canada	0.05	0.09	0.00	0.01	0.01	0.01
Chile	0.18	0.22	0.03	0.05	0.03	0.03
Chinese Taipei	0.13	0.08	0.02	0.01	0.02	0.01
Egypt	0.14	0.13	0.02	0.02	0.01	0.02
England	0.02	0.07	0.00	0.00	0.01	0.01
Georgia	0.06	0.07	0.00	0.00	0.00	0.00
Hong Kong SAR	0.10	0.01	0.01	0.00	0.01	0.01
Hungary	-0.01	-0.07	0.00	0.01	0.00	0.00
Iran, Islamic Rep. of	0.23	0.23	0.05	0.05	0.06	0.04
Ireland	0.06	0.06	0.00	0.00	0.00	0.00
Israel	0.01	0.00	0.00	0.00	0.01	0.01
Italy	0.01	0.02	0.00	0.00	0.01	0.01
Japan	0.02	0.04	0.00	0.00	0.00	0.00
Jordan	0.23	0.19	0.05	0.04	0.03	0.03
Kazakhstan	0.08	0.08	0.01	0.01	0.01	0.01
Korea, Rep. of	0.05	0.01	0.00	0.00	0.00	0.00
Kuwait	0.07	0.09	0.00	0.01	0.00	0.01
Lebanon	0.13	0.20	0.02	0.04	0.02	0.03
Lithuania	0.07	-0.02	0.00	0.00	0.01	0.00
Malaysia	0.07	0.05	0.01	0.00	0.00	0.02
Malta	0.07	0.10	0.01	0.01	0.01	0.01
Morocco	0.12	0.12	0.01	0.01	0.01	0.02
New Zealand	0.08	0.14	0.01	0.02	0.01	0.01
Norway (9)	0.06	0.02	0.00	0.00	0.00	0.00
Oman	0.04	0.07	0.00	0.00	0.00	0.00
Qatar	-0.08	-0.13	0.01	0.02	0.01	0.01
Russian Federation	0.05	0.09	0.00	0.01	0.00	0.01
Saudi Arabia	0.18	0.16	0.03	0.03	0.02	0.03
Singapore	0.07	0.12	0.00	0.01	0.00	0.02
Slovenia	0.02	0.04	0.00	0.00	0.00	0.00
South Africa (9)	0.41	0.41	0.17	0.17	0.19	0.15
Sweden	-0.01	0.01	0.00	0.00	0.01	0.00
Thailand	0.12	0.14	0.01	0.02	0.01	0.02
Turkey	0.16	0.20	0.03	0.04	0.01	0.02
United Arab Emirates	0.18	0.17	0.03	0.03	0.02	0.02
United States	0.08	0.12	0.01	0.01	0.00	0.02
International Median	0.07	0.09	0.01	0.01	0.01	0.01
Benchmarking Participants						
Buenos Aires, Argentina	0.32	0.18	0.10	0.03	0.11	0.01
Ontario, Canada	0.03	0.05	0.00	0.00	0.00	0.00
Quebec, Canada	0.03	0.12	0.00	0.02	0.01	0.02
Norway (8)	0.02	0.01	0.00	0.00	0.00	0.00
Abu Dhabi, UAE	0.10	0.02	0.01	0.00	0.00	0.00
Dubai, UAE	0.23	0.24	0.05	0.06	0.05	0.05
Florida, US	0.12	0.15	0.02	0.02	0.02	0.02

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Safe and Orderly School–Teachers' Reports Scale, Eighth Grade

The Safe and Orderly School–Teachers' Reports (SOS) scale was created based on teachers' degree of agreement with the eight statements described below.

Items in the TIMSS 2015 Safe and Orderly School–Teachers' Reports Scale, Eighth Grade[1]



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

1 For the purpose of scaling, categories in which there were very few respondents were combined. The categories "Disagree a little" and "Disagree a lot" were combined for all variables. The scale statistics that are reported herein reflect analysis of the items following collapsing.

Item Parameters for the TIMSS 2015 Safe and Orderly School - Teachers' Reports Scale, Eighth Grade

Item	delta	tau_1	tau_2	Infit
BTBG07A	-0.80503	-1.12750	1.12750	1.25
BTBG07B	-1.38913	-1.25587	1.25587	1.00
BTBG07C	-0.51907	-1.43177	1.43177	1.02
BTBG07D	0.92295	-1.81668	1.81668	0.92
BTBG07E	0.58019	-1.77905	1.77905	0.92
BTBG07F	1.54089	-1.74888	1.74888	0.94
BTBG07G	-0.48566	-1.36955	1.36955	1.13
BTBG07H	0.15486	-1.50409	1.50409	1.07

Scale Transformation Constants for the TIMSS 2015 Safe and Orderly School - Teachers' Reports Scale, Eighth Grade

Scale Transformation Constants	
A = 8.92966	Transformed Scale Score = 8.92966 + 1.031502 • Logit Scale Score
B = 1.031502	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Safe and Orderly School - Teachers' Reports Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	4.21352	
1	5.50950	
2	6.20806	
3	6.73583	
4	7.18910	7.2
5	7.60560	
6	8.00514	
7	8.40086	
8	8.79988	
9	9.21200	
10	9.64573	
11	10.11020	
12	10.61839	10.6
13	11.18541	
14	11.83862	
15	12.65468	
16	14.06211	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Safe and Orderly School - Teachers' Reports Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item							
			BTBG07A	BTBG07B	BTBG07C	BTBG07D	BTBG07E	BTBG07F	BTBG07G	BTBG07H
Australia	0.90	60	0.65	0.75	0.72	0.86	0.87	0.81	0.72	0.78
Bahrain	0.86	52	0.55	0.63	0.68	0.74	0.80	0.77	0.75	0.80
Botswana (9)	0.84	47	0.67	0.74	0.67	0.75	0.77	0.69	0.55	0.64
Canada	0.87	53	0.58	0.58	0.64	0.83	0.82	0.81	0.74	0.76
Chile	0.85	51	0.44	0.64	0.74	0.82	0.80	0.72	0.72	0.77
Chinese Taipei	0.89	57	0.70	0.78	0.71	0.79	0.77	0.75	0.78	0.78
Egypt	0.87	53	0.60	0.67	0.70	0.74	0.73	0.78	0.80	0.76
England	0.86	51	0.49	0.62	0.59	0.83	0.82	0.81	0.70	0.79
Georgia	0.78	41	0.60	0.67	0.75	0.63	0.68	0.53	0.57	0.65
Hong Kong SAR	0.81	44	0.48	0.59	0.58	0.74	0.78	0.75	0.65	0.65
Hungary	0.87	52	0.54	0.69	0.75	0.80	0.80	0.77	0.66	0.73
Iran, Islamic Rep. of	0.84	47	0.58	0.68	0.69	0.75	0.71	0.71	0.71	0.65
Ireland	0.86	51	0.71	0.62	0.63	0.84	0.84	0.79	0.53	0.68
Israel	0.84	48	0.49	0.62	0.60	0.79	0.77	0.76	0.72	0.74
Italy	0.85	49	0.68	0.76	0.67	0.72	0.73	0.72	0.65	0.65
Japan	0.84	48	0.65	0.70	0.62	0.79	0.76	0.78	0.56	0.67
Jordan	0.88	54	0.60	0.70	0.75	0.77	0.74	0.74	0.77	0.77
Kazakhstan	0.86	51	0.59	0.68	0.68	0.78	0.73	0.72	0.75	0.80
Korea, Rep. of	0.88	55	0.68	0.75	0.76	0.76	0.79	0.72	0.72	0.75
Kuwait	0.86	51	0.50	0.64	0.72	0.76	0.73	0.73	0.79	0.77
Lebanon	0.85	50	0.44	0.48	0.64	0.76	0.82	0.82	0.77	0.83
Lithuania	0.86	51	0.43	0.76	0.78	0.73	0.76	0.73	0.69	0.73
Malaysia	0.86	50	0.61	0.65	0.71	0.75	0.73	0.72	0.71	0.75
Malta	0.87	52	0.51	0.67	0.72	0.83	0.78	0.80	0.69	0.73
Morocco	0.89	56	0.67	0.78	0.78	0.81	0.79	0.75	0.69	0.73
New Zealand	0.88	55	0.58	0.64	0.69	0.83	0.85	0.80	0.73	0.75
Norway (9)	0.77	39	0.51	0.46	0.45	0.78	0.79	0.72	0.55	0.63
Oman	0.86	52	0.40	0.54	0.70	0.84	0.83	0.78	0.76	0.78
Qatar	0.83	46	0.33	0.61	0.57	0.76	0.75	0.76	0.76	0.78
Russian Federation	0.84	47	0.59	0.62	0.68	0.75	0.75	0.78	0.55	0.74
Saudi Arabia	0.86	51	0.59	0.66	0.73	0.76	0.74	0.79	0.67	0.74
Singapore	0.89	58	0.58	0.73	0.71	0.83	0.82	0.82	0.77	0.79
Slovenia	0.87	53	0.65	0.73	0.78	0.76	0.76	0.73	0.68	0.71
South Africa (9)	0.88	55	0.73	0.78	0.75	0.79	0.72	0.80	0.64	0.72
Sweden	0.86	51	0.56	0.62	0.75	0.78	0.77	0.76	0.67	0.77
Thailand	0.86	50	0.57	0.70	0.75	0.76	0.73	0.71	0.72	0.70
Turkey	0.88	56	0.72	0.76	0.80	0.78	0.77	0.71	0.72	0.69
United Arab Emirates	0.86	51	0.48	0.56	0.63	0.79	0.78	0.82	0.80	0.79
United States	0.90	59	0.60	0.71	0.74	0.87	0.86	0.84	0.70	0.77
Benchmarking Participants										
Buenos Aires, Argentina	0.80	45	0.31	0.70	0.78	0.74	0.73	0.70	0.56	0.69
Ontario, Canada	0.87	53	0.58	0.62	0.61	0.84	0.83	0.80	0.75	0.76
Quebec, Canada	0.85	49	0.50	0.50	0.66	0.81	0.79	0.80	0.72	0.74
Norway (8)	0.79	41	0.40	0.56	0.58	0.79	0.80	0.73	0.56	0.61
Abu Dhabi, UAE	0.86	51	0.49	0.53	0.62	0.78	0.78	0.83	0.78	0.78
Dubai, UAE	0.87	52	0.35	0.61	0.63	0.82	0.77	0.82	0.83	0.81
Florida, US	0.90	59	0.71	0.71	0.74	0.85	0.84	0.81	0.72	0.75

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Safe and Orderly School - Teachers' Reports Scale, Eighth Grade, and TIMSS 2015 Achievement

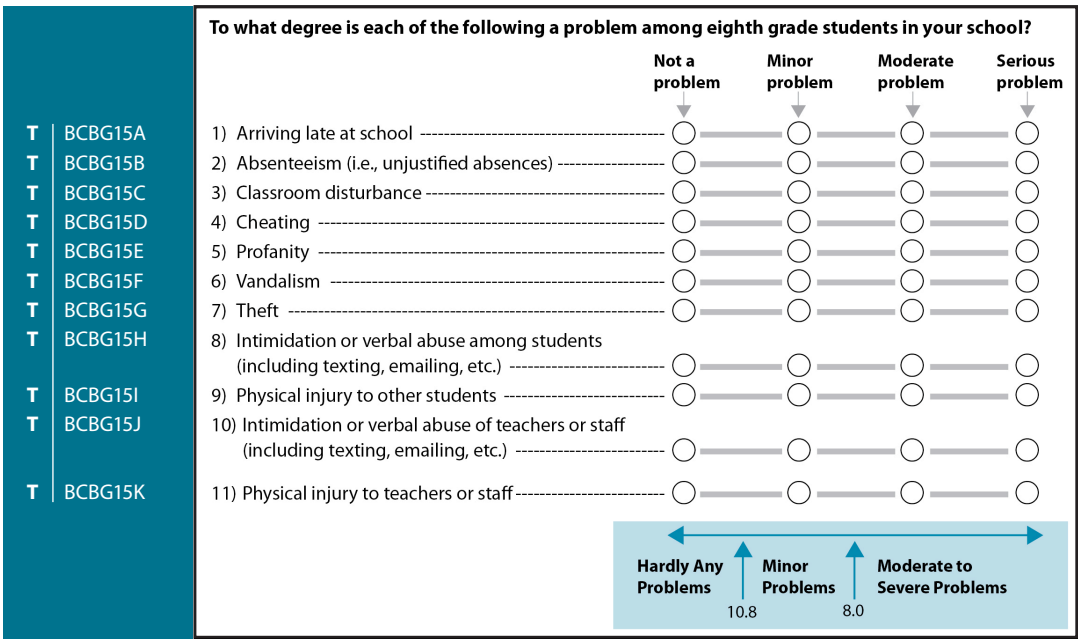
Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.29	0.20	0.08	0.04	0.07	0.04
Bahrain	0.14	0.15	0.02	0.02	0.01	0.01
Botswana (9)	0.10	0.08	0.01	0.01	0.01	0.01
Canada	0.04	0.10	0.00	0.01	0.01	0.02
Chile	0.28	0.27	0.08	0.07	0.06	0.06
Chinese Taipei	0.13	0.09	0.02	0.01	0.01	0.00
Egypt	0.15	0.20	0.02	0.04	0.02	0.03
England	0.22	0.21	0.05	0.04	0.04	0.04
Georgia	0.06	0.04	0.00	0.00	0.02	0.00
Hong Kong SAR	0.25	0.13	0.06	0.02	0.03	0.01
Hungary	0.21	0.21	0.04	0.04	0.03	0.03
Iran, Islamic Rep. of	0.18	0.20	0.03	0.04	0.02	0.02
Ireland	0.25	0.20	0.06	0.04	0.07	0.05
Israel	0.20	0.08	0.04	0.01	0.03	0.01
Italy	0.17	0.15	0.03	0.02	0.03	0.02
Japan	0.07	0.12	0.01	0.01	0.00	0.01
Jordan	0.15	0.17	0.02	0.03	0.02	0.03
Kazakhstan	0.05	0.02	0.00	0.00	0.00	0.00
Korea, Rep. of	0.05	0.06	0.00	0.00	0.00	0.00
Kuwait	0.14	0.17	0.02	0.03	0.00	0.03
Lebanon	0.07	0.07	0.00	0.01	0.01	0.01
Lithuania	0.07	0.01	0.00	0.00	0.00	0.00
Malaysia	0.18	0.09	0.03	0.01	0.05	0.00
Malta	0.20	0.16	0.04	0.03	0.03	0.03
Morocco	0.13	0.12	0.02	0.01	0.01	0.01
New Zealand	0.17	0.28	0.03	0.08	0.02	0.07
Norway (9)	0.11	0.09	0.01	0.01	0.01	0.01
Oman	0.14	0.10	0.02	0.01	0.02	0.01
Qatar	0.12	0.11	0.01	0.01	0.00	0.02
Russian Federation	0.15	0.09	0.02	0.01	0.01	0.01
Saudi Arabia	0.18	0.18	0.03	0.03	0.02	0.03
Singapore	0.20	0.21	0.04	0.04	0.02	0.02
Slovenia	0.05	0.06	0.00	0.00	0.01	0.00
South Africa (9)	0.23	0.24	0.05	0.06	0.05	0.05
Sweden	0.13	0.16	0.02	0.02	0.01	0.03
Thailand	0.08	0.04	0.01	0.00	0.01	0.00
Turkey	0.19	0.20	0.04	0.04	0.05	0.02
United Arab Emirates	0.29	0.28	0.08	0.08	0.05	0.07
United States	0.28	0.22	0.08	0.05	0.07	0.05
International Median	0.15	0.15	0.02	0.02	0.02	0.02
Benchmarking Participants						
Buenos Aires, Argentina	0.06	0.17	0.00	0.03	0.00	0.01
Ontario, Canada	0.07	0.06	0.00	0.00	0.01	0.01
Quebec, Canada	0.13	0.26	0.02	0.07	0.01	0.07
Norway (8)	0.11	0.05	0.01	0.00	0.01	0.00
Abu Dhabi, UAE	0.26	0.24	0.07	0.06	0.04	0.06
Dubai, UAE	0.25	0.29	0.06	0.09	0.05	0.07
Florida, US	0.17	0.18	0.03	0.03	0.04	0.03

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

School Discipline Problems–Principals' Reports Scale, Eighth Grade

The School Discipline Problems–Principals' Reports (DAS) scale was created based on principals' responses concerning the eleven potential school problems described below.

Items in the TIMSS 2015 School Discipline Problems–Principals' Reports Scale, Eighth Grade



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 School Discipline Problems - Principals' Reports Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BCBG15A	0.35543	-2.45404	-0.50450	2.95854	1.38
BCBG15B	0.81556	-1.87731	-0.68567	2.56298	1.13
BCBG15C	0.70602	-2.36267	-0.37850	2.74117	1.00
BCBG15D	-0.17898	-1.54132	-0.62883	2.17015	1.09
BCBG15E	0.40992	-1.72903	-0.46635	2.19538	0.88
BCBG15F	0.06453	-0.93256	-0.64660	1.57916	0.84
BCBG15G	-0.34720	-0.36836	-1.00450	1.37286	0.83
BCBG15H	0.40049	-1.81251	-0.70589	2.51840	0.90
BCBG15I	-0.28471	-0.92448	-0.85294	1.77742	0.78
BCBG15J	-0.70539	-0.40379	-0.86401	1.26780	0.87
BCBG15K	-1.23567	1.05912	-0.69101	-0.36811	0.86

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 School Discipline Problems - Principals' Reports Scale, Eighth Grade

Scale Transformation Constants	
A = 8.418512	Transformed Scale Score = 8.418512 + 0.981214 • Logit Scale Score
B = 0.981214	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 School Discipline Problems - Principals' Reports Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	4.07274	
1	5.16684	
2	5.67741	
3	6.01327	
4	6.26434	
5	6.46647	
6	6.63787	
7	6.78911	
8	6.92690	
9	7.05599	
10	7.17997	
11	7.30166	
12	7.42228	
13	7.54644	
14	7.67382	
15	7.80615	
16	7.94503	8.0
17	8.09232	
18	8.24902	
19	8.41762	
20	8.60012	
21	8.79847	
22	9.01619	
23	9.25431	
24	9.51506	
25	9.79961	
26	10.10915	
27	10.44316	
28	10.80339	10.8
29	11.19421	
30	11.62747	
31	12.13360	
32	12.80087	
33	14.02734	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 School Discipline Problems - Principals' Reports Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item										
			BCBG15A	BCBG15B	BCBG15C	BCBG15D	BCBG15E	BCBG15F	BCBG15G	BCBG15H	BCBG15I	BCBG15J	BCBG15K
Australia	0.87	44	0.64	0.67	0.74	0.58	0.75	0.80	0.62	0.66	0.73	0.69	0.36
Bahrain	0.97	75	0.72	0.83	0.84	0.84	0.86	0.91	0.90	0.89	0.86	0.93	0.90
Botswana (9)	0.89	47	0.57	0.63	0.63	0.74	0.72	0.68	0.80	0.75	0.75	0.67	0.55
Canada	0.87	45	0.64	0.63	0.71	0.59	0.76	0.79	0.78	0.71	0.71	0.68	0.26
Chile	0.88	48	0.57	0.63	0.68	0.65	0.83	0.78	0.76	0.74	0.77	0.71	0.37
Chinese Taipei	0.90	50	0.67	0.75	0.76	0.68	0.77	0.79	0.77	0.67	0.74	0.67	0.39
Egypt	0.95	67	0.54	0.54	0.82	0.77	0.90	0.87	0.90	0.88	0.88	0.89	0.87
England	0.81	35	0.68	0.73	0.82	0.24	0.65	0.61	0.42	0.70	0.60	0.55	0.09
Georgia	0.91	55	0.59	0.66	0.70	0.57	0.78	0.74	0.84	0.72	0.81	0.84	0.84
Hong Kong SAR	0.86	44	0.73	0.69	0.71	0.60	0.68	0.76	0.69	0.60	0.70	0.65	0.44
Hungary	0.90	51	0.58	0.58	0.78	0.68	0.75	0.80	0.72	0.83	0.84	0.76	0.42
Iran, Islamic Rep. of	0.92	58	0.69	0.74	0.71	0.69	0.81	0.76	0.80	0.79	0.80	0.78	0.76
Ireland	0.88	46	0.66	0.64	0.71	0.60	0.78	0.73	0.62	0.76	0.65	0.78	0.50
Israel	0.95	66	0.68	0.78	0.77	0.82	0.81	0.81	0.84	0.83	0.86	0.86	0.84
Italy	0.91	52	0.47	0.68	0.56	0.41	0.57	0.86	0.85	0.68	0.86	0.89	0.85
Japan	0.92	60	0.62	0.40	0.85	0.82	0.90	0.85	0.77	0.71	0.85	0.77	0.83
Jordan	0.95	68	0.67	0.70	0.73	0.80	0.87	0.86	0.89	0.88	0.90	0.87	0.86
Kazakhstan	0.97	80	0.84	0.90	0.88	0.66	0.92	0.95	0.94	0.94	0.94	0.95	0.88
Korea, Rep. of	0.94	63	0.68	0.80	0.74	0.83	0.83	0.84	0.80	0.78	0.86	0.81	0.73
Kuwait	0.95	66	0.49	0.66	0.72	0.86	0.89	0.87	0.87	0.84	0.89	0.90	0.86
Lebanon	0.97	79	0.82	0.86	0.82	0.83	0.90	0.92	0.94	0.88	0.94	0.92	0.92
Lithuania	0.85	40	0.62	0.65	0.71	0.66	0.74	0.61	0.56	0.77	0.63	0.65	0.08
Malaysia	0.88	49	0.56	0.48	0.64	0.77	0.83	0.80	0.79	0.77	0.72	0.71	0.52
Malta	0.93	60	0.64	0.86	0.80	0.77	0.83	0.83	0.80	0.73	0.84	0.84	0.52
Morocco	0.94	65	0.49	0.65	0.84	0.79	0.85	0.88	0.92	0.82	0.87	0.87	0.82
New Zealand	0.88	46	0.65	0.64	0.69	0.53	0.79	0.70	0.64	0.68	0.74	0.77	0.61
Norway (9)	0.83	38	0.60	0.57	0.69	0.63	0.71	0.65	0.47	0.70	0.68	0.69	0.33
Oman	0.97	74	0.73	0.82	0.78	0.86	0.90	0.86	0.90	0.89	0.90	0.91	0.90
Qatar	0.97	78	0.55	0.76	0.83	0.93	0.92	0.93	0.95	0.92	0.95	0.92	0.93
Russian Federation	0.81	36	0.66	0.63	0.66	0.56	0.61	0.65	0.68	0.72	0.65	0.38	0.07
Saudi Arabia	0.97	73	0.56	0.70	0.82	0.92	0.86	0.90	0.91	0.91	0.93	0.92	0.92
Singapore	0.88	50	0.65	0.69	0.68	0.68	0.75	0.71	0.80	0.76	0.69	0.64	-
Slovenia	0.90	50	0.71	0.67	0.75	0.74	0.82	0.74	0.61	0.77	0.81	0.70	0.29
South Africa (9)	0.91	51	0.73	0.81	0.69	0.70	0.74	0.80	0.78	0.77	0.76	0.64	0.38
Sweden	0.84	39	0.63	0.75	0.56	0.46	0.73	0.68	0.67	0.68	0.74	0.62	0.19
Thailand	0.89	48	0.66	0.63	0.70	0.79	0.64	0.80	0.80	0.76	0.77	0.55	0.46
Turkey	0.95	66	0.71	0.72	0.78	0.80	0.73	0.83	0.87	0.86	0.88	0.88	0.84
United Arab Emirates	0.93	60	0.67	0.73	0.77	0.78	0.84	0.84	0.78	0.79	0.82	0.81	0.68
United States	0.88	46	0.67	0.65	0.71	0.56	0.75	0.72	0.73	0.71	0.76	0.70	0.36
Benchmarking Participants													
Buenos Aires, Argentina	0.86	46	0.66	0.72	0.74	0.61	0.68	0.70	0.76	0.65	0.83	0.60	0.39
Ontario, Canada	0.88	46	0.64	0.59	0.73	0.62	0.77	0.81	0.80	0.77	0.69	0.61	0.24
Quebec, Canada	0.87	46	0.61	0.61	0.63	0.51	0.83	0.78	0.77	0.66	0.81	0.80	0.27
Norway (8)	0.79	34	0.44	0.64	0.61	0.73	0.71	0.60	0.59	0.48	0.57	0.44	0.52
Abu Dhabi, UAE	0.90	55	0.66	0.71	0.75	0.69	0.82	0.83	0.76	0.76	0.78	0.78	0.61
Dubai, UAE	0.92	57	0.55	0.62	0.77	0.82	0.84	0.82	0.79	0.72	0.82	0.74	0.75
Florida, US	0.91	53	0.80	0.76	0.76	0.71	0.83	0.49	0.81	0.75	0.83	0.82	0.25

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 School Discipline Problems - Principals' Reports Scale, Eighth Grade, and TIMSS 2015 Achievement

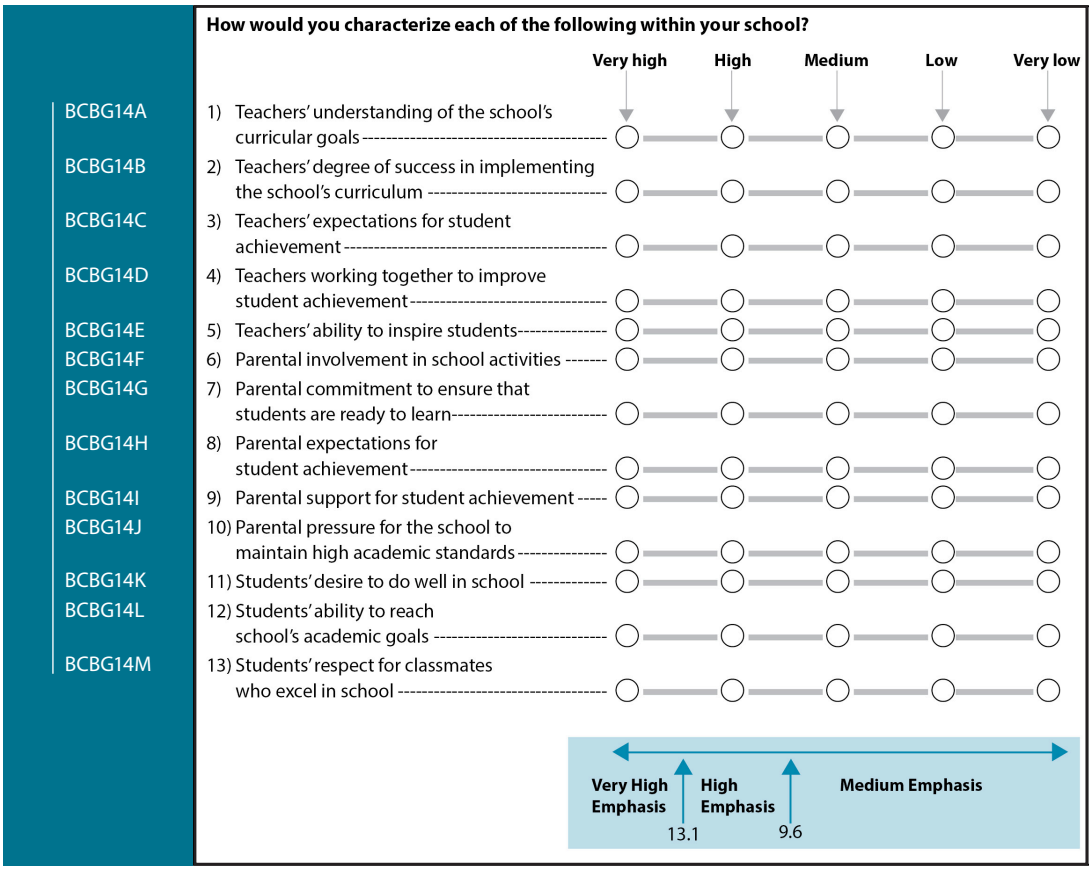
Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.29	0.26	0.08	0.07	0.07	0.05
Bahrain	0.14	0.15	0.02	0.02	0.02	0.04
Botswana (9)	0.23	0.21	0.05	0.04	0.04	0.04
Canada	0.10	0.08	0.01	0.01	0.01	0.01
Chile	0.22	0.23	0.05	0.05	0.04	0.04
Chinese Taipei	0.24	0.23	0.06	0.06	0.06	0.05
Egypt	0.02	0.03	0.00	0.00	0.00	0.00
England	0.23	0.22	0.05	0.05	0.02	0.02
Georgia	-0.07	-0.04	0.01	0.00	0.00	0.00
Hong Kong SAR	0.27	0.23	0.07	0.05	0.04	0.03
Hungary	0.29	0.28	0.08	0.08	0.09	0.08
Iran, Islamic Rep. of	0.11	0.09	0.01	0.01	0.01	0.01
Ireland	0.20	0.18	0.04	0.03	0.03	0.03
Israel	0.22	0.22	0.05	0.05	0.04	0.05
Italy	-0.01	0.01	0.00	0.00	0.00	0.00
Japan	0.08	0.07	0.01	0.01	0.01	0.01
Jordan	0.01	0.02	0.00	0.00	0.01	0.01
Kazakhstan	0.08	0.10	0.01	0.01	0.01	0.02
Korea, Rep. of	-0.07	-0.05	0.01	0.00	0.00	0.00
Kuwait	0.15	0.21	0.02	0.04	0.03	0.04
Lebanon	0.05	0.03	0.00	0.00	0.01	0.01
Lithuania	0.09	0.08	0.01	0.01	0.01	0.01
Malaysia	0.17	0.18	0.03	0.03	0.02	0.02
Malta	0.26	0.27	0.07	0.07	0.09	0.10
Morocco	0.05	0.06	0.00	0.00	0.01	0.01
New Zealand	0.18	0.19	0.03	0.03	0.03	0.03
Norway (9)	0.08	0.10	0.01	0.01	0.00	0.00
Oman	0.10	0.08	0.01	0.01	0.01	0.01
Qatar	0.04	0.03	0.00	0.00	0.00	0.00
Russian Federation	0.19	0.21	0.04	0.04	0.01	0.02
Saudi Arabia	0.09	0.15	0.01	0.02	0.02	0.04
Singapore	0.26	0.24	0.07	0.06	0.03	0.03
Slovenia	0.07	0.08	0.00	0.01	0.00	0.00
South Africa (9)	0.20	0.19	0.04	0.04	0.05	0.04
Sweden	0.16	0.18	0.02	0.03	0.03	0.03
Thailand	0.11	0.12	0.01	0.01	0.01	0.02
Turkey	0.13	0.13	0.02	0.02	0.03	0.03
United Arab Emirates	0.24	0.25	0.06	0.06	0.03	0.03
United States	0.27	0.28	0.07	0.08	0.05	0.05
International Median	0.14	0.15	0.02	0.02	0.02	0.02
Benchmarking Participants						
Buenos Aires, Argentina	0.32	0.28	0.10	0.08	0.06	0.04
Ontario, Canada	0.08	0.05	0.01	0.00	0.01	0.00
Quebec, Canada	0.10	0.08	0.01	0.01	0.01	0.01
Norway (8)	0.05	0.07	0.00	0.00	0.01	0.01
Abu Dhabi, UAE	0.18	0.19	0.03	0.04	0.01	0.01
Dubai, UAE	0.30	0.31	0.09	0.10	0.05	0.06
Florida, US	0.03	0.02	0.00	0.00	0.10	0.11

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

School Emphasis on Academic Success–Principals' Reports Scale, Eighth Grade

The School Emphasis on Academic Success–Principals' Reports (EAS) scale was created based on teachers' responses characterizing the thirteen aspects described below.

Items in the TIMSS 2015 School Emphasis on Academic Success–Principals' Reports Scale, Eighth Grade[1]



1 For the purpose of scaling, categories in which there were very few respondents were combined. The categories "Low" and "Very low" were combined for all variables. The scale statistics that are reported herein reflect analysis of the items following collapsing.

Item Parameters for the TIMSS 2015 School Emphasis on Academic Success - Principals' Reports Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BCBG14A	-1.76385	-3.28017	-0.07481	3.35498	1.08
BCBG14B	-1.17365	-3.50530	0.06625	3.43905	0.96
BCBG14C	-0.88646	-3.14005	-0.04034	3.18039	0.95
BCBG14D	-0.76453	-2.71198	-0.12909	2.84107	1.08
BCBG14E	-0.49217	-3.19184	0.00480	3.18704	0.95
BCBG14F	1.62433	-2.27811	0.09269	2.18542	1.11
BCBG14G	1.38302	-2.36022	0.06460	2.29562	0.85
BCBG14H	-0.06276	-2.26101	-0.22820	2.48921	1.03
BCBG14I	1.13998	-2.47307	0.03842	2.43465	0.79
BCBG14J	0.78562	-2.02339	-0.09617	2.11956	1.23
BCBG14K	0.20569	-3.16759	0.13127	3.03632	0.87
BCBG14L	0.44841	-3.54657	0.11136	3.43521	0.81
BCBG14M	-0.44363	-2.97276	-0.18570	3.15846	1.15

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 School Emphasis on Academic Success - Principals' Reports Scale, Eighth Grade

Scale Transformation Constants	
A = 9.587978	Transformed Scale Score = 9.587978 + 1.101886 • Logit Scale Score
B = 1.101886	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 School Emphasis on Academic Success - Principals' Reports Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	1.93343	
1	3.33811	
2	4.10092	
3	4.66995	
4	5.14483	
5	5.56379	
6	5.94753	
7	6.30527	
8	6.64249	
9	6.96191	
10	7.26508	
11	7.55352	
12	7.82881	
13	8.09374	
14	8.35031	
15	8.60068	
16	8.84696	
17	9.09098	
18	9.33426	
19	9.57780	9.6
20	9.82234	
21	10.06789	
22	10.31430	
23	10.56114	
24	10.80795	
25	11.05447	
26	11.30073	
27	11.54716	
28	11.79471	
29	12.04479	
30	12.29937	
31	12.56014	
32	12.83181	
33	13.11864	13.1
34	13.42815	
35	13.76917	
36	14.16268	
37	14.64698	
38	15.31745	
39	16.63263	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 School Emphasis on Academic Success - Principals' Reports Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item												
			BCBG14A	BCBG14B	BCBG14C	BCBG14D	BCBG14E	BCBG14F	BCBG14G	BCBG14H	BCBG14I	BCBG14J	BCBG14K	BCBG14L	BCBG14M
Australia	0.94	60	0.70	0.75	0.83	0.72	0.82	0.72	0.83	0.83	0.83	0.77	0.79	0.68	0.74
Bahrain	0.93	55	0.59	0.71	0.79	0.68	0.79	0.81	0.81	0.78	0.87	0.70	0.78	0.84	0.45
Botswana (9)	0.86	39	0.58	0.59	0.69	0.67	0.70	0.62	0.64	0.52	0.71	0.49	0.70	0.60	0.60
Canada	0.94	58	0.74	0.78	0.78	0.63	0.75	0.73	0.85	0.81	0.85	0.75	0.77	0.74	0.68
Chile	0.92	51	0.74	0.79	0.73	0.62	0.76	0.68	0.75	0.76	0.69	0.70	0.75	0.70	0.64
Chinese Taipei	0.93	56	0.64	0.73	0.77	0.68	0.77	0.82	0.83	0.80	0.79	0.70	0.78	0.82	0.58
Egypt	0.88	42	0.50	0.61	0.44	0.53	0.50	0.73	0.69	0.76	0.76	0.69	0.71	0.74	0.60
England	0.95	61	0.69	0.77	0.78	0.63	0.80	0.84	0.89	0.81	0.84	0.84	0.81	0.72	0.72
Georgia	0.89	43	0.69	0.67	0.74	0.70	0.74	0.63	0.59	0.59	0.74	0.59	0.63	0.56	0.65
Hong Kong SAR	0.92	52	0.59	0.65	0.74	0.63	0.74	0.54	0.83	0.79	0.84	0.73	0.79	0.81	0.58
Hungary	0.89	45	0.37	0.61	0.57	0.42	0.65	0.70	0.80	0.76	0.72	0.68	0.81	0.75	0.72
Iran, Islamic Rep. of	0.91	49	0.63	0.73	0.60	0.65	0.71	0.66	0.79	0.67	0.76	0.72	0.77	0.77	0.61
Ireland	0.93	56	0.63	0.64	0.81	0.61	0.70	0.64	0.85	0.82	0.82	0.79	0.84	0.82	0.65
Israel	0.89	44	0.62	0.72	0.73	0.48	0.58	0.59	0.72	0.72	0.80	0.55	0.73	0.71	0.60
Italy	0.87	40	0.65	0.62	0.49	0.47	0.64	0.62	0.70	0.66	0.63	0.68	0.71	0.69	0.62
Japan	0.89	44	0.60	0.63	0.75	0.55	0.53	0.55	0.73	0.70	0.77	0.54	0.78	0.76	0.67
Jordan	0.91	49	0.65	0.65	0.55	0.73	0.72	0.69	0.78	0.71	0.71	0.69	0.73	0.77	0.66
Kazakhstan	0.92	52	0.61	0.63	0.63	0.75	0.80	0.75	0.82	0.71	0.80	0.71	0.74	0.75	0.66
Korea, Rep. of	0.90	46	0.44	0.57	0.77	0.60	0.62	0.77	0.81	0.75	0.81	0.59	0.67	0.79	0.52
Kuwait	0.91	48	0.63	0.62	0.69	0.67	0.71	0.68	0.80	0.71	0.77	0.64	0.71	0.77	0.58
Lebanon	0.90	46	0.61	0.68	0.66	0.69	0.59	0.70	0.75	0.77	0.75	0.56	0.70	0.73	0.54
Lithuania	0.89	43	0.54	0.58	0.59	0.65	0.74	0.67	0.73	0.73	0.70	0.44	0.73	0.70	0.65
Malaysia	0.91	49	0.44	0.63	0.60	0.61	0.68	0.72	0.79	0.79	0.80	0.63	0.80	0.77	0.70
Malta	0.93	55	0.78	0.82	0.66	0.68	0.67	0.72	0.78	0.72	0.82	0.72	0.80	0.81	0.59
Morocco	0.88	41	0.58	0.54	0.59	0.63	0.64	0.57	0.75	0.73	0.69	0.71	0.64	0.68	0.55
New Zealand	0.90	48	0.65	0.69	0.71	0.61	0.74	0.62	0.76	0.66	0.79	0.73	0.76	0.70	0.48
Norway (9)	0.88	43	0.46	0.59	0.76	0.59	0.62	0.80	0.71	0.66	0.76	0.54	0.61	0.66	0.63
Oman	0.90	46	0.65	0.68	0.62	0.62	0.65	0.70	0.77	0.78	0.78	0.50	0.64	0.71	0.61
Qatar	0.92	52	0.56	0.72	0.75	0.67	0.69	0.67	0.85	0.70	0.74	0.73	0.81	0.77	0.65
Russian Federation	0.83	37	0.60	0.68	0.55	0.60	0.65	0.72	0.70	0.39	0.64	0.01	0.67	0.70	0.59
Saudi Arabia	0.90	47	0.62	0.64	0.62	0.66	0.61	0.72	0.73	0.76	0.68	0.60	0.77	0.83	0.66
Singapore	0.93	56	0.58	0.72	0.77	0.70	0.77	0.64	0.83	0.75	0.83	0.72	0.81	0.80	0.72
Slovenia	0.84	36	0.72	0.76	0.71	0.76	0.79	0.50	0.55	0.27	0.56	0.40	0.54	0.54	0.48
South Africa (9)	0.89	45	0.57	0.63	0.63	0.75	0.70	0.72	0.74	0.52	0.76	0.56	0.69	0.76	0.68
Sweden	0.91	48	0.56	0.68	0.71	0.63	0.69	0.62	0.76	0.80	0.79	0.70	0.64	0.73	0.64
Thailand	0.91	48	0.62	0.72	0.63	0.65	0.67	0.76	0.78	0.66	0.77	0.66	0.71	0.76	0.62
Turkey	0.91	49	0.61	0.65	0.67	0.56	0.70	0.71	0.78	0.66	0.81	0.76	0.81	0.79	0.57
United Arab Emirates	0.93	56	0.72	0.71	0.81	0.73	0.72	0.73	0.77	0.72	0.79	0.70	0.82	0.80	0.66
United States	0.93	55	0.61	0.70	0.74	0.66	0.71	0.79	0.84	0.80	0.82	0.69	0.78	0.73	0.75
Benchmarking Participants															
Buenos Aires, Argentina	0.87	42	0.70	0.62	0.67	0.58	0.61	0.60	0.66	0.64	0.74	0.70	0.60	0.62	0.62
Ontario, Canada	0.93	56	0.74	0.77	0.79	0.48	0.65	0.70	0.85	0.80	0.85	0.78	0.79	0.76	0.65
Quebec, Canada	0.94	58	0.76	0.73	0.72	0.79	0.79	0.79	0.83	0.77	0.82	0.69	0.71	0.72	0.73
Norway (8)	0.88	42	0.47	0.60	0.76	0.57	0.64	0.81	0.71	0.63	0.77	0.52	0.59	0.65	0.63
Abu Dhabi, UAE	0.92	52	0.72	0.72	0.82	0.69	0.74	0.70	0.78	0.66	0.75	0.64	0.84	0.74	0.57
Dubai, UAE	0.94	60	0.74	0.77	0.83	0.78	0.80	0.71	0.73	0.74	0.83	0.70	0.83	0.85	0.75
Florida, US	0.94	60	0.68	0.81	0.79	0.72	0.62	0.87	0.89	0.81	0.81	0.73	0.86	0.63	0.75

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 School Emphasis on Academic Success - Principals' Reports Scale, Eighth Grade, and TIMSS 2015 Achievement

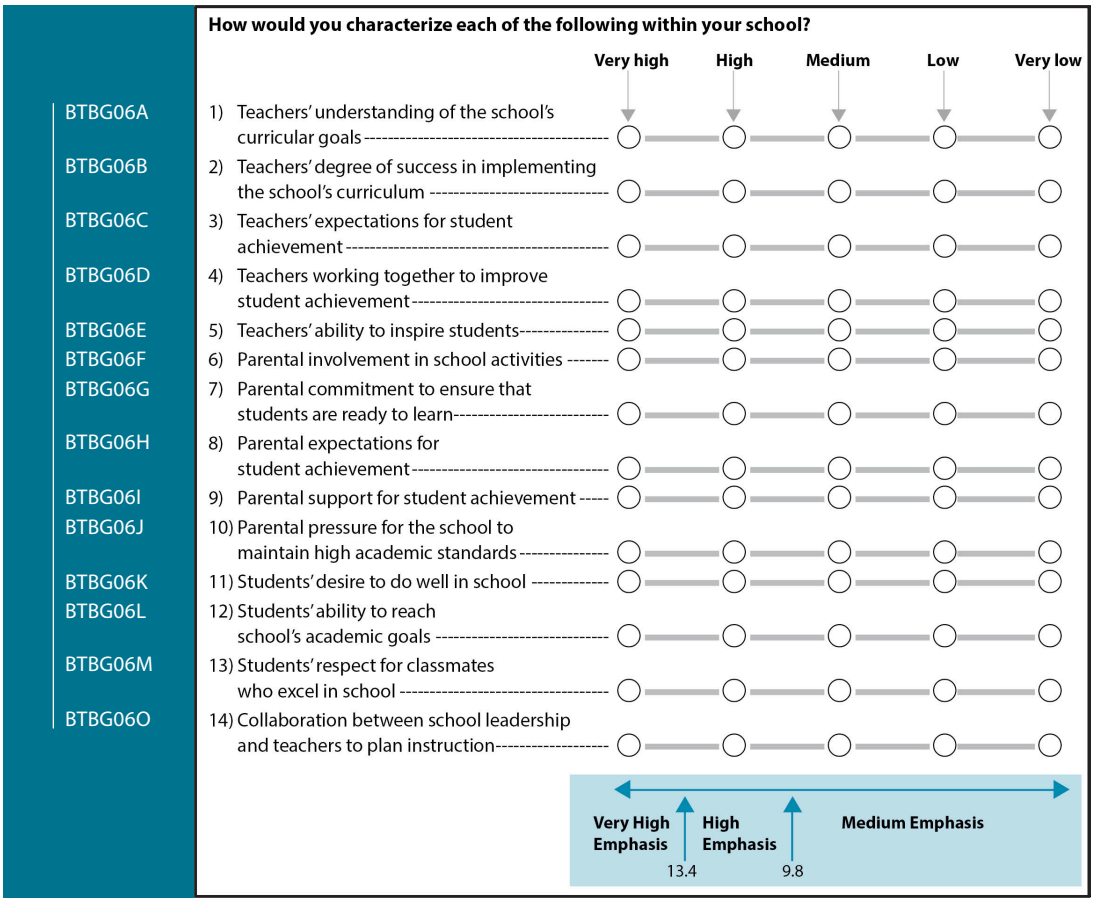
Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.32	0.27	0.10	0.07	0.09	0.07
Bahrain	0.24	0.21	0.06	0.04	0.08	0.05
Botswana (9)	0.34	0.31	0.12	0.10	0.13	0.11
Canada	0.21	0.14	0.05	0.02	0.04	0.02
Chile	0.30	0.30	0.09	0.09	0.07	0.06
Chinese Taipei	0.36	0.35	0.13	0.12	0.10	0.10
Egypt	0.09	0.09	0.01	0.01	0.00	0.01
England	0.38	0.35	0.14	0.13	0.14	0.12
Georgia	0.06	0.06	0.00	0.00	0.00	0.00
Hong Kong SAR	0.33	0.31	0.11	0.09	0.13	0.11
Hungary	0.43	0.42	0.19	0.17	0.12	0.12
Iran, Islamic Rep. of	0.31	0.30	0.10	0.09	0.07	0.06
Ireland	0.22	0.21	0.05	0.04	0.04	0.04
Israel	0.25	0.23	0.06	0.05	0.04	0.04
Italy	0.07	0.07	0.00	0.00	0.00	0.00
Japan	0.24	0.20	0.06	0.04	0.03	0.03
Jordan	0.27	0.26	0.07	0.07	0.06	0.05
Kazakhstan	0.14	0.10	0.02	0.01	0.00	0.00
Korea, Rep. of	0.19	0.15	0.03	0.02	0.02	0.01
Kuwait	0.22	0.26	0.05	0.07	0.04	0.06
Lebanon	0.28	0.28	0.08	0.08	0.07	0.08
Lithuania	0.14	0.13	0.02	0.02	0.01	0.01
Malaysia	0.21	0.22	0.04	0.05	0.05	0.04
Malta	0.32	0.32	0.10	0.10	0.06	0.06
Morocco	0.28	0.24	0.08	0.06	0.08	0.06
New Zealand	0.26	0.25	0.07	0.06	0.06	0.06
Norway (9)	0.18	0.18	0.03	0.03	0.03	0.03
Oman	0.11	0.10	0.01	0.01	0.01	0.01
Qatar	0.21	0.23	0.05	0.05	0.03	0.04
Russian Federation	0.21	0.24	0.05	0.06	0.03	0.03
Saudi Arabia	0.17	0.21	0.03	0.04	0.04	0.05
Singapore	0.34	0.33	0.11	0.11	0.10	0.09
Slovenia	0.09	0.08	0.01	0.01	0.01	0.01
South Africa (9)	0.20	0.19	0.04	0.04	0.04	0.04
Sweden	0.22	0.23	0.05	0.05	0.04	0.05
Thailand	0.13	0.12	0.02	0.02	0.01	0.01
Turkey	0.37	0.35	0.14	0.12	0.13	0.11
United Arab Emirates	0.32	0.31	0.10	0.10	0.09	0.08
United States	0.33	0.31	0.11	0.10	0.07	0.06
International Median	0.24	0.23	0.06	0.05	0.04	0.05
Benchmarking Participants						
Buenos Aires, Argentina	0.33	0.28	0.11	0.08	0.07	0.05
Ontario, Canada	0.18	0.11	0.03	0.01	0.02	0.01
Quebec, Canada	0.15	0.16	0.02	0.03	0.02	0.03
Norway (8)	0.18	0.18	0.03	0.03	0.03	0.03
Abu Dhabi, UAE	0.30	0.27	0.09	0.07	0.06	0.04
Dubai, UAE	0.28	0.28	0.08	0.08	0.09	0.10
Florida, US	0.30	0.26	0.09	0.07	0.04	0.03

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

School Emphasis on Academic Success–Teachers' Reports Scale, Eighth Grade

The School Emphasis on Academic Success–Teachers' Reports (EAS) scale was created based on teachers' responses characterizing the fourteen aspects described below.

Items in the TIMSS 2015 School Emphasis on Academic Success–Teachers' Reports Scale, Eighth Grade[1]



1 For the purpose of scaling, categories in which there were very few respondents were combined. The categories "Low" and "Very low" were combined for all variables. The scale statistics that are reported herein reflect analysis of the items following collapsing.

Item Parameters for the TIMSS 2015 School Emphasis on Academic Success - Teachers' Reports Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BTBG06A	-1.68045	-2.66063	-0.27020	2.93083	1.09
BTBG06B	-1.23725	-3.06845	-0.05158	3.12003	1.03
BTBG06C	-0.74602	-2.64414	0.01364	2.63050	1.06
BTBG06D	-0.90371	-2.10492	-0.18604	2.29096	1.11
BTBG06E	-0.96090	-2.89984	-0.06546	2.96530	1.01
BTBG06F	1.23541	-1.97221	0.09341	1.87880	1.01
BTBG06G	1.38741	-2.14973	0.06550	2.08423	0.81
BTBG06H	0.11852	-2.02680	-0.08263	2.10943	1.03
BTBG06I	1.09297	-2.17010	0.06285	2.10725	0.84
BTBG06J	0.81054	-1.85391	-0.02340	1.87731	1.08
BTBG06K	0.44514	-2.56091	0.08041	2.48050	0.90
BTBG06L	0.78421	-2.99698	0.22187	2.77511	0.86
BTBG06M	0.06382	-2.32494	-0.24518	2.57012	1.13
BTBG06O	-0.40969	-1.72466	-0.33054	2.05520	1.28

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 School Emphasis on Academic Success - Teachers' Reports Scale, Eighth Grade

Scale Transformation Constants	
A = 9.648219	Transformed Scale Score = 9.648219 + 1.396196 • Logit Scale Score
B = 1.396196	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 School Emphasis on Academic Success - Teachers' Reports Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	0.62601	
1	2.37454	
2	3.30485	
3	3.99189	
4	4.55434	
5	5.03713	
6	5.46429	
7	5.84928	
8	6.20193	
9	6.52956	
10	6.83772	
11	7.13072	
12	7.41200	
13	7.68391	
14	7.94962	
15	8.21035	
16	8.46755	
17	8.72250	
18	8.97609	
19	9.22901	
20	9.48165	
21	9.73421	9.8
22	9.98673	
23	10.23910	
24	10.49131	
25	10.74338	
26	10.99555	
27	11.24826	
28	11.50221	
29	11.75840	
30	12.01811	
31	12.28292	
32	12.55479	
33	12.83506	
34	13.12842	
35	13.43840	13.4
36	13.77078	
37	14.13422	
38	14.54168	
39	15.01763	
40	15.61090	
41	16.44334	
42	18.09479	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 School Emphasis on Academic Success - Teachers' Reports Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item													
			BTBG06A	BTBG06B	BTBG06C	BTBG06D	BTBG06E	BTBG06F	BTBG06G	BTBG06H	BTBG06I	BTBG06J	BTBG06K	BTBG06L	BTBG06M	BTBG06O
Australia	0.92	51	0.61	0.69	0.73	0.59	0.69	0.67	0.84	0.78	0.82	0.70	0.79	0.74	0.67	0.60
Bahrain	0.89	42	0.49	0.66	0.70	0.51	0.68	0.60	0.75	0.56	0.75	0.56	0.75	0.75	0.70	0.55
Botswana (9)	0.84	34	0.50	0.51	0.50	0.55	0.54	0.65	0.71	0.49	0.65	0.61	0.69	0.59	0.59	0.56
Canada	0.90	45	0.59	0.66	0.62	0.56	0.66	0.70	0.81	0.76	0.81	0.67	0.71	0.69	0.58	0.55
Chile	0.90	45	0.53	0.71	0.67	0.56	0.55	0.72	0.74	0.75	0.76	0.68	0.73	0.74	0.62	0.59
Chinese Taipei	0.91	47	0.51	0.40	0.68	0.59	0.71	0.74	0.75	0.80	0.81	0.69	0.79	0.77	0.55	0.64
Egypt	0.90	44	0.61	0.62	0.60	0.64	0.64	0.74	0.73	0.61	0.70	0.66	0.74	0.71	0.58	0.65
England	0.92	50	0.57	0.70	0.70	0.67	0.67	0.69	0.80	0.79	0.78	0.71	0.74	0.75	0.73	0.50
Georgia	0.88	40	0.55	0.58	0.62	0.65	0.63	0.69	0.72	0.66	0.71	0.61	0.63	0.56	0.57	0.58
Hong Kong SAR	0.90	42	0.40	0.54	0.70	0.60	0.65	0.59	0.76	0.76	0.75	0.70	0.69	0.76	0.51	0.54
Hungary	0.90	45	0.47	0.67	0.63	0.41	0.71	0.70	0.81	0.74	0.83	0.68	0.76	0.72	0.69	0.46
Iran, Islamic Rep. of	0.91	45	0.57	0.62	0.63	0.66	0.67	0.76	0.77	0.63	0.71	0.69	0.74	0.70	0.62	0.63
Ireland	0.92	48	0.57	0.68	0.77	0.55	0.63	0.69	0.83	0.76	0.80	0.76	0.77	0.71	0.65	0.51
Israel	0.87	39	0.56	0.66	0.59	0.54	0.60	0.62	0.73	0.61	0.72	0.56	0.70	0.66	0.59	0.50
Italy	0.87	38	0.62	0.72	0.62	0.57	0.56	0.67	0.67	0.55	0.61	0.62	0.58	0.70	0.45	0.59
Japan	0.87	39	0.60	0.55	0.65	0.49	0.59	0.44	0.75	0.71	0.74	0.53	0.71	0.71	0.54	0.58
Jordan	0.88	40	0.45	0.66	0.42	0.56	0.62	0.71	0.79	0.65	0.74	0.64	0.66	0.72	0.53	0.57
Kazakhstan	0.90	44	0.54	0.58	0.64	0.63	0.67	0.73	0.76	0.74	0.77	0.63	0.70	0.67	0.58	0.58
Korea, Rep. of	0.91	46	0.55	0.60	0.72	0.63	0.62	0.75	0.80	0.71	0.79	0.65	0.68	0.74	0.59	0.59
Kuwait	0.90	44	0.59	0.62	0.54	0.54	0.62	0.74	0.78	0.66	0.77	0.64	0.67	0.76	0.63	0.63
Lebanon	0.90	44	0.55	0.61	0.57	0.58	0.50	0.69	0.82	0.70	0.82	0.73	0.67	0.75	0.66	0.55
Lithuania	0.88	40	0.63	0.64	0.64	0.60	0.62	0.69	0.73	0.66	0.68	0.49	0.66	0.68	0.56	0.56
Malaysia	0.88	41	0.50	0.54	0.55	0.56	0.63	0.71	0.77	0.68	0.74	0.51	0.76	0.71	0.65	0.54
Malta	0.91	46	0.48	0.63	0.73	0.56	0.62	0.72	0.79	0.71	0.78	0.73	0.76	0.73	0.63	0.58
Morocco	0.88	41	0.50	0.59	0.54	0.61	0.62	0.70	0.78	0.64	0.74	0.73	0.68	0.67	0.48	0.66
New Zealand	0.90	45	0.59	0.64	0.70	0.53	0.66	0.63	0.78	0.74	0.74	0.74	0.75	0.66	0.62	0.56
Norway (9)	0.86	37	0.54	0.60	0.65	0.53	0.57	0.71	0.69	0.65	0.72	0.57	0.63	0.58	0.55	0.39
Oman	0.90	43	0.55	0.56	0.67	0.62	0.59	0.71	0.77	0.72	0.76	0.56	0.69	0.77	0.60	0.54
Qatar	0.89	41	0.34	0.36	0.65	0.40	0.61	0.68	0.81	0.75	0.80	0.63	0.80	0.78	0.71	0.37
Russian Federation	0.85	36	0.56	0.65	0.63	0.64	0.65	0.64	0.68	0.54	0.63	0.09	0.61	0.66	0.59	0.59
Saudi Arabia	0.90	43	0.64	0.68	0.53	0.70	0.66	0.72	0.77	0.61	0.73	0.61	0.73	0.64	0.50	0.63
Singapore	0.90	44	0.59	0.63	0.70	0.56	0.65	0.66	0.74	0.72	0.77	0.64	0.69	0.72	0.61	0.60
Slovenia	0.82	31	0.60	0.67	0.63	0.68	0.67	0.58	0.59	0.37	0.55	0.28	0.55	0.49	0.52	0.54
South Africa (9)	0.91	46	0.56	0.59	0.59	0.60	0.60	0.72	0.80	0.63	0.79	0.68	0.74	0.79	0.71	0.63
Sweden	0.86	37	0.58	0.64	0.66	0.58	0.59	0.64	0.72	0.63	0.62	0.52	0.64	0.59	0.51	0.55
Thailand	0.89	43	0.53	0.63	0.63	0.62	0.59	0.68	0.73	0.71	0.79	0.66	0.69	0.72	0.55	0.60
Turkey	0.89	41	0.46	0.58	0.64	0.50	0.53	0.73	0.78	0.71	0.78	0.70	0.72	0.75	0.51	0.50
United Arab Emirates	0.91	45	0.49	0.57	0.71	0.58	0.61	0.71	0.81	0.71	0.78	0.67	0.76	0.78	0.66	0.46
United States	0.92	49	0.51	0.64	0.67	0.54	0.67	0.77	0.84	0.79	0.84	0.75	0.77	0.68	0.66	0.49
Benchmarking Participants																
Buenos Aires, Argentina	0.88	40	0.55	0.61	0.61	0.56	0.59	0.74	0.79	0.68	0.76	0.70	0.57	0.57	0.56	0.43
Ontario, Canada	0.89	43	0.56	0.62	0.65	0.45	0.60	0.73	0.83	0.78	0.80	0.73	0.70	0.67	0.50	0.42
Quebec, Canada	0.91	47	0.60	0.70	0.53	0.61	0.73	0.69	0.80	0.70	0.81	0.62	0.71	0.72	0.68	0.67
Norway (8)	0.85	35	0.45	0.50	0.62	0.47	0.56	0.71	0.66	0.73	0.72	0.57	0.68	0.64	0.51	0.36
Abu Dhabi, UAE	0.90	43	0.42	0.53	0.70	0.50	0.59	0.66	0.80	0.66	0.78	0.69	0.80	0.79	0.65	0.39
Dubai, UAE	0.91	48	0.61	0.63	0.73	0.64	0.64	0.72	0.79	0.73	0.76	0.64	0.76	0.76	0.64	0.58
Florida, US	0.92	51	0.64	0.67	0.57	0.60	0.73	0.79	0.81	0.79	0.80	0.74	0.74	0.79	0.74	0.53

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 School Emphasis on Academic Success - Teachers' Reports Scale, Eighth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.26	0.24	0.07	0.06	0.07	0.03
Bahrain	0.16	0.22	0.03	0.05	0.04	0.04
Botswana (9)	0.24	0.19	0.06	0.04	0.04	0.03
Canada	0.18	0.15	0.03	0.02	0.03	0.02
Chile	0.27	0.30	0.07	0.09	0.06	0.05
Chinese Taipei	0.24	0.21	0.06	0.04	0.05	0.05
Egypt	0.18	0.20	0.03	0.04	0.02	0.04
England	0.30	0.30	0.09	0.09	0.10	0.07
Georgia	0.11	0.12	0.01	0.01	0.01	0.01
Hong Kong SAR	0.39	0.31	0.15	0.09	0.11	0.07
Hungary	0.40	0.33	0.16	0.11	0.11	0.05
Iran, Islamic Rep. of	0.32	0.33	0.10	0.11	0.08	0.08
Ireland	0.25	0.22	0.06	0.05	0.07	0.05
Israel	0.28	0.14	0.08	0.02	0.08	0.03
Italy	0.15	0.13	0.02	0.02	0.00	0.00
Japan	0.19	0.15	0.04	0.02	0.02	0.02
Jordan	0.18	0.23	0.03	0.05	0.02	0.04
Kazakhstan	0.11	0.01	0.01	0.00	0.03	0.00
Korea, Rep. of	0.12	0.11	0.02	0.01	0.02	0.01
Kuwait	0.23	0.23	0.05	0.05	0.08	0.04
Lebanon	0.18	0.19	0.03	0.03	0.04	0.02
Lithuania	0.20	0.10	0.04	0.01	0.04	0.01
Malaysia	0.24	0.15	0.06	0.02	0.03	0.02
Malta	0.26	0.21	0.07	0.05	0.03	0.03
Morocco	0.11	0.13	0.01	0.02	0.02	0.03
New Zealand	0.20	0.25	0.04	0.06	0.02	0.05
Norway (9)	0.13	0.13	0.02	0.02	0.01	0.01
Oman	0.16	0.08	0.02	0.01	0.02	0.00
Qatar	0.23	0.20	0.05	0.04	0.06	0.03
Russian Federation	0.18	0.12	0.03	0.01	0.02	0.02
Saudi Arabia	0.14	0.17	0.02	0.03	0.07	0.02
Singapore	0.29	0.32	0.08	0.10	0.06	0.11
Slovenia	0.05	0.06	0.00	0.00	0.00	0.00
South Africa (9)	0.22	0.21	0.05	0.04	0.04	0.07
Sweden	0.20	0.17	0.04	0.03	0.03	0.02
Thailand	0.20	0.17	0.04	0.03	0.04	0.03
Turkey	0.31	0.31	0.09	0.10	0.05	0.07
United Arab Emirates	0.26	0.32	0.07	0.10	0.06	0.09
United States	0.27	0.26	0.07	0.07	0.07	0.05
International Median	0.20	0.20	0.04	0.04	0.04	0.03
Benchmarking Participants						
Buenos Aires, Argentina	0.15	0.17	0.02	0.03	0.01	0.04
Ontario, Canada	0.17	0.12	0.03	0.01	0.02	0.01
Quebec, Canada	0.06	0.18	0.00	0.03	0.01	0.04
Norway (8)	0.17	0.16	0.03	0.02	0.02	0.01
Abu Dhabi, UAE	0.16	0.29	0.03	0.08	0.02	0.08
Dubai, UAE	0.29	0.26	0.08	0.07	0.10	0.06
Florida, US	0.36	0.18	0.13	0.03	0.11	0.04

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

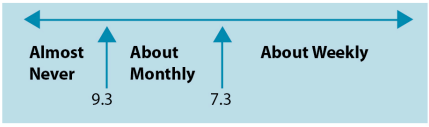
Student Bullying Scale, Eighth Grade

The Student Bullying (SB) scale was created based on students' responses to how often they experienced the nine bullying behaviors described below.

Items in the TIMSS 2015 Student Bullying Scale, Eighth Grade

During this school year, how often have other students from your school done any of the following things to you (including through texting or the Internet)?

		Never	A few times a year	Once or twice a month	At least once a week
BSBG16A	1) Made fun of me or called me names	○	○	○	○
BSBG16B	2) Left me out of their games or activities	○	○	○	○
BSBG16C	3) Spread lies about me	○	○	○	○
BSBG16D	4) Stole something from me	○	○	○	○
BSBG16E	5) Hit or hurt me (*e.g., shoving, hitting, kicking*)	○	○	○	○
BSBG16F	6) Made me do things I didn't want to do	○	○	○	○
BSBG16G	7) Shared embarrassing information about me	○	○	○	○
BSBG16H	8) Posted embarrassing things about me online	○	○	○	○
BSBG16I	9) Threatened me	○	○	○	○



Item Parameters for the TIMSS 2015 Student Bullying Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBG16A	0.89179	0.05940	-0.30863	0.24923	1.09
BSBG16B	0.19770	-0.01912	0.16738	-0.14826	1.17
BSBG16C	0.34002	-0.23740	-0.12720	0.36460	0.98
BSBG16D	0.07870	0.05469	-0.03394	-0.02075	1.10
BSBG16E	-0.01022	0.16315	-0.02603	-0.13712	1.00
BSBG16F	-0.32348	0.09818	0.17832	-0.27650	0.93
BSBG16G	-0.07434	0.01975	-0.05531	0.03556	0.91
BSBG16H	-0.65156	0.44861	0.29035	-0.73896	0.95
BSBG16I	-0.44861	0.40213	0.17194	-0.57407	0.89

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Student Bullying Scale, Eighth Grade

Scale Transformation Constants	
A = 7.415134	Transformed Scale Score = 7.415134 + 1.807351 • Logit Scale Score
B = 1.807351	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Student Bullying Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	2.46657	
1	4.10309	
2	4.76912	
3	5.19497	
4	5.51718	
5	5.78147	
6	6.01006	
7	6.21894	
8	6.41095	
9	6.59120	
10	6.76349	
11	6.93080	
12	7.09541	
13	7.25929	7.3
14	7.42473	
15	7.59182	
16	7.76410	
17	7.94315	
18	8.13155	
19	8.33231	
20	8.54672	
21	8.78408	
22	9.05164	
23	9.36313	9.3
24	9.74130	
25	10.24057	
26	11.00609	
27	12.78394	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Student Bullying Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item								
			BSBG16A	BSBG16B	BSBG16C	BSBG16D	BSBG16E	BSBG16F	BSBG16G	BSBG16H	BSBG16I
Australia	0.87	49	0.73	0.68	0.77	0.64	0.68	0.70	0.76	0.64	0.72
Bahrain	0.86	48	0.61	0.66	0.72	0.61	0.73	0.73	0.77	0.65	0.76
Botswana (9)	0.74	33	0.49	0.50	0.63	0.41	0.59	0.63	0.68	0.58	0.61
Canada	0.84	46	0.71	0.65	0.74	0.61	0.65	0.68	0.74	0.62	0.65
Chile	0.83	46	0.63	0.65	0.70	0.57	0.70	0.70	0.78	0.67	0.68
Chinese Taipei	0.83	44	0.71	0.59	0.71	0.57	0.66	0.70	0.74	0.61	0.69
Egypt	0.85	47	0.60	0.58	0.68	0.61	0.75	0.74	0.76	0.71	0.72
England	0.85	47	0.71	0.68	0.76	0.61	0.68	0.66	0.73	0.64	0.71
Georgia	0.76	41	0.51	0.47	0.63	0.55	0.62	0.72	0.76	0.71	0.72
Hong Kong SAR	0.83	45	0.49	0.61	0.68	0.65	0.70	0.75	0.74	0.67	0.71
Hungary	0.78	38	0.68	0.62	0.65	0.49	0.62	0.60	0.70	0.56	0.62
Iran, Islamic Rep. of	0.80	41	0.59	0.55	0.65	0.55	0.69	0.69	0.73	0.54	0.72
Ireland	0.84	44	0.70	0.62	0.75	0.57	0.67	0.64	0.74	0.62	0.67
Israel	-	-	-	-	-	-	-	-	-	-	-
Italy	0.77	36	0.71	0.65	0.67	0.42	0.62	0.60	0.69	0.41	0.58
Japan	0.81	42	0.69	0.65	0.71	0.59	0.66	0.72	0.68	0.49	0.58
Jordan	0.86	49	0.62	0.62	0.69	0.60	0.77	0.74	0.77	0.70	0.76
Kazakhstan	0.77	40	0.57	0.48	0.67	0.59	0.64	0.66	0.73	0.68	0.63
Korea, Rep. of	0.76	39	0.61	0.57	0.68	0.47	0.68	0.68	0.72	0.51	0.65
Kuwait	0.81	42	0.54	0.55	0.68	0.58	0.70	0.66	0.72	0.64	0.70
Lebanon	0.88	52	0.65	0.66	0.72	0.70	0.73	0.75	0.75	0.78	0.75
Lithuania	0.83	44	0.69	0.58	0.73	0.58	0.69	0.66	0.72	0.63	0.70
Malaysia	0.81	42	0.50	0.61	0.69	0.55	0.67	0.70	0.70	0.68	0.69
Malta	0.87	50	0.67	0.68	0.74	0.66	0.72	0.71	0.76	0.69	0.74
Morocco	0.81	41	0.57	0.57	0.61	0.52	0.71	0.70	0.72	0.65	0.69
New Zealand	0.87	50	0.69	0.68	0.77	0.67	0.70	0.69	0.75	0.67	0.71
Norway (9)	0.83	43	0.73	0.63	0.71	0.58	0.62	0.65	0.71	0.62	0.61
Oman	0.81	41	0.63	0.43	0.71	0.58	0.66	0.64	0.74	0.60	0.69
Qatar	0.88	53	0.66	0.69	0.74	0.63	0.75	0.75	0.80	0.73	0.78
Russian Federation	0.79	40	0.70	0.49	0.71	0.52	0.70	0.58	0.75	0.59	0.57
Saudi Arabia	0.86	49	0.60	0.61	0.70	0.65	0.73	0.74	0.77	0.71	0.76
Singapore	0.84	45	0.64	0.62	0.73	0.61	0.68	0.67	0.75	0.63	0.68
Slovenia	0.84	45	0.68	0.68	0.75	0.57	0.64	0.62	0.79	0.59	0.65
South Africa (9)	0.78	38	0.57	0.56	0.63	0.41	0.63	0.65	0.74	0.62	0.66
Sweden	0.83	43	0.71	0.61	0.74	0.59	0.67	0.63	0.69	0.63	0.66
Thailand	0.80	40	0.53	0.55	0.65	0.56	0.66	0.71	0.75	0.61	0.63
Turkey	0.81	42	0.57	0.60	0.66	0.54	0.69	0.67	0.75	0.66	0.70
United Arab Emirates	0.85	47	0.62	0.62	0.71	0.61	0.72	0.70	0.76	0.66	0.73
United States	0.86	48	0.72	0.68	0.74	0.63	0.70	0.65	0.76	0.66	0.70
Benchmarking Participants											
Buenos Aires, Argentina	0.79	40	0.68	0.59	0.66	0.47	0.66	0.67	0.69	0.60	0.64
Ontario, Canada	0.85	46	0.72	0.65	0.77	0.60	0.66	0.68	0.75	0.61	0.66
Quebec, Canada	0.81	42	0.70	0.63	0.72	0.55	0.57	0.66	0.71	0.62	0.63
Norway (8)	0.85	46	0.74	0.68	0.77	0.57	0.62	0.72	0.71	0.66	0.65
Abu Dhabi, UAE	0.86	49	0.65	0.64	0.71	0.60	0.75	0.72	0.78	0.67	0.76
Dubai, UAE	0.84	45	0.63	0.63	0.73	0.59	0.71	0.67	0.74	0.63	0.69
Florida, US	0.85	46	0.71	0.65	0.72	0.63	0.70	0.62	0.74	0.67	0.69

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Student Bullying Scale, Eighth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.12	0.12	0.02	0.02	0.02	0.02
Bahrain	0.13	0.16	0.02	0.03	0.03	0.05
Botswana (9)	0.14	0.17	0.02	0.03	0.03	0.05
Canada	0.08	0.07	0.01	0.01	0.01	0.01
Chile	0.02	0.04	0.00	0.00	0.01	0.01
Chinese Taipei	0.02	0.02	0.00	0.00	0.00	0.00
Egypt	0.27	0.28	0.07	0.08	0.10	0.10
England	0.07	0.02	0.00	0.00	0.01	0.01
Georgia	0.11	0.12	0.01	0.01	0.01	0.03
Hong Kong SAR	-0.08	-0.09	0.01	0.01	0.00	0.01
Hungary	0.11	0.08	0.01	0.01	0.02	0.01
Iran, Islamic Rep. of	0.11	0.11	0.01	0.01	0.03	0.03
Ireland	0.03	0.04	0.00	0.00	0.01	0.01
Israel	-	-	-	-	-	-
Italy	0.05	0.04	0.00	0.00	0.00	0.01
Japan	-0.06	-0.03	0.00	0.00	0.00	0.00
Jordan	0.17	0.26	0.03	0.07	0.04	0.09
Kazakhstan	0.06	0.03	0.00	0.00	0.01	0.00
Korea, Rep. of	-0.04	-0.05	0.00	0.00	0.00	0.00
Kuwait	0.04	0.07	0.00	0.01	0.01	0.02
Lebanon	0.17	0.23	0.03	0.05	0.05	0.09
Lithuania	0.05	0.05	0.00	0.00	0.01	0.01
Malaysia	0.15	0.21	0.02	0.04	0.03	0.06
Malta	0.08	0.06	0.01	0.00	0.03	0.03
Morocco	0.06	0.08	0.00	0.01	0.01	0.01
New Zealand	0.09	0.09	0.01	0.01	0.01	0.01
Norway (9)	0.05	0.07	0.00	0.00	0.01	0.01
Oman	0.12	0.15	0.01	0.02	0.02	0.03
Qatar	0.12	0.15	0.01	0.02	0.04	0.06
Russian Federation	0.05	0.05	0.00	0.00	0.01	0.00
Saudi Arabia	0.08	0.18	0.01	0.03	0.02	0.06
Singapore	0.10	0.09	0.01	0.01	0.01	0.01
Slovenia	0.03	0.03	0.00	0.00	0.01	0.01
South Africa (9)	0.23	0.28	0.05	0.08	0.07	0.10
Sweden	0.08	0.08	0.01	0.01	0.01	0.02
Thailand	0.04	0.04	0.00	0.00	0.01	0.01
Turkey	0.14	0.14	0.02	0.02	0.03	0.03
United Arab Emirates	0.14	0.16	0.02	0.03	0.04	0.05
United States	0.05	0.06	0.00	0.00	0.01	0.01
International Median	0.08	0.08	0.01	0.01	0.01	0.01
Benchmarking Participants						
Buenos Aires, Argentina	0.03	0.04	0.00	0.00	0.00	0.01
Ontario, Canada	0.06	0.08	0.00	0.01	0.01	0.01
Quebec, Canada	0.03	0.02	0.00	0.00	0.00	0.00
Norway (8)	0.10	0.11	0.01	0.01	0.02	0.02
Abu Dhabi, UAE	0.16	0.19	0.02	0.04	0.05	0.07
Dubai, UAE	0.09	0.10	0.01	0.01	0.02	0.02
Florida, US	0.05	0.05	0.00	0.00	0.01	0.01

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students Confident in Biology Scale, Eighth Grade

The Students Confident in Biology (SCB) scale was created based on students' degree of agreement with the eight statements described below.

Items in the TIMSS 2015 Students Confident in Biology Scale, Eighth Grade

How much do you agree with these statements about biology?

		Agree a lot	Agree a little	Disagree a little	Disagree a lot
T	BSBB24A	1) I usually do well in biology			
T	BSBB24B*	2) Biology is more difficult for me than for many of my classmates*			
T	BSBB24C*	3) Biology is not one of my strengths*			
T	BSBB24D	4) I learn things quickly in biology			
T	BSBB24E	5) I am good at working out difficult biology problems			
T	BSBB24F	6) My teacher tells me I am good at biology			
T	BSBB24G*	7) Biology is harder for me than any other subject*			
	BSBB24H*	8) Biology makes me confused*			

* Reverse coded

T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Students Confident in Biology Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBB24A	-0.53880	-1.22367	-0.47664	1.70031	0.92
BSBB24B*	0.02820	-1.04634	-0.25298	1.29932	1.00
BSBB24C*	0.26502	-1.08484	-0.13799	1.22283	0.96
BSBB24D	-0.22053	-1.39570	-0.22015	1.61585	0.91
BSBB24E	0.30089	-1.62811	0.00932	1.61879	1.02
BSBB24F	0.21858	-1.53529	-0.08286	1.61815	1.09
BSBB24G*	0.03479	-0.82612	-0.35591	1.18203	1.01
BSBB24H*	-0.08815	-0.59141	-0.39757	0.98898	1.07

*Reverse coded

Scale Transformation Constants for the TIMSS 2015 Students Confident in Biology Scale, Eighth Grade

Scale Transformation Constants	
A = 8.684972	Transformed Scale Score = 8.684972 + 1.447375 • Logit Scale Score
B = 1.447375	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students Confident in Biology Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	2.85186	
1	4.49062	
2	5.28824	
3	5.84050	
4	6.27693	
5	6.64380	
6	6.97197	
7	7.27080	
8	7.54690	
9	7.81493	
10	8.07299	
11	8.32835	
12	8.58506	8.6
13	8.84688	
14	9.11736	
15	9.40008	
16	9.69874	
17	10.01647	
18	10.36086	
19	10.73954	
20	11.16602	11.1
21	11.66296	
22	12.28106	
23	13.14959	
24	14.86445	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students Confident in Biology Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item							
			BSBB24A	BSBB24B*	BSBB24C*	BSBB24D	BSBB24E	BSBB24F	BSBB24G*	BSBB24H*
Georgia	0.80	42	0.67	0.63	0.69	0.70	0.65	0.62	0.60	0.62
Hungary	0.88	55	0.80	0.72	0.78	0.80	0.71	0.72	0.73	0.67
Kazakhstan	0.87	52	0.74	0.68	0.73	0.78	0.74	0.72	0.69	0.68
Lebanon	0.75	37	0.66	0.62	0.51	0.71	0.63	0.66	0.62	0.44
Lithuania	0.85	50	0.77	0.68	0.75	0.77	0.74	0.63	0.69	0.60
Malta	0.91	61	0.81	0.76	0.76	0.83	0.79	0.76	0.77	0.76
Morocco	0.67	31	0.66	0.36	0.26	0.74	0.70	0.71	0.38	0.40
Russian Federation	0.87	53	0.74	0.71	0.80	0.80	0.74	0.69	0.69	0.67
Slovenia	0.90	58	0.79	0.73	0.79	0.82	0.76	0.69	0.76	0.73
Sweden	0.87	53	0.77	0.69	0.77	0.79	0.74	0.65	0.70	0.70

*Reverse coded

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students Confident in Biology Scale, Eighth Grade, and TIMSS 2015 Science Achievement

Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Georgia	0.36	0.13	0.14
Hungary	0.26	0.07	0.08
Kazakhstan	0.20	0.04	0.04
Lebanon	0.38	0.15	0.14
Lithuania	0.24	0.06	0.06
Malta	0.44	0.20	0.21
Morocco	0.32	0.10	0.09
Russian Federation	0.16	0.02	0.02
Slovenia	0.26	0.07	0.07
Sweden	0.30	0.09	0.09
International Median	0.28	0.08	0.08

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students Confident in Chemistry Scale, Eighth Grade

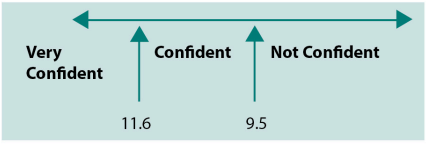
The Students Confident in Chemistry (SCC) scale was created based on students' degree of agreement with the eight statements described below.

Items in the TIMSS 2015 Students Confident in Chemistry Scale, Eighth Grade

How much do you agree with these statements about chemistry?

		Agree a lot	Agree a little	Disagree a little	Disagree a lot
T	BSBC32A	1) I usually do well in chemistry	○	○	○	○
T	BSBC32B*	2) Chemistry is more difficult for me than for many of my classmates*	○	○	○	○
T	BSBC32C*	3) Chemistry is not one of my strengths*	○	○	○	○
T	BSBC32D	4) I learn things quickly in chemistry	○	○	○	○
T	BSBC32E	5) I am good at working out difficult chemistry problems	○	○	○	○
T	BSBC32F	6) My teacher tells me I am good at chemistry	○	○	○	○
T	BSBC32G*	7) Chemistry is harder for me than any other subject*	○	○	○	○
	BSBC32H*	8) Chemistry makes me confused*	○	○	○	○

* Reverse coded



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Students Confident in Chemistry Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBC32A	-0.43252	-1.24702	-0.21914	1.46616	0.88
BSBC32B*	-0.07136	-1.07970	-0.06435	1.14405	1.02
BSBC32C*	0.20772	-1.09748	0.01172	1.08576	0.98
BSBC32D	-0.09316	-1.42123	0.01572	1.40551	0.87
BSBC32E	0.29153	-1.42513	0.11128	1.31385	1.00
BSBC32F	0.08171	-1.42824	0.02111	1.40713	1.01
BSBC32G*	0.11166	-0.94209	-0.08266	1.02475	1.07
BSBC32H*	-0.09558	-0.71550	-0.16147	0.87697	1.20

*Reverse coded

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Students Confident in Chemistry Scale, Eighth Grade

Scale Transformation Constants	
A = 9.428069	Transformed Scale Score = 9.428069 + 1.394223 • Logit Scale Score
B = 1.394223	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students Confident in Chemistry Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.83109	
1	5.43486	
2	6.22207	
3	6.76721	
4	7.19805	
5	7.56067	
6	7.87953	
7	8.16824	
8	8.43786	
9	8.69269	
10	8.93765	
11	9.17680	
12	9.41304	9.5
13	9.65127	
14	9.89290	
15	10.14184	
16	10.40188	
17	10.67761	
18	10.97271	
19	11.29909	
20	11.66958	11.6
21	12.10853	
22	12.66162	
23	13.45723	
24	15.06951	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students Confident in Chemistry Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item							
			BSBC32A	BSBC32B*	BSBC32C*	BSBC32D	BSBC32E	BSBC32F	BSBC32G*	BSBC32H*
Georgia	0.81	43	0.70	0.61	0.69	0.75	0.69	0.65	0.57	0.54
Hungary	0.89	57	0.82	0.68	0.79	0.81	0.76	0.78	0.71	0.67
Kazakhstan	0.87	54	0.78	0.72	0.73	0.79	0.77	0.76	0.65	0.64
Lebanon	0.74	37	0.72	0.53	0.44	0.76	0.69	0.76	0.46	0.31
Lithuania	0.87	53	0.82	0.69	0.74	0.80	0.77	0.73	0.67	0.58
Malta	0.92	65	0.82	0.80	0.83	0.82	0.81	0.78	0.79	0.78
Morocco	0.63	35	0.69	-0.38	-0.42	0.72	0.77	0.77	-0.43	-0.35
Russian Federation	0.91	60	0.80	0.76	0.82	0.84	0.80	0.79	0.71	0.67
Slovenia	0.92	63	0.82	0.78	0.80	0.85	0.79	0.76	0.78	0.75
Sweden	0.89	56	0.79	0.71	0.78	0.81	0.77	0.67	0.71	0.71

*Reverse coded

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students Confident in Chemistry Scale, Eighth Grade, and TIMSS 2015 Science Achievement

Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Georgia	0.34	0.11	0.14
Hungary	0.23	0.05	0.08
Kazakhstan	0.19	0.04	0.04
Lebanon	0.31	0.10	0.10
Lithuania	0.24	0.06	0.08
Malta	0.34	0.12	0.15
Morocco	0.31	0.10	0.09
Russian Federation	0.20	0.04	0.05
Slovenia	0.39	0.15	0.16
Sweden	0.31	0.10	0.11
International Median	0.31	0.10	0.10

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students Confident in Earth Science Scale, Eighth Grade

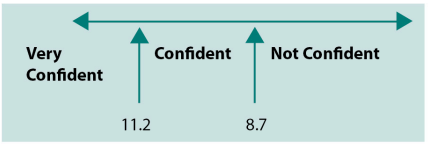
The Students Confident in Earth Science (SCE) scale was created based on students' degree of agreement with the eight statements described below.

Items in the TIMSS 2015 Students Confident in Earth Science Scale, Eighth Grade

How much do you agree with these statements about earth science?

		Agree a lot	Agree a little	Disagree a little	Disagree a lot
T	BSBE28A	1) I usually do well in earth science			
T	BSBE28B*	2) Earth science is more difficult for me than for many of my classmates*			
T	BSBE28C*	3) Earth science is not one of my strengths*			
T	BSBE28D	4) I learn things quickly in earth science			
T	BSBE28E	5) I am good at working out difficult earth science problems			
T	BSBE28F	6) My teacher tells me I am good at earth science			
T	BSBE28G*	7) Earth science is harder for me than any other subject*			
	BSBE28H*	8) Earth science makes me confused*			

* Reverse coded



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Students Confident in Earth Science Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBE28A	-0.42005	-1.17384	-0.44817	1.62201	0.90
BSBE28B*	-0.06756	-1.01438	-0.28584	1.30022	0.97
BSBE28C*	0.19190	-1.06848	-0.14054	1.20902	0.93
BSBE28D	-0.15726	-1.36012	-0.24217	1.60229	0.89
BSBE28E	0.31769	-1.54826	0.00872	1.53954	1.01
BSBE28F	0.24063	-1.49092	-0.07339	1.56431	1.04
BSBE28G*	0.04915	-0.92539	-0.33018	1.25557	1.02
BSBE28H*	-0.15450	-0.55000	-0.43709	0.98709	1.07

*Reverse coded

Scale Transformation Constants for the TIMSS 2015 Students Confident in Earth Science Scale, Eighth Grade

Scale Transformation Constants	
A = 8.804148	Transformed Scale Score = 8.804148 + 1.447084 • Logit Scale Score
B = 1.447084	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students Confident in Earth Science Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.05255	
1	4.68088	
2	5.46730	
3	6.00837	
4	6.43368	
5	6.79112	
6	7.11037	
7	7.39780	
8	7.66917	
9	7.92933	
10	8.18503	
11	8.43655	
12	8.69029	8.7
13	8.94985	
14	9.21859	
15	9.49991	
16	9.79733	
17	10.11386	
18	10.45693	
19	10.83407	
20	11.25874	11.2
21	11.75346	
22	12.36898	
23	13.23453	
24	14.94588	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students Confident in Earth Science Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item							
			BSBE28A	BSBE28B*	BSBE28C*	BSBE28D	BSBE28E	BSBE28F	BSBE28G*	BSBE28H*
Georgia	0.76	37	0.64	0.58	0.64	0.68	0.63	0.60	0.55	0.57
Hungary	0.89	56	0.81	0.72	0.80	0.80	0.73	0.76	0.74	0.65
Kazakhstan	0.87	52	0.76	0.70	0.75	0.78	0.74	0.74	0.65	0.64
Lebanon	-	-	-	-	-	-	-	-	-	-
Lithuania	0.84	48	0.76	0.70	0.74	0.75	0.72	0.64	0.65	0.55
Malta	0.87	52	0.78	0.66	0.69	0.80	0.76	0.73	0.67	0.69
Morocco	0.65	32	0.72	-0.24	-0.29	0.74	0.78	0.79	-0.24	-0.21
Russian Federation	0.87	52	0.75	0.71	0.79	0.79	0.74	0.71	0.64	0.63
Slovenia	0.90	58	0.81	0.76	0.79	0.80	0.75	0.70	0.76	0.72
Sweden	-	-	-	-	-	-	-	-	-	-

*Reverse coded

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students Confident in Earth Science Scale, Eighth Grade, and TIMSS 2015 Science Achievement

Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Georgia	0.38	0.14	0.15
Hungary	0.22	0.05	0.07
Kazakhstan	0.18	0.03	0.04
Lebanon	-	-	-
Lithuania	0.30	0.09	0.09
Malta	0.32	0.10	0.12
Morocco	0.30	0.09	0.08
Russian Federation	0.18	0.03	0.04
Slovenia	0.27	0.07	0.09
Sweden	-	-	-
International Median	0.28	0.08	0.08

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students Confident in Mathematics Scale, Eighth Grade

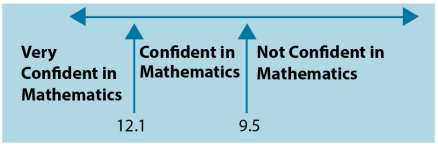
The Students Confident in Mathematics (SCM) scale was created based on students' degree of agreement with the nine statements described below.

Items in the TIMSS 2015 Students Confident in Mathematics Scale, Eighth Grade

How much do you agree with these statements about mathematics?

		Agree a lot	Agree a little	Disagree a little	Disagree a lot
T	BSBM19A 1) I usually do well in mathematics	○	○	○	○
T	BSBM19B* 2) Mathematics is more difficult for me than for many of my classmates*	○	○	○	○
T	BSBM19C* 3) Mathematics is not one of my strengths*	○	○	○	○
T	BSBM19D 4) I learn things quickly in mathematics	○	○	○	○
	BSBM19E* 5) Mathematics makes me nervous*	○	○	○	○
T	BSBM19F 6) I am good at working out difficult mathematics problems	○	○	○	○
T	BSBM19G 7) My teacher tells me I am good at mathematics	○	○	○	○
T	BSBM19H* 8) Mathematics is harder for me than any other subject*	○	○	○	○
	BSBM19I* 9) Mathematics makes me confused*	○	○	○	○

* Reverse coded



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Students Confident in Mathematics Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBM19A	-0.50782	-1.09617	-0.31356	1.40973	0.93
BSBM19B*	0.02025	-1.16866	0.14633	1.02233	1.04
BSBM19C*	0.24765	-0.85950	0.16100	0.69850	0.94
BSBM19D	-0.23484	-1.26266	-0.08260	1.34526	0.94
BSBM19E*	-0.05673	-0.97126	0.06128	0.90998	1.21
BSBM19F	0.28492	-1.25325	-0.17310	1.42635	0.99
BSBM19G	0.02811	-1.08338	-0.13552	1.21890	1.11
BSBM19H*	0.11634	-0.69162	0.02593	0.66569	0.92
BSBM19I*	0.10212	-0.89145	0.10503	0.78642	0.99

*Reverse coded

Scale Transformation Constants for the TIMSS 2015 Students Confident in Mathematics Scale, Eighth Grade

Scale Transformation Constants	
A = 9.553292	Transformed Scale Score = 9.553292 + 1.590838 • Logit Scale Score
B = 1.590838	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students Confident in Mathematics Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.19619	
1	4.99370	
2	5.86478	
3	6.46291	
4	6.92948	
5	7.32079	
6	7.66196	
7	7.96832	
8	8.24834	
9	8.51163	
10	8.76064	
11	8.99900	
12	9.22981	
13	9.45579	9.5
14	9.67949	
15	9.90347	
16	10.13034	
17	10.36309	
18	10.60515	
19	10.86066	
20	11.13293	
21	11.43104	
22	11.76507	
23	12.15148	12.1
24	12.61729	
25	13.22021	
26	14.10390	
27	15.92523	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students Confident in Mathematics Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item								
			BSBM19A	BSBM19B*	BSBM19C*	BSBM19D	BSBM19E*	BSBM19F	BSBM19G	BSBM19H*	BSBM19I*
Australia	0.90	56	0.80	0.75	0.83	0.79	0.58	0.77	0.58	0.80	0.77
Bahrain	0.80	38	0.49	0.58	0.61	0.65	0.58	0.64	0.59	0.72	0.65
Botswana (9)	0.71	32	0.71	0.38	0.49	0.68	0.10	0.71	0.66	0.49	0.53
Canada	0.92	62	0.83	0.82	0.86	0.82	0.66	0.80	0.58	0.84	0.81
Chile	0.85	46	0.76	0.53	0.66	0.78	0.48	0.75	0.67	0.70	0.73
Chinese Taipei	0.93	65	0.85	0.81	0.88	0.85	0.54	0.82	0.80	0.84	0.81
Egypt	0.70	30	0.19	0.67	0.59	0.38	0.68	0.34	0.29	0.74	0.71
England	0.89	53	0.76	0.72	0.79	0.78	0.60	0.77	0.48	0.82	0.77
Georgia	0.80	39	0.63	0.62	0.70	0.66	0.43	0.62	0.59	0.66	0.64
Hong Kong SAR	0.91	58	0.78	0.76	0.85	0.76	0.62	0.77	0.68	0.83	0.77
Hungary	0.91	59	0.83	0.73	0.83	0.83	0.57	0.79	0.78	0.76	0.74
Iran, Islamic Rep. of	0.85	46	0.75	0.53	0.63	0.73	0.65	0.69	0.69	0.71	0.72
Ireland	0.89	55	0.80	0.74	0.81	0.81	0.60	0.77	0.52	0.80	0.76
Israel	0.87	49	0.75	0.68	0.70	0.73	0.63	0.70	0.60	0.75	0.72
Italy	0.92	63	0.84	0.76	0.85	0.85	0.67	0.78	0.76	0.81	0.79
Japan	0.90	56	0.77	0.70	0.84	0.74	0.63	0.78	0.66	0.78	0.78
Jordan	0.76	34	0.33	0.63	0.62	0.54	0.65	0.52	0.51	0.70	0.68
Kazakhstan	0.89	54	0.77	0.72	0.76	0.79	0.59	0.76	0.76	0.74	0.72
Korea, Rep. of	0.91	60	0.86	0.79	0.86	0.76	0.36	0.84	0.78	0.82	0.76
Kuwait	0.82	40	0.54	0.59	0.54	0.70	0.63	0.67	0.61	0.73	0.68
Lebanon	0.77	36	0.62	0.62	0.60	0.59	0.63	0.50	0.57	0.71	0.55
Lithuania	0.88	52	0.81	0.72	0.80	0.75	0.60	0.75	0.66	0.74	0.65
Malaysia	0.81	39	0.58	0.58	0.73	0.56	0.68	0.57	0.46	0.70	0.74
Malta	0.89	53	0.78	0.66	0.76	0.77	0.63	0.73	0.63	0.78	0.77
Morocco	0.68	29	0.62	0.31	0.26	0.69	0.51	0.60	0.68	0.47	0.52
New Zealand	0.88	51	0.75	0.71	0.80	0.75	0.56	0.75	0.54	0.79	0.72
Norway (9)	0.93	63	0.83	0.77	0.86	0.83	0.73	0.83	0.71	0.81	0.74
Oman	0.78	36	0.41	0.71	0.60	0.52	0.69	0.41	0.38	0.76	0.73
Qatar	0.82	40	0.58	0.65	0.65	0.63	0.63	0.59	0.56	0.72	0.69
Russian Federation	0.91	58	0.78	0.74	0.83	0.82	0.67	0.77	0.71	0.77	0.75
Saudi Arabia	0.75	34	0.29	0.65	0.56	0.55	0.66	0.44	0.44	0.74	0.72
Singapore	0.91	59	0.84	0.76	0.85	0.78	0.65	0.78	0.64	0.82	0.77
Slovenia	0.91	59	0.81	0.73	0.82	0.81	0.67	0.79	0.73	0.78	0.77
South Africa (9)	0.80	38	0.66	0.51	0.63	0.65	0.51	0.65	0.62	0.65	0.67
Sweden	0.92	60	0.82	0.77	0.84	0.82	0.61	0.82	0.66	0.84	0.80
Thailand	0.80	39	0.59	0.62	0.75	0.58	0.52	0.51	0.55	0.71	0.70
Turkey	0.87	50	0.76	0.67	0.78	0.72	0.50	0.72	0.71	0.73	0.75
United Arab Emirates	0.85	45	0.64	0.65	0.74	0.66	0.66	0.64	0.59	0.73	0.71
United States	0.90	56	0.77	0.76	0.82	0.79	0.63	0.76	0.58	0.82	0.78
Benchmarking Participants											
Buenos Aires, Argentina	0.85	46	0.73	0.66	0.73	0.69	0.54	0.63	0.63	0.75	0.72
Ontario, Canada	0.92	61	0.81	0.82	0.85	0.81	0.65	0.80	0.56	0.84	0.81
Quebec, Canada	0.92	63	0.84	0.81	0.87	0.84	0.67	0.79	0.61	0.83	0.81
Norway (8)	0.91	60	0.81	0.77	0.84	0.82	0.71	0.81	0.64	0.79	0.74
Abu Dhabi, UAE	0.83	42	0.58	0.64	0.73	0.61	0.66	0.60	0.53	0.70	0.71
Dubai, UAE	0.88	51	0.74	0.70	0.77	0.72	0.67	0.70	0.64	0.77	0.74
Florida, US	0.89	53	0.75	0.71	0.80	0.77	0.60	0.72	0.61	0.80	0.77

*Reverse coded

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students Confident in Mathematics Scale, Eighth Grade, and TIMSS 2015 Mathematics Achievement

Country	Pearson's Correlation with Mathematics Achievement		Variance in Mathematics Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.51	0.26	0.25
Bahrain	0.40	0.16	0.15
Botswana (9)	0.26	0.07	0.09
Canada	0.55	0.30	0.29
Chile	0.43	0.18	0.18
Chinese Taipei	0.52	0.27	0.24
Egypt	0.35	0.12	0.11
England	0.46	0.21	0.18
Georgia	0.45	0.20	0.19
Hong Kong SAR	0.37	0.14	0.14
Hungary	0.53	0.28	0.28
Iran, Islamic Rep. of	0.42	0.18	0.17
Ireland	0.44	0.19	0.19
Israel	0.36	0.13	0.13
Italy	0.50	0.25	0.23
Japan	0.44	0.19	0.16
Jordan	0.37	0.14	0.14
Kazakhstan	0.25	0.06	0.07
Korea, Rep. of	0.52	0.27	0.24
Kuwait	0.30	0.09	0.09
Lebanon	0.33	0.11	0.11
Lithuania	0.54	0.29	0.29
Malaysia	0.33	0.11	0.11
Malta	0.39	0.15	0.16
Morocco	0.39	0.15	0.14
New Zealand	0.47	0.22	0.20
Norway (9)	0.61	0.37	0.34
Oman	0.35	0.12	0.11
Qatar	0.42	0.17	0.16
Russian Federation	0.44	0.19	0.18
Saudi Arabia	0.35	0.12	0.11
Singapore	0.40	0.16	0.16
Slovenia	0.54	0.29	0.28
South Africa (9)	0.24	0.06	0.08
Sweden	0.59	0.35	0.32
Thailand	0.23	0.05	0.10
Turkey	0.48	0.23	0.24
United Arab Emirates	0.37	0.14	0.14
United States	0.43	0.18	0.18
International Median	0.42	0.18	0.16
Benchmarking Participants			
Buenos Aires, Argentina	0.37	0.13	0.12
Ontario, Canada	0.59	0.35	0.35
Quebec, Canada	0.54	0.29	0.27
Norway (8)	0.57	0.33	0.30
Abu Dhabi, UAE	0.39	0.15	0.14
Dubai, UAE	0.42	0.18	0.17
Florida, US	0.33	0.11	0.10

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students Confident in Physics Scale, Eighth Grade

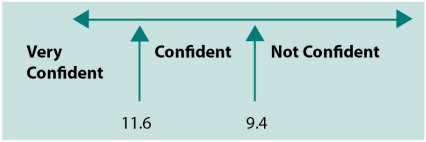
The Students Confident in Physics (SCP) scale was created based on students' degree of agreement with the eight statements described below.

Items in the TIMSS 2015 Students Confident in Physics Scale, Eighth Grade

How much do you agree with these statements about physics?

		Agree a lot	Agree a little	Disagree a little	Disagree a lot
T	BSBP36A	1) I usually do well in physics			
T	BSBP36B*	2) Physics is more difficult for me than for many of my classmates*			
T	BSBP36C*	3) Physics is not one of my strengths*			
T	BSBP36D	4) I learn things quickly in physics			
T	BSBP36E	5) I am good at working out difficult physics problems			
T	BSBP36F	6) My teacher tells me I am good at physics			
T	BSBP36G*	7) Physics is harder for me than any other subject*			
	BSBP36H*	8) Physics makes me confused*			

* Reverse coded



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Students Confident in Physics Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBP36A	-0.38641	-1.18505	-0.21963	1.40468	0.89
BSBP36B*	-0.06965	-1.03618	-0.08308	1.11926	1.03
BSBP36C*	0.18964	-1.07039	0.01690	1.05349	0.97
BSBP36D	-0.11066	-1.41785	0.00024	1.41761	0.89
BSBP36E	0.26746	-1.41522	0.14013	1.27509	1.00
BSBP36F	0.06832	-1.36952	0.01208	1.35744	1.00
BSBP36G*	0.11199	-0.95260	-0.05350	1.00610	1.07
BSBP36H*	-0.07069	-0.70594	-0.15808	0.86402	1.17

*Reverse coded

Scale Transformation Constants for the TIMSS 2015 Students Confident in Physics Scale, Eighth Grade

Scale Transformation Constants	
A = 9.354065	Transformed Scale Score = 9.354065 + 1.474407 • Logit Scale Score
B = 1.474407	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students Confident in Physics Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.48271	
1	5.17467	
2	6.00291	
3	6.57512	
4	7.02652	
5	7.40595	
6	7.73926	
7	8.04083	
8	8.32236	
9	8.58833	
10	8.84388	
11	9.09326	
12	9.33953	9.4
13	9.58774	
14	9.83945	
15	10.09876	
16	10.36970	
17	10.65709	
18	10.96483	
19	11.30549	
20	11.69268	11.6
21	12.15215	
22	12.73226	
23	13.56872	
24	15.26874	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students Confident in Physics Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item							
			BSBP36A	BSBP36B*	BSBP36C*	BSBP36D	BSBP36E	BSBP36F	BSBP36G*	BSBP36H*
Georgia	0.80	42	0.73	0.58	0.63	0.75	0.72	0.69	0.52	0.51
Hungary	0.90	58	0.83	0.72	0.78	0.83	0.74	0.77	0.72	0.67
Kazakhstan	0.86	51	0.76	0.69	0.73	0.76	0.75	0.76	0.63	0.62
Lebanon	0.72	35	0.78	0.35	0.27	0.81	0.78	0.81	0.26	0.18
Lithuania	0.86	52	0.82	0.70	0.71	0.80	0.76	0.74	0.65	0.53
Malta	0.89	57	0.78	0.73	0.76	0.79	0.78	0.74	0.72	0.73
Morocco	0.63	35	0.67	-0.43	-0.46	0.66	0.73	0.74	-0.49	-0.40
Russian Federation	0.89	56	0.79	0.73	0.82	0.82	0.77	0.76	0.67	0.62
Slovenia	0.91	60	0.82	0.74	0.81	0.83	0.80	0.74	0.74	0.72
Sweden	0.89	56	0.80	0.71	0.77	0.82	0.76	0.69	0.69	0.72

*Reverse coded

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students Confident in Physics Scale, Eighth Grade, and TIMSS 2015 Science Achievement

Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Georgia	0.26	0.07	0.09
Hungary	0.33	0.11	0.14
Kazakhstan	0.17	0.03	0.03
Lebanon	0.33	0.11	0.12
Lithuania	0.27	0.07	0.10
Malta	0.44	0.20	0.21
Morocco	0.31	0.10	0.09
Russian Federation	0.25	0.06	0.06
Slovenia	0.35	0.12	0.14
Sweden	0.34	0.11	0.13
International Median	0.32	0.10	0.11

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students Confident in Science Scale, Eighth Grade

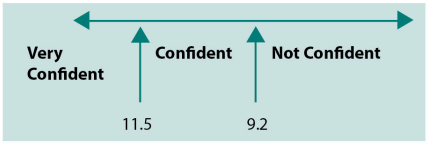
The Students Confident in Science (SCS) scale was created based on students' degree of agreement with the eight statements described below.

Items in the TIMSS 2015 Students Confident in Science Scale, Eighth Grade

How much do you agree with these statements about science?

			Agree a lot	Agree a little	Disagree a little	Disagree a lot
T	BSBS23A	1) I usually do well in science	○	○	○	○
T	BSBS23B*	2) Science is more difficult for me than for many of my classmates*	○	○	○	○
T	BSBS23C*	3) Science is not one of my strengths*	○	○	○	○
T	BSBS23D	4) I learn things quickly in science	○	○	○	○
T	BSBS23E	5) I am good at working out difficult science problems	○	○	○	○
T	BSBS23F	6) My teacher tells me I am good at science	○	○	○	○
T	BSBS23G*	7) Science is harder for me than any other subject*	○	○	○	○
	BSBS23H*	8) Science makes me confused*	○	○	○	○

* Reverse coded



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Students Confident in Science Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBS23A	-0.40602	-0.90090	-0.39226	1.29316	0.92
BSBS23B*	0.02223	-1.15732	0.20137	0.95595	1.05
BSBS23C*	0.27706	-1.01187	0.22919	0.78268	1.05
BSBS23D	-0.24566	-1.21791	-0.02344	1.24135	0.90
BSBS23E	0.17088	-1.28471	0.00993	1.27478	1.02
BSBS23F	0.09152	-1.12464	0.01922	1.10542	1.10
BSBS23G*	0.03010	-0.88164	0.03964	0.84200	1.02
BSBS23H*	0.05989	-0.92434	0.16959	0.75475	1.06

*Reverse coded

Scale Transformation Constants for the TIMSS 2015 Students Confident in Science Scale, Eighth Grade

Scale Transformation Constants	
A = 9.091884	Transformed Scale Score = 9.091884 + 1.615239 • Logit Scale Score
B = 1.615239	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students Confident in Science Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	2.82098	
1	4.65523	
2	5.54634	
3	6.15963	
4	6.64373	
5	7.05126	
6	7.40989	
7	7.73394	
8	8.03689	
9	8.32242	
10	8.59538	
11	8.85979	
12	9.12033	9.2
13	9.37683	
14	9.63617	
15	9.90101	
16	10.17585	
17	10.46634	
18	10.77961	
19	11.12175	
20	11.51463	11.5
21	11.98495	
22	12.58681	
23	13.46826	
24	15.29598	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students Confident in Science Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item							
			BSBS23A	BSBS23B*	BSBS23C*	BSBS23D	BSBS23E	BSBS23F	BSBS23G*	BSBS23H*
Australia	0.90	58	0.79	0.73	0.79	0.80	0.78	0.67	0.75	0.75
Bahrain	0.76	37	0.49	0.64	0.59	0.65	0.57	0.60	0.68	0.63
Botswana (9)	0.72	34	0.69	0.43	0.46	0.68	0.68	0.66	0.46	0.51
Canada	0.89	58	0.79	0.75	0.81	0.81	0.78	0.63	0.75	0.75
Chile	0.81	43	0.76	0.51	0.56	0.78	0.74	0.65	0.58	0.63
Chinese Taipei	0.93	67	0.85	0.79	0.84	0.85	0.82	0.79	0.81	0.78
Egypt	0.68	31	0.09	0.78	0.68	0.37	0.26	0.31	0.78	0.72
England	0.90	59	0.80	0.75	0.81	0.82	0.78	0.64	0.77	0.76
Georgia	-	-	-	-	-	-	-	-	-	-
Hong Kong SAR	0.88	55	0.79	0.73	0.78	0.77	0.76	0.65	0.77	0.69
Hungary	-	-	-	-	-	-	-	-	-	-
Iran, Islamic Rep. of	0.82	45	0.73	0.57	0.60	0.75	0.71	0.70	0.65	0.66
Ireland	0.91	61	0.83	0.78	0.80	0.83	0.78	0.67	0.78	0.76
Israel	0.86	51	0.78	0.68	0.69	0.78	0.75	0.69	0.68	0.68
Italy	0.88	55	0.79	0.71	0.78	0.81	0.69	0.69	0.73	0.71
Japan	0.89	58	0.79	0.73	0.82	0.76	0.78	0.68	0.76	0.74
Jordan	0.72	34	0.30	0.71	0.65	0.54	0.48	0.51	0.69	0.65
Kazakhstan	-	-	-	-	-	-	-	-	-	-
Korea, Rep. of	0.93	66	0.86	0.79	0.84	0.81	0.84	0.81	0.80	0.76
Kuwait	0.79	41	0.55	0.66	0.57	0.71	0.67	0.64	0.65	0.63
Lebanon	-	-	-	-	-	-	-	-	-	-
Lithuania	-	-	-	-	-	-	-	-	-	-
Malaysia	0.67	30	0.60	0.48	0.57	0.56	0.57	0.40	0.59	0.59
Malta	-	-	-	-	-	-	-	-	-	-
Morocco	-	-	-	-	-	-	-	-	-	-
New Zealand	0.88	54	0.78	0.72	0.77	0.78	0.75	0.64	0.74	0.69
Norway (9)	0.90	60	0.81	0.76	0.82	0.82	0.79	0.69	0.75	0.72
Oman	0.74	36	0.37	0.76	0.66	0.52	0.39	0.44	0.76	0.72
Qatar	0.78	39	0.65	0.60	0.54	0.73	0.67	0.67	0.59	0.55
Russian Federation	-	-	-	-	-	-	-	-	-	-
Saudi Arabia	0.71	34	0.20	0.77	0.66	0.43	0.30	0.37	0.79	0.76
Singapore	0.91	62	0.83	0.79	0.83	0.80	0.79	0.69	0.79	0.76
Slovenia	-	-	-	-	-	-	-	-	-	-
South Africa (9)	0.78	40	0.68	0.54	0.60	0.71	0.69	0.61	0.57	0.61
Sweden	-	-	-	-	-	-	-	-	-	-
Thailand	0.73	35	0.78	0.14	0.27	0.85	0.83	0.77	0.13	0.20
Turkey	0.84	48	0.75	0.69	0.70	0.72	0.67	0.65	0.67	0.68
United Arab Emirates	0.82	44	0.64	0.65	0.66	0.72	0.67	0.63	0.67	0.65
United States	0.88	54	0.75	0.75	0.76	0.79	0.73	0.60	0.76	0.74
Benchmarking Participants										
Buenos Aires, Argentina	0.78	40	0.71	0.56	0.43	0.77	0.69	0.62	0.63	0.61
Ontario, Canada	0.90	58	0.79	0.75	0.81	0.81	0.78	0.62	0.76	0.76
Quebec, Canada	0.90	59	0.79	0.76	0.83	0.82	0.77	0.65	0.74	0.76
Norway (8)	0.89	57	0.81	0.75	0.80	0.81	0.78	0.65	0.71	0.71
Abu Dhabi, UAE	0.79	40	0.61	0.60	0.63	0.70	0.65	0.64	0.61	0.62
Dubai, UAE	0.86	51	0.72	0.71	0.71	0.77	0.72	0.65	0.73	0.69
Florida, US	0.85	50	0.73	0.71	0.73	0.77	0.70	0.58	0.72	0.71

*Reverse coded

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students Confident in Science Scale, Eighth Grade, and TIMSS 2015 Science Achievement

Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.39	0.15	0.16
Bahrain	0.38	0.15	0.16
Botswana (9)	0.26	0.07	0.08
Canada	0.35	0.12	0.12
Chile	0.24	0.06	0.08
Chinese Taipei	0.38	0.15	0.18
Egypt	0.41	0.16	0.16
England	0.39	0.15	0.15
Georgia	-	-	-
Hong Kong SAR	0.31	0.09	0.12
Hungary	-	-	-
Iran, Islamic Rep. of	0.31	0.10	0.10
Ireland	0.49	0.24	0.23
Israel	0.38	0.15	0.18
Italy	0.31	0.10	0.10
Japan	0.37	0.14	0.14
Jordan	0.39	0.15	0.15
Kazakhstan	-	-	-
Korea, Rep. of	0.45	0.20	0.23
Kuwait	0.36	0.13	0.12
Lebanon	-	-	-
Lithuania	-	-	-
Malaysia	-0.16	0.03	0.02
Malta	-	-	-
Morocco	-	-	-
New Zealand	0.33	0.11	0.13
Norway (9)	0.44	0.19	0.20
Oman	0.30	0.09	0.09
Qatar	0.39	0.15	0.17
Russian Federation	-	-	-
Saudi Arabia	0.34	0.11	0.14
Singapore	0.24	0.06	0.07
Slovenia	-	-	-
South Africa (9)	0.19	0.03	0.05
Sweden	-	-	-
Thailand	0.17	0.03	0.06
Turkey	0.39	0.15	0.16
United Arab Emirates	0.35	0.12	0.15
United States	0.34	0.11	0.13
International Median	0.35	0.12	0.14
Benchmarking Participants			
Buenos Aires, Argentina	0.20	0.04	0.06
Ontario, Canada	0.36	0.13	0.12
Quebec, Canada	0.32	0.10	0.10
Norway (8)	0.35	0.13	0.13
Abu Dhabi, UAE	0.34	0.12	0.14
Dubai, UAE	0.34	0.11	0.12
Florida, US	0.33	0.11	0.13

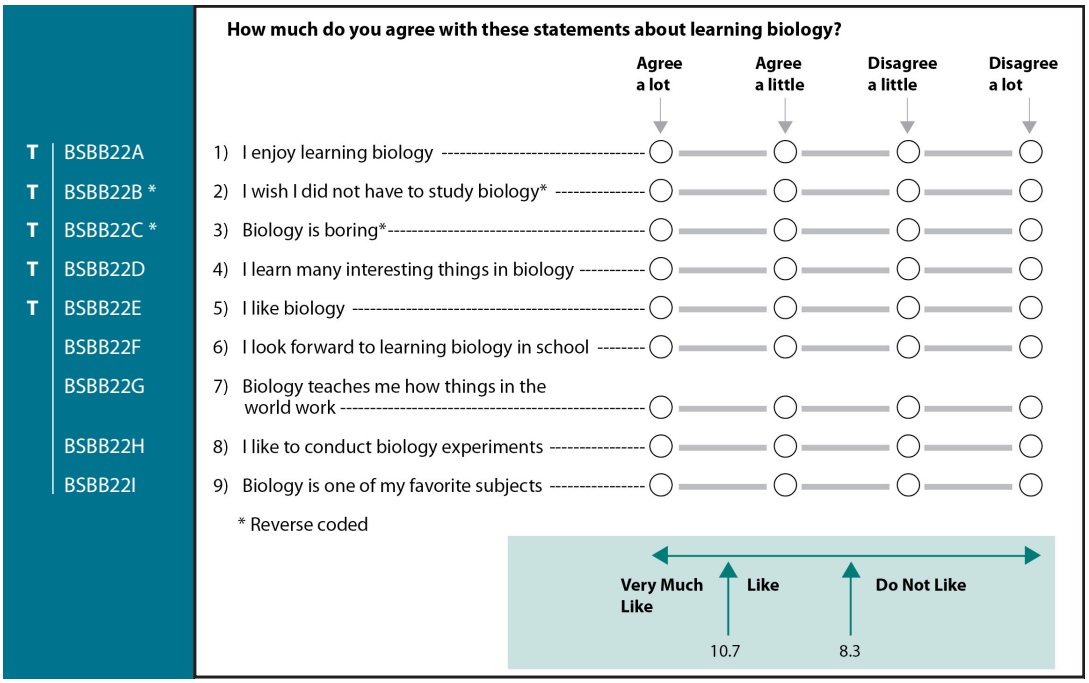
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students Like Learning Biology Scale, Eighth Grade

The Students Like Learning Biology (SLB) scale was created based on students' degree of agreement with the nine statements described below.

Items in the TIMSS 2015 Students Like Learning Biology Scale, Eighth Grade



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Students Like Learning Biology Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBB22A	-0.21561	-1.36738	-0.38682	1.75420	0.78
BSBB22B*	0.48941	-0.97790	-0.35507	1.33297	1.53
BSBB22C*	0.32744	-1.12315	-0.37329	1.49644	1.36
BSBB22D	-0.70652	-1.04264	-0.60801	1.65065	0.86
BSBB22E	-0.08498	-1.26709	-0.29413	1.56122	0.63
BSBB22F	0.47630	-1.62094	-0.00453	1.62547	0.85
BSBB22G	-0.71956	-1.08900	-0.74172	1.83072	1.15
BSBB22H	-0.28187	-1.07022	-0.43544	1.50566	1.27
BSBB22I	0.71539	-1.35579	0.06572	1.29007	0.87

*Reverse coded

Scale Transformation Constants for the TIMSS 2015 Students Like Learning Biology Scale, Eighth Grade

Scale Transformation Constants	
A = 8.424458	Transformed Scale Score = 8.424458 + 1.150254 • Logit Scale Score
B = 1.150254	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students Like Learning Biology Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.58422	
1	4.83770	
2	5.43659	
3	5.85367	
4	6.18434	
5	6.46579	
6	6.72147	
7	6.95733	
8	7.17826	
9	7.39267	
10	7.60305	
11	7.80935	
12	8.01503	
13	8.22181	8.3
14	8.43143	
15	8.64503	
16	8.86456	
17	9.09141	
18	9.32733	
19	9.57355	
20	9.83403	
21	10.11239	
22	10.41516	
23	10.75327	10.7
24	11.14479	
25	11.63080	
26	12.31447	
27	13.66963	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students Like Learning Biology Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item								
			BSBB22A	BSBB22B*	BSBB22C*	BSBB22D	BSBB22E	BSBB22F	BSBB22G	BSBB22H	BSBB22I
Georgia	0.85	47	0.81	0.43	0.45	0.67	0.87	0.77	0.60	0.62	0.79
Hungary	0.91	60	0.87	0.66	0.75	0.79	0.91	0.84	0.63	0.63	0.84
Kazakhstan	0.87	52	0.80	0.36	0.49	0.80	0.87	0.81	0.66	0.73	0.83
Lebanon	0.84	49	0.75	0.29	0.33	0.74	0.87	0.78	0.68	0.74	0.83
Lithuania	0.92	61	0.86	0.66	0.71	0.80	0.91	0.84	0.71	0.65	0.83
Malta	0.92	63	0.87	0.75	0.76	0.78	0.91	0.89	0.67	0.58	0.89
Morocco	0.85	50	0.75	0.35	0.46	0.77	0.85	0.83	0.68	0.71	0.79
Russian Federation	0.89	55	0.83	0.49	0.69	0.77	0.88	0.81	0.67	0.64	0.84
Slovenia	0.93	63	0.87	0.68	0.76	0.84	0.91	0.89	0.65	0.65	0.85
Sweden	0.92	62	0.87	0.70	0.77	0.83	0.91	0.89	0.66	0.58	0.80

*Reverse coded

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students Like Learning Biology Scale, Eighth Grade, and TIMSS 2015 Science Achievement

Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Georgia	0.16	0.03	0.03
Hungary	0.09	0.01	0.01
Kazakhstan	0.13	0.02	0.01
Lebanon	0.30	0.09	0.09
Lithuania	0.06	0.00	0.00
Malta	0.31	0.10	0.10
Morocco	0.22	0.05	0.04
Russian Federation	0.05	0.00	0.00
Slovenia	0.05	0.00	0.00
Sweden	0.12	0.01	0.01
International Median	0.13	0.02	0.01

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students Like Learning Chemistry Scale, Eighth Grade

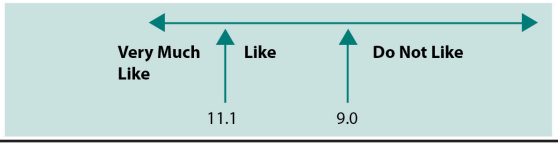
The Students Like Learning Chemistry (SLC) scale was created based on students' degree of agreement with the nine statements described below.

Items in the TIMSS 2015 Students Like Learning Chemistry Scale, Eighth Grade

How much do you agree with these statements about learning chemistry?

			Agree a lot	Agree a little	Disagree a little	Disagree a lot
T	BSBC30A	1) I enjoy learning chemistry	○	○	○	○
T	BSBC30B *	2) I wish I did not have to study chemistry*	○	○	○	○
T	BSBC30C *	3) Chemistry is boring*	○	○	○	○
T	BSBC30D	4) I learn many interesting things in chemistry	○	○	○	○
T	BSBC30E	5) I like chemistry	○	○	○	○
	BSBC30F	6) I look forward to learning chemistry in school	○	○	○	○
	BSBC30G	7) Chemistry teaches me how things in the world work	○	○	○	○
	BSBC30H	8) I like to conduct chemistry experiments	○	○	○	○
	BSBC30I	9) Chemistry is one of my favorite subjects	○	○	○	○

* Reverse coded



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Students Like Learning Chemistry Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBC30A	-0.02523	-1.23109	-0.19180	1.42289	0.78
BSBC30B*	0.48146	-0.92656	-0.23159	1.15815	1.68
BSBC30C*	0.25060	-1.07638	-0.32509	1.40147	1.54
BSBC30D	-0.53330	-1.12674	-0.47727	1.60401	0.82
BSBC30E	0.04614	-1.23609	-0.14551	1.38160	0.62
BSBC30F	0.44759	-1.46092	0.09506	1.36586	0.79
BSBC30G	-0.33281	-1.19842	-0.43524	1.63366	1.09
BSBC30H	-0.88655	-0.62539	-0.71378	1.33917	1.28
BSBC30I	0.55210	-1.26474	0.09353	1.17121	0.80

*Reverse coded

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Students Like Learning Chemistry Scale, Eighth Grade

Scale Transformation Constants	
A = 9.10346	Transformed Scale Score = 9.10346 + 1.077212 • Logit Scale Score
B = 1.077212	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students Like Learning Chemistry Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	4.69247	
1	5.86077	
2	6.41657	
3	6.79900	
4	7.10281	
5	7.36210	
6	7.59312	
7	7.80909	
8	8.01275	
9	8.20800	
10	8.39762	
11	8.58367	
12	8.76781	
13	8.95150	9.0
14	9.13676	
15	9.32284	
16	9.51333	
17	9.70911	
18	9.91208	
19	10.12367	
20	10.34801	
21	10.58902	
22	10.85319	
23	11.15104	11.1
24	11.49986	
25	11.93805	
26	12.56219	
27	13.81623	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students Like Learning Chemistry Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item								
			BSBC30A	BSBC30B*	BSBC30C*	BSBC30D	BSBC30E	BSBC30F	BSBC30G	BSBC30H	BSBC30I
Georgia	0.87	52	0.83	0.39	0.42	0.78	0.89	0.81	0.69	0.64	0.83
Hungary	0.91	60	0.87	0.63	0.67	0.80	0.91	0.87	0.70	0.58	0.85
Kazakhstan	0.90	58	0.83	0.43	0.51	0.83	0.89	0.83	0.75	0.77	0.85
Lebanon	0.84	51	0.78	0.23	0.24	0.79	0.87	0.80	0.77	0.75	0.83
Lithuania	0.92	63	0.89	0.65	0.67	0.81	0.92	0.86	0.73	0.68	0.88
Malta	0.94	69	0.88	0.77	0.79	0.85	0.92	0.90	0.76	0.64	0.89
Morocco	0.85	51	0.74	0.22	0.31	0.79	0.86	0.85	0.75	0.77	0.80
Russian Federation	0.91	59	0.87	0.45	0.63	0.83	0.91	0.86	0.73	0.68	0.87
Slovenia	0.93	64	0.87	0.66	0.73	0.86	0.92	0.91	0.74	0.58	0.88
Sweden	0.93	64	0.89	0.67	0.74	0.86	0.91	0.88	0.70	0.64	0.83

*Reverse coded

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students Like Learning Chemistry Scale, Eighth Grade, and TIMSS 2015 Science Achievement

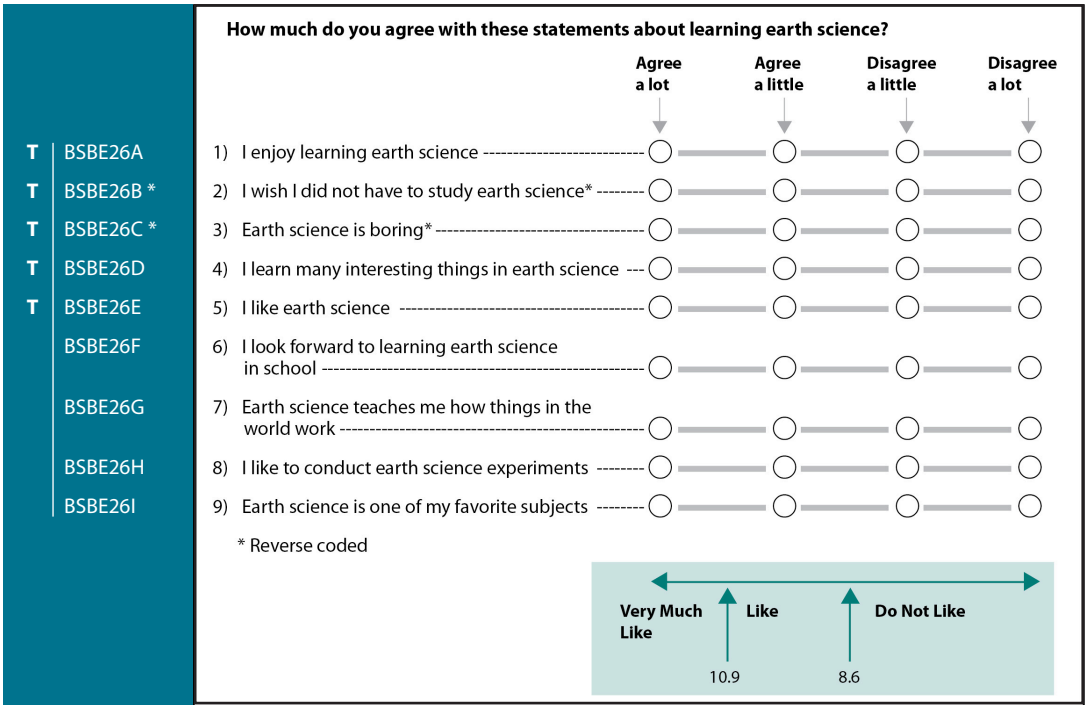
Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Georgia	0.20	0.04	0.04
Hungary	0.11	0.01	0.02
Kazakhstan	0.17	0.03	0.03
Lebanon	0.20	0.04	0.05
Lithuania	0.16	0.02	0.02
Malta	0.31	0.10	0.09
Morocco	0.24	0.06	0.06
Russian Federation	0.16	0.03	0.02
Slovenia	0.24	0.06	0.05
Sweden	0.19	0.04	0.03
International Median	0.19	0.04	0.03

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students Like Learning Earth Science Scale, Eighth Grade

The Students Like Learning Earth Science (SLE) scale was created based on students' degree of agreement with the nine statements described below.

Items in the TIMSS 2015 Students Like Learning Earth Science Scale, Eighth Grade



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Students Like Learning Earth Science Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBE26A	-0.23011	-1.44006	-0.28759	1.72765	0.77
BSBE26B*	0.38072	-1.07357	-0.31732	1.39089	1.61
BSBE26C*	0.15618	-1.23747	-0.35190	1.58937	1.40
BSBE26D	-0.70905	-1.24739	-0.55289	1.80028	0.86
BSBE26E	-0.12440	-1.34236	-0.29463	1.63699	0.65
BSBE26F	0.43991	-1.68433	0.08108	1.60325	0.83
BSBE26G	-0.82465	-1.18029	-0.67026	1.85055	1.09
BSBE26H	0.25967	-1.34111	-0.13343	1.47454	1.15
BSBE26I	0.65173	-1.39181	0.01682	1.37499	0.85

*Reverse coded

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Students Like Learning Earth Science Scale, Eighth Grade

Scale Transformation Constants	
A = 8.692574	Transformed Scale Score = 8.692574 + 1.090836 • Logit Scale Score
B = 1.090836	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students Like Learning Earth Science Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.96247	
1	5.17563	
2	5.76426	
3	6.17484	
4	6.50371	
5	6.78595	
6	7.03864	
7	7.27438	
8	7.49669	
9	7.70979	
10	7.91683	
11	8.12025	
12	8.32207	
13	8.52407	8.6
14	8.72785	
15	8.93490	
16	9.14666	
17	9.36457	
18	9.59024	
19	9.82482	
20	10.07207	
21	10.33557	
22	10.62160	
23	10.94063	10.9
24	11.31149	
25	11.76867	
26	12.41427	
27	13.69652	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students Like Learning Earth Science Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item								
			BSBE26A	BSBE26B*	BSBE26C*	BSBE26D	BSBE26E	BSBE26F	BSBE26G	BSBE26H	BSBE26I
Georgia	0.83	46	0.77	0.26	0.27	0.73	0.85	0.76	0.70	0.71	0.76
Hungary	0.92	61	0.87	0.63	0.71	0.81	0.90	0.86	0.67	0.71	0.84
Kazakhstan	0.88	54	0.80	0.37	0.47	0.81	0.88	0.81	0.75	0.73	0.83
Lebanon	-	-	-	-	-	-	-	-	-	-	-
Lithuania	0.91	60	0.87	0.64	0.68	0.77	0.90	0.82	0.70	0.70	0.84
Malta	0.93	65	0.88	0.64	0.71	0.82	0.92	0.90	0.71	0.75	0.85
Morocco	0.85	51	0.76	0.27	0.37	0.78	0.86	0.84	0.72	0.76	0.79
Russian Federation	0.89	56	0.84	0.38	0.62	0.80	0.89	0.83	0.70	0.70	0.83
Slovenia	0.93	64	0.86	0.66	0.73	0.84	0.92	0.90	0.68	0.71	0.86
Sweden	-	-	-	-	-	-	-	-	-	-	-

*Reverse coded

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students Like Learning Earth Science Scale, Eighth Grade, and TIMSS 2015 Science Achievement

Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Georgia	0.18	0.03	0.03
Hungary	0.02	0.00	0.00
Kazakhstan	0.09	0.01	0.01
Lebanon	-	-	-
Lithuania	0.13	0.02	0.02
Malta	0.16	0.03	0.02
Morocco	0.20	0.04	0.04
Russian Federation	0.04	0.00	0.00
Slovenia	0.07	0.01	0.00
Sweden	-	-	-
International Median	0.11	0.01	0.01

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students Like Learning Mathematics Scale, Eighth Grade

The Students Like Learning Mathematics (SLM) scale was created based on students' degree of agreement with the nine statements described below.

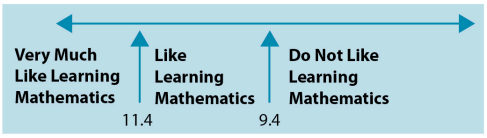
Items in the TIMSS 2015 Students Like Learning Mathematics Scale, Eighth Grade

T	BSBM17A
T	BSBM17B *
T	BSBM17C *
T	BSBM17D
T	BSBM17E
	BSBM17F
	BSBM17G
	BSBM17H
	BSBM17I

How much do you agree with these statements about learning mathematics?

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
1) I enjoy learning mathematics	○	○	○	○
2) I wish I did not have to study mathematics*	○	○	○	○
3) Mathematics is boring*	○	○	○	○
4) I learn many interesting things in mathematics	○	○	○	○
5) I like mathematics	○	○	○	○
6) I like any schoolwork that involves numbers	○	○	○	○
7) I like to solve mathematics problems	○	○	○	○
8) I look forward to mathematics class	○	○	○	○
9) Mathematics is one of my favorite subjects	○	○	○	○

* Reverse coded



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Students Like Learning Mathematics Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBM17A	-0.48929	-1.41673	-0.43072	1.84745	0.81
BSBM17B*	-0.07466	-1.22401	0.09794	1.12607	1.72
BSBM17C*	0.11238	-1.62447	0.14173	1.48274	1.39
BSBM17D	-0.71855	-1.68593	-0.23274	1.91867	1.10
BSBM17E	-0.22025	-1.25167	-0.34163	1.59330	0.67
BSBM17F	0.20385	-1.83417	0.00020	1.83397	1.01
BSBM17G	0.13127	-1.51555	-0.16902	1.68457	0.90
BSBM17H	0.56595	-1.67774	-0.09470	1.77244	0.92
BSBM17I	0.48930	-1.06313	-0.07995	1.14308	0.81

*Reverse coded

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Students Like Learning Mathematics Scale, Eighth Grade

Scale Transformation Constants	
A = 9.42706	Transformed Scale Score = 9.42706 + 0.987588 • Logit Scale Score
B = 0.987588	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students Like Learning Mathematics Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	4.96789	
1	6.12033	
2	6.69346	
3	7.09477	
4	7.41571	
5	7.68894	
6	7.93203	
7	8.15498	
8	8.36376	
9	8.56346	
10	8.75617	
11	8.94416	
12	9.12922	
13	9.31285	9.4
14	9.49639	
15	9.68118	
16	9.86866	
17	10.06049	
18	10.25863	
19	10.46547	
20	10.68282	
21	10.91671	
22	11.17269	
23	11.46067	11.4
24	11.79792	
25	12.21629	
26	12.80770	
27	13.97818	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students Like Learning Mathematics Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item								
			BSBM17A	BSBM17B*	BSBM17C*	BSBM17D	BSBM17E	BSBM17F	BSBM17G	BSBM17H	BSBM17I
Australia	0.94	67	0.88	0.71	0.74	0.74	0.91	0.81	0.85	0.86	0.85
Bahrain	0.92	63	0.84	0.56	0.61	0.81	0.90	0.77	0.85	0.84	0.87
Botswana (9)	0.87	50	0.76	0.52	0.60	0.64	0.83	0.68	0.77	0.70	0.78
Canada	0.94	68	0.89	0.70	0.78	0.74	0.91	0.81	0.85	0.86	0.87
Chile	0.93	66	0.85	0.61	0.72	0.74	0.90	0.83	0.87	0.86	0.87
Chinese Taipei	0.95	70	0.89	0.74	0.78	0.83	0.92	0.85	0.88	0.78	0.88
Egypt	0.88	54	0.78	0.33	0.48	0.75	0.86	0.75	0.83	0.82	0.82
England	0.94	67	0.87	0.75	0.78	0.74	0.90	0.82	0.83	0.83	0.85
Georgia	0.90	56	0.81	0.49	0.58	0.68	0.87	0.76	0.81	0.80	0.83
Hong Kong SAR	0.94	69	0.89	0.67	0.73	0.82	0.92	0.84	0.88	0.81	0.89
Hungary	0.93	65	0.87	0.67	0.72	0.76	0.91	0.82	0.83	0.82	0.84
Iran, Islamic Rep. of	0.92	62	0.83	0.70	0.64	0.75	0.89	0.73	0.83	0.80	0.88
Ireland	0.94	66	0.88	0.74	0.75	0.75	0.90	0.79	0.82	0.83	0.85
Israel	0.93	65	0.85	0.64	0.73	0.80	0.90	0.78	0.85	0.80	0.87
Italy	0.95	71	0.90	0.79	0.82	0.71	0.92	0.84	0.80	0.86	0.88
Japan	0.94	68	0.88	0.61	0.72	0.82	0.92	0.85	0.88	0.82	0.88
Jordan	0.91	60	0.82	0.45	0.55	0.78	0.90	0.79	0.84	0.87	0.86
Kazakhstan	0.91	60	0.78	0.51	0.65	0.74	0.87	0.78	0.86	0.83	0.85
Korea, Rep. of	0.94	70	0.89	0.66	0.78	0.83	0.92	0.86	0.87	0.77	0.89
Kuwait	0.92	62	0.86	0.49	0.68	0.80	0.90	0.79	0.85	0.79	0.88
Lebanon	0.87	52	0.77	0.45	0.42	0.66	0.87	0.74	0.81	0.75	0.85
Lithuania	0.93	65	0.86	0.67	0.71	0.71	0.90	0.82	0.88	0.82	0.84
Malaysia	0.89	54	0.82	0.58	0.67	0.74	0.86	0.75	0.60	0.73	0.82
Malta	0.94	67	0.88	0.71	0.77	0.76	0.91	0.78	0.78	0.85	0.88
Morocco	0.88	52	0.80	0.44	0.56	0.73	0.86	0.69	0.70	0.84	0.80
New Zealand	0.93	64	0.87	0.67	0.70	0.71	0.90	0.81	0.83	0.84	0.85
Norway (9)	0.94	70	0.88	0.71	0.78	0.80	0.92	0.84	0.89	0.86	0.85
Oman	0.87	52	0.78	0.39	0.60	0.73	0.86	0.65	0.81	0.71	0.83
Qatar	0.92	62	0.85	0.51	0.55	0.80	0.90	0.81	0.86	0.85	0.88
Russian Federation	0.92	62	0.86	0.54	0.71	0.74	0.89	0.78	0.81	0.83	0.85
Saudi Arabia	0.92	63	0.85	0.46	0.61	0.83	0.90	0.79	0.85	0.87	0.88
Singapore	0.94	69	0.88	0.77	0.78	0.75	0.91	0.79	0.87	0.82	0.89
Slovenia	0.93	66	0.85	0.64	0.80	0.78	0.91	0.78	0.84	0.86	0.84
South Africa (9)	0.89	54	0.82	0.55	0.61	0.62	0.86	0.73	0.80	0.76	0.82
Sweden	0.95	71	0.88	0.71	0.83	0.80	0.92	0.87	0.86	0.86	0.87
Thailand	0.89	56	0.80	0.44	0.56	0.67	0.87	0.81	0.77	0.83	0.85
Turkey	0.92	61	0.82	0.63	0.74	0.59	0.89	0.76	0.83	0.83	0.87
United Arab Emirates	0.93	64	0.85	0.61	0.70	0.78	0.89	0.77	0.84	0.82	0.87
United States	0.94	69	0.88	0.70	0.75	0.76	0.91	0.82	0.88	0.87	0.87
Benchmarking Participants											
Buenos Aires, Argentina	0.92	62	0.83	0.57	0.64	0.73	0.89	0.84	0.84	0.83	0.86
Ontario, Canada	0.95	70	0.90	0.73	0.78	0.74	0.91	0.82	0.87	0.88	0.87
Quebec, Canada	0.93	64	0.87	0.63	0.79	0.73	0.90	0.80	0.81	0.82	0.84
Norway (8)	0.95	71	0.88	0.73	0.81	0.79	0.92	0.84	0.88	0.86	0.85
Abu Dhabi, UAE	0.93	64	0.85	0.56	0.68	0.79	0.89	0.80	0.85	0.84	0.88
Dubai, UAE	0.93	65	0.86	0.71	0.75	0.76	0.89	0.76	0.83	0.82	0.87
Florida, US	0.94	68	0.88	0.68	0.71	0.77	0.91	0.81	0.89	0.86	0.86

*Reverse coded

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students Like Learning Mathematics Scale, Eighth Grade, and TIMSS 2015 Mathematics Achievement

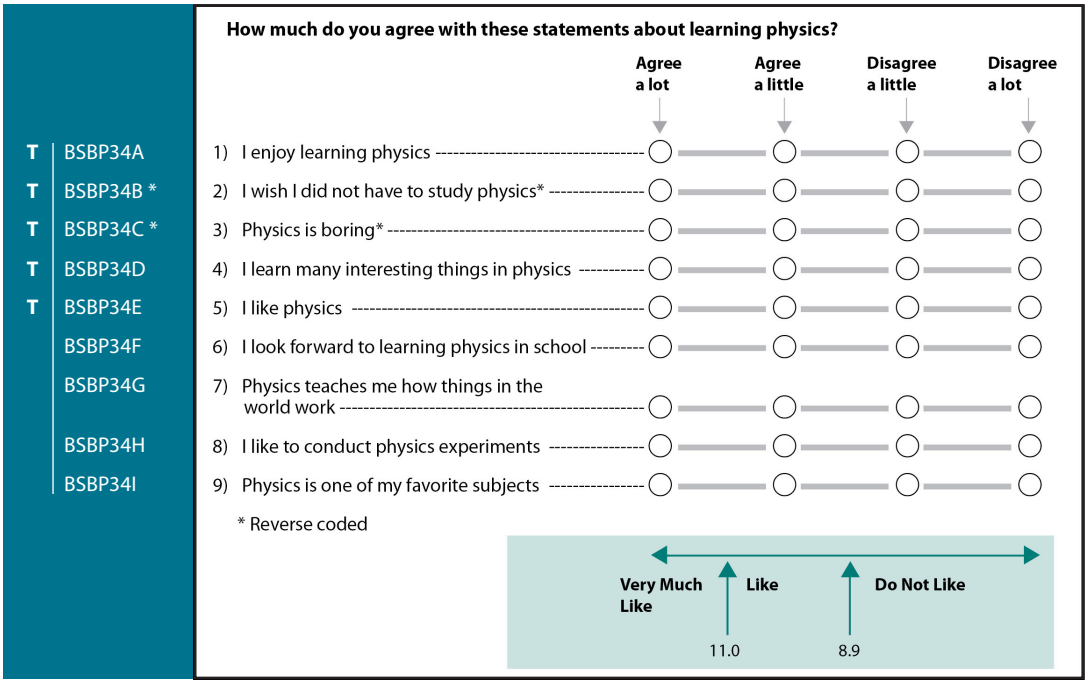
Country	Pearson's Correlation with Mathematics Achievement		Variance in Mathematics Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.34	0.11	0.09
Bahrain	0.27	0.07	0.07
Botswana (9)	0.27	0.07	0.07
Canada	0.36	0.13	0.10
Chile	0.25	0.06	0.07
Chinese Taipei	0.43	0.18	0.15
Egypt	0.24	0.06	0.08
England	0.30	0.09	0.08
Georgia	0.23	0.05	0.05
Hong Kong SAR	0.33	0.11	0.09
Hungary	0.29	0.09	0.08
Iran, Islamic Rep. of	0.27	0.07	0.07
Ireland	0.32	0.10	0.08
Israel	0.11	0.01	0.01
Italy	0.34	0.11	0.11
Japan	0.35	0.13	0.11
Jordan	0.16	0.03	0.04
Kazakhstan	0.18	0.03	0.03
Korea, Rep. of	0.40	0.16	0.13
Kuwait	0.16	0.02	0.02
Lebanon	0.18	0.03	0.04
Lithuania	0.28	0.08	0.07
Malaysia	0.27	0.07	0.06
Malta	0.26	0.07	0.06
Morocco	0.30	0.09	0.08
New Zealand	0.25	0.06	0.05
Norway (9)	0.40	0.16	0.13
Oman	0.26	0.07	0.07
Qatar	0.29	0.08	0.08
Russian Federation	0.25	0.06	0.06
Saudi Arabia	0.19	0.04	0.03
Singapore	0.32	0.10	0.08
Slovenia	0.30	0.09	0.08
South Africa (9)	0.08	0.01	0.02
Sweden	0.40	0.16	0.15
Thailand	0.19	0.04	0.04
Turkey	0.19	0.04	0.05
United Arab Emirates	0.23	0.05	0.05
United States	0.27	0.07	0.06
International Median	0.27	0.07	0.07
Benchmarking Participants			
Buenos Aires, Argentina	0.16	0.03	0.02
Ontario, Canada	0.41	0.17	0.15
Quebec, Canada	0.33	0.11	0.07
Norway (8)	0.35	0.12	0.10
Abu Dhabi, UAE	0.22	0.05	0.05
Dubai, UAE	0.27	0.07	0.07
Florida, US	0.16	0.03	0.03

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students Like Learning Physics Scale, Eighth Grade

The Students Like Learning Physics (SLP) scale was created based on students' degree of agreement with the nine statements described below.

Items in the TIMSS 2015 Students Like Learning Physics Scale, Eighth Grade



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Students Like Learning Physics Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBP34A	-0.07404	-1.30547	-0.15488	1.46035	0.78
BSBP34B*	0.45993	-1.00740	-0.17183	1.17923	1.73
BSBP34C*	0.26168	-1.15919	-0.28413	1.44332	1.54
BSBP34D	-0.54501	-1.21552	-0.43870	1.65422	0.83
BSBP34E	0.07244	-1.28315	-0.11316	1.39631	0.62
BSBP34F	0.42153	-1.49755	0.11984	1.37771	0.82
BSBP34G	-0.62535	-1.08281	-0.62965	1.71246	1.12
BSBP34H	-0.57460	-0.91537	-0.50031	1.41568	1.10
BSBP34I	0.60342	-1.27446	0.09125	1.18321	0.80

*Reverse coded

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Students Like Learning Physics Scale, Eighth Grade

Scale Transformation Constants	
A = 9.037567	Transformed Scale Score = 9.037567 + 1.051045 • Logit Scale Score
B = 1.051045	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students Like Learning Physics Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	4.64895	
1	5.80878	
2	6.36558	
3	6.74953	
4	7.05428	
5	7.31372	
6	7.54411	
7	7.75905	
8	7.96155	
9	8.15567	
10	8.34431	
11	8.52962	
12	8.71320	
13	8.89640	8.9
14	9.08040	
15	9.26639	
16	9.45564	
17	9.64960	
18	9.85004	
19	10.05832	
20	10.27840	
21	10.51415	
22	10.77194	
23	11.06214	11.0
24	11.40300	
25	11.82828	
26	12.43593	
27	13.65813	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students Like Learning Physics Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item								
			BSBP34A	BSBP34B*	BSBP34C*	BSBP34D	BSBP34E	BSBP34F	BSBP34G	BSBP34H	BSBP34I
Georgia	0.87	52	0.83	0.35	0.38	0.76	0.88	0.82	0.68	0.71	0.83
Hungary	0.92	62	0.88	0.62	0.68	0.82	0.91	0.85	0.69	0.72	0.85
Kazakhstan	0.89	58	0.82	0.40	0.50	0.83	0.89	0.83	0.80	0.79	0.84
Lebanon	0.86	54	0.81	0.19	0.19	0.82	0.90	0.82	0.78	0.80	0.85
Lithuania	0.92	61	0.88	0.60	0.64	0.81	0.91	0.84	0.73	0.73	0.85
Malta	0.93	65	0.89	0.66	0.70	0.83	0.92	0.90	0.75	0.70	0.88
Morocco	0.85	52	0.77	0.22	0.31	0.82	0.87	0.86	0.76	0.79	0.80
Russian Federation	0.90	57	0.85	0.41	0.59	0.81	0.89	0.83	0.73	0.72	0.85
Slovenia	0.93	64	0.86	0.64	0.72	0.86	0.92	0.90	0.66	0.71	0.86
Sweden	0.93	65	0.88	0.68	0.77	0.87	0.92	0.89	0.71	0.70	0.83

*Reverse coded

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students Like Learning Physics Scale, Eighth Grade, and TIMSS 2015 Science Achievement

Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Georgia	0.14	0.02	0.03
Hungary	0.14	0.02	0.03
Kazakhstan	0.16	0.03	0.03
Lebanon	0.23	0.05	0.07
Lithuania	0.22	0.05	0.05
Malta	0.36	0.13	0.11
Morocco	0.23	0.05	0.05
Russian Federation	0.19	0.04	0.03
Slovenia	0.18	0.03	0.03
Sweden	0.22	0.05	0.04
International Median	0.21	0.04	0.03

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students Like Learning Science Scale, Eighth Grade

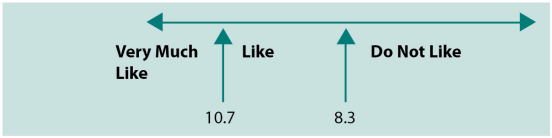
The Students Like Learning Science (SLS) scale was created based on students' degree of agreement with the nine statements described below.

Items in the TIMSS 2015 Students Like Learning Science Scale, Eighth Grade

How much do you agree with these statements about learning science?

			Agree a lot	Agree a little	Disagree a little	Disagree a lot
T	BSBS21A	1) I enjoy learning science	○	○	○	○
T	BSBS21B *	2) I wish I did not have to study science*	○	○	○	○
T	BSBS21C *	3) Science is boring*	○	○	○	○
T	BSBS21D	4) I learn many interesting things in science	○	○	○	○
T	BSBS21E	5) I like science	○	○	○	○
	BSBS21F	6) I look forward to learning science in school	○	○	○	○
	BSBS21G	7) Science teaches me how things in the world work	○	○	○	○
	BSBS21H	8) I like to conduct science experiments	○	○	○	○
	BSBS21I	9) Science is one of my favorite subjects	○	○	○	○

* Reverse coded



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Students Like Learning Science Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBS21A	-0.13142	-1.01695	-0.52680	1.54375	0.76
BSBS21B*	0.56759	-1.19007	-0.00233	1.19240	1.65
BSBS21C*	0.47515	-1.36232	0.00944	1.35288	1.42
BSBS21D	-0.52383	-0.93744	-0.51695	1.45439	0.90
BSBS21E	0.01158	-1.06294	-0.35802	1.42096	0.65
BSBS21F	0.41917	-1.45338	-0.07468	1.52806	0.83
BSBS21G	-0.64772	-0.96459	-0.57542	1.54001	1.10
BSBS21H	-0.67455	-0.78921	-0.43697	1.22618	1.33
BSBS21I	0.50403	-1.16503	-0.06851	1.23354	0.81

*Reverse coded

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Students Like Learning Science Scale, Eighth Grade

Scale Transformation Constants	
A = 8.489044	Transformed Scale Score = 8.489044 + 1.163944 • Logit Scale Score
B = 1.163944	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students Like Learning Science Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.77142	
1	5.02704	
2	5.62048	
3	6.02909	
4	6.34989	
5	6.62088	
6	6.86531	
7	7.08748	
8	7.29855	
9	7.50187	
10	7.70183	
11	7.89809	
12	8.09428	
13	8.29197	8.3
14	8.49247	
15	8.69676	
16	8.90626	
17	9.12229	
18	9.34659	
19	9.58043	
20	9.82838	
21	10.09453	
22	10.38590	
23	10.71393	10.7
24	11.09720	
25	11.57741	
26	12.25898	
27	13.62135	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students Like Learning Science Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item								
			BSBS21A	BSBS21B*	BSBS21C*	BSBS21D	BSBS21E	BSBS21F	BSBS21G	BSBS21H	BSBS21I
Australia	0.93	65	0.89	0.71	0.75	0.81	0.92	0.91	0.73	0.61	0.87
Bahrain	0.89	56	0.83	0.37	0.45	0.83	0.89	0.86	0.78	0.68	0.87
Botswana (9)	0.83	44	0.72	0.50	0.61	0.65	0.79	0.71	0.59	0.58	0.75
Canada	0.92	61	0.88	0.65	0.74	0.79	0.91	0.88	0.68	0.59	0.87
Chile	0.89	56	0.86	0.45	0.61	0.80	0.89	0.82	0.71	0.66	0.84
Chinese Taipei	0.93	64	0.89	0.71	0.73	0.83	0.91	0.85	0.73	0.64	0.88
Egypt	0.81	45	0.69	0.25	0.35	0.73	0.82	0.80	0.71	0.70	0.77
England	0.93	65	0.89	0.77	0.78	0.80	0.92	0.90	0.71	0.57	0.87
Georgia	-	-	-	-	-	-	-	-	-	-	-
Hong Kong SAR	0.92	64	0.87	0.61	0.64	0.85	0.91	0.87	0.78	0.72	0.88
Hungary	-	-	-	-	-	-	-	-	-	-	-
Iran, Islamic Rep. of	0.89	54	0.83	0.59	0.59	0.74	0.87	0.80	0.67	0.63	0.85
Ireland	0.93	64	0.90	0.69	0.74	0.81	0.92	0.90	0.72	0.61	0.87
Israel	0.92	62	0.88	0.62	0.67	0.84	0.91	0.82	0.73	0.65	0.88
Italy	0.92	60	0.87	0.78	0.76	0.78	0.90	0.83	0.57	0.54	0.85
Japan	0.92	62	0.89	0.66	0.72	0.82	0.90	0.87	0.65	0.63	0.88
Jordan	0.86	54	0.78	0.33	0.42	0.81	0.88	0.86	0.74	0.71	0.85
Kazakhstan	-	-	-	-	-	-	-	-	-	-	-
Korea, Rep. of	0.93	65	0.89	0.71	0.76	0.82	0.91	0.83	0.72	0.66	0.89
Kuwait	0.89	56	0.83	0.49	0.62	0.79	0.89	0.85	0.66	0.62	0.86
Lebanon	-	-	-	-	-	-	-	-	-	-	-
Lithuania	-	-	-	-	-	-	-	-	-	-	-
Malaysia	0.90	56	0.83	0.55	0.61	0.80	0.87	0.74	0.77	0.69	0.82
Malta	-	-	-	-	-	-	-	-	-	-	-
Morocco	-	-	-	-	-	-	-	-	-	-	-
New Zealand	0.92	62	0.88	0.71	0.70	0.77	0.91	0.89	0.73	0.59	0.87
Norway (9)	0.92	63	0.88	0.76	0.79	0.81	0.91	0.88	0.66	0.50	0.84
Oman	0.84	49	0.75	0.31	0.46	0.76	0.85	0.78	0.74	0.68	0.81
Qatar	0.90	59	0.85	0.41	0.44	0.85	0.91	0.88	0.79	0.71	0.87
Russian Federation	-	-	-	-	-	-	-	-	-	-	-
Saudi Arabia	0.89	58	0.84	0.32	0.44	0.84	0.91	0.89	0.73	0.75	0.88
Singapore	0.92	63	0.87	0.78	0.78	0.77	0.91	0.87	0.70	0.54	0.87
Slovenia	-	-	-	-	-	-	-	-	-	-	-
South Africa (9)	0.87	51	0.79	0.49	0.58	0.67	0.86	0.80	0.64	0.68	0.81
Sweden	-	-	-	-	-	-	-	-	-	-	-
Thailand	0.86	50	0.75	0.45	0.52	0.71	0.83	0.76	0.72	0.68	0.83
Turkey	0.88	52	0.81	0.54	0.66	0.63	0.86	0.80	0.68	0.62	0.85
United Arab Emirates	0.91	60	0.84	0.55	0.63	0.82	0.89	0.86	0.76	0.65	0.86
United States	0.92	63	0.88	0.62	0.69	0.80	0.91	0.89	0.73	0.66	0.87
Benchmarking Participants											
Buenos Aires, Argentina	0.88	52	0.82	0.44	0.50	0.80	0.89	0.82	0.67	0.61	0.82
Ontario, Canada	0.92	63	0.88	0.67	0.75	0.79	0.91	0.89	0.70	0.61	0.88
Quebec, Canada	0.91	60	0.87	0.60	0.78	0.79	0.91	0.87	0.62	0.57	0.85
Norway (8)	0.93	63	0.88	0.75	0.80	0.83	0.92	0.89	0.67	0.48	0.85
Abu Dhabi, UAE	0.91	59	0.83	0.47	0.55	0.83	0.90	0.87	0.77	0.68	0.86
Dubai, UAE	0.92	61	0.86	0.67	0.74	0.79	0.89	0.85	0.72	0.56	0.87
Florida, US	0.92	61	0.88	0.56	0.64	0.82	0.91	0.88	0.76	0.65	0.86

*Reverse coded

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students Like Learning Science Scale, Eighth Grade, and TIMSS 2015 Science Achievement

Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.34	0.12	0.10
Bahrain	0.28	0.08	0.07
Botswana (9)	0.41	0.17	0.15
Canada	0.23	0.05	0.05
Chile	0.16	0.03	0.03
Chinese Taipei	0.38	0.14	0.12
Egypt	0.37	0.14	0.13
England	0.31	0.10	0.09
Georgia	-	-	-
Hong Kong SAR	0.32	0.10	0.09
Hungary	-	-	-
Iran, Islamic Rep. of	0.18	0.03	0.04
Ireland	0.39	0.15	0.13
Israel	0.20	0.04	0.03
Italy	0.19	0.03	0.03
Japan	0.30	0.09	0.08
Jordan	0.26	0.07	0.06
Kazakhstan	-	-	-
Korea, Rep. of	0.40	0.16	0.15
Kuwait	0.23	0.06	0.04
Lebanon	-	-	-
Lithuania	-	-	-
Malaysia	0.35	0.12	0.11
Malta	-	-	-
Morocco	-	-	-
New Zealand	0.27	0.07	0.06
Norway (9)	0.28	0.08	0.07
Oman	0.27	0.07	0.06
Qatar	0.36	0.13	0.12
Russian Federation	-	-	-
Saudi Arabia	0.27	0.07	0.07
Singapore	0.27	0.07	0.07
Slovenia	-	-	-
South Africa (9)	0.19	0.04	0.03
Sweden	-	-	-
Thailand	0.22	0.05	0.04
Turkey	0.22	0.05	0.05
United Arab Emirates	0.30	0.09	0.09
United States	0.26	0.07	0.06
International Median	0.27	0.07	0.07
Benchmarking Participants			
Buenos Aires, Argentina	0.10	0.01	0.01
Ontario, Canada	0.23	0.06	0.05
Quebec, Canada	0.25	0.06	0.05
Norway (8)	0.21	0.04	0.03
Abu Dhabi, UAE	0.29	0.08	0.08
Dubai, UAE	0.28	0.08	0.08
Florida, US	0.23	0.05	0.05

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

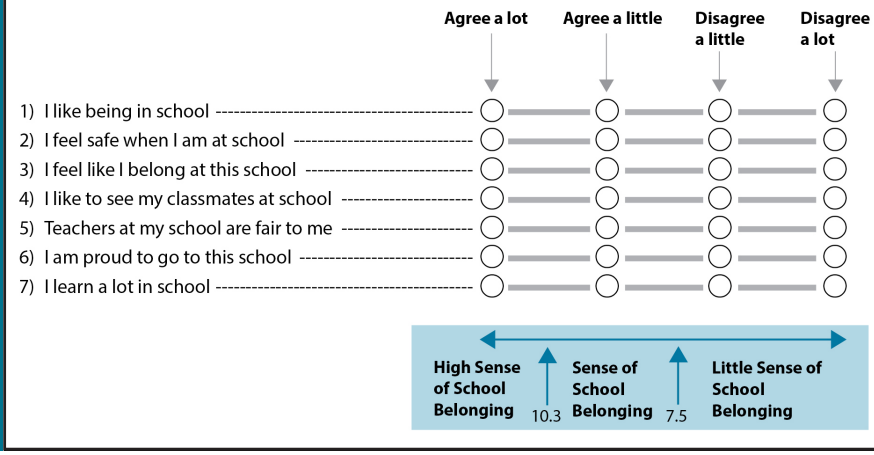
A dash (–) indicates comparable data not available.

Students' Sense of School Belonging Scale, Eighth Grade

The Students' Sense of School Belonging (SSB) scale was created based on students' degree of agreement with the seven statements described below.

Items in the TIMSS 2015 Students' Sense of School Belonging, Eighth Grade

What do you think about your school? Tell how much you agree with these statements.



Item Parameters for the TIMSS 2015 Students' Sense of School Belonging Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBG15A	0.38218	-0.95870	-0.74432	1.70302	1.01
BSBG15B	0.07288	-0.94599	-0.58632	1.53231	0.99
BSBG15C	0.21160	-0.83609	-0.55012	1.38621	0.94
BSBG15D	-0.73119	-0.52286	-0.46686	0.98972	1.17
BSBG15E	0.20067	-0.98123	-0.56256	1.54379	1.12
BSBG15F	0.26647	-0.76246	-0.50391	1.26637	0.91
BSBG15G	-0.40261	-0.89880	-0.61886	1.51766	0.98

Scale Transformation Constants for the TIMSS 2015 Students' Sense of School Belonging Scale, Eighth Grade

Scale Transformation Constants	
A = 7.847376	Transformed Scale Score = 7.847376 + 1.363355 • Logit Scale Score
B = 1.363355	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students' Sense of School Belonging Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.04846	
1	4.43161	
2	5.08351	
3	5.53680	
4	5.89159	
5	6.19976	
6	6.47840	
7	6.73927	
8	6.99036	
9	7.23785	
10	7.48892	7.5
11	7.74446	
12	8.01437	
13	8.30564	
14	8.62531	
15	8.98361	
16	9.39043	
17	9.85678	
18	10.39858	10.3
19	11.05536	
20	11.94384	
21	13.62245	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students' Sense of School Belonging Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Factor Loadings for Each Item						
			BSBG15A	BSBG15B	BSBG15C	BSBG15D	BSBG15E	BSBG15F	BSBG15G
Australia	0.86	55	0.75	0.75	0.81	0.55	0.70	0.84	0.75
Bahrain	0.83	50	0.73	0.73	0.77	0.51	0.65	0.80	0.70
Botswana (9)	0.68	36	0.66	0.65	0.64	0.53	0.42	0.66	0.59
Canada	0.83	49	0.70	0.72	0.76	0.59	0.64	0.81	0.70
Chile	0.85	53	0.71	0.77	0.77	0.60	0.66	0.82	0.72
Chinese Taipei	0.82	49	0.71	0.72	0.77	0.62	0.59	0.75	0.69
Egypt	0.81	47	0.69	0.71	0.77	0.47	0.63	0.76	0.71
England	0.84	51	0.74	0.72	0.80	0.48	0.67	0.82	0.72
Georgia	0.76	41	0.54	0.66	0.66	0.53	0.65	0.76	0.67
Hong Kong SAR	0.87	57	0.77	0.80	0.84	0.63	0.66	0.78	0.75
Hungary	0.80	46	0.73	0.69	0.78	0.50	0.62	0.79	0.58
Iran, Islamic Rep. of	0.72	40	0.69	0.73	0.70	0.52	0.65	0.40	0.67
Ireland	0.84	51	0.71	0.72	0.79	0.55	0.67	0.80	0.73
Israel	0.85	53	0.75	0.72	0.79	0.55	0.69	0.82	0.72
Italy	0.81	46	0.71	0.71	0.74	0.48	0.63	0.80	0.65
Japan	0.87	57	0.81	0.79	0.81	0.73	0.63	0.80	0.69
Jordan	0.82	48	0.70	0.70	0.79	0.54	0.59	0.79	0.71
Kazakhstan	0.80	46	0.67	0.62	0.72	0.61	0.69	0.76	0.67
Korea, Rep. of	0.86	54	0.77	0.76	0.76	0.71	0.62	0.78	0.73
Kuwait	0.80	45	0.69	0.71	0.75	0.47	0.61	0.79	0.64
Lebanon	0.78	44	0.64	0.72	0.75	0.55	0.55	0.72	0.66
Lithuania	0.79	45	0.71	0.73	0.68	0.56	0.63	0.75	0.60
Malaysia	0.80	45	0.72	0.69	0.61	0.55	0.65	0.78	0.69
Malta	0.84	51	0.74	0.74	0.79	0.51	0.64	0.82	0.74
Morocco	0.75	41	0.63	0.65	0.70	0.45	0.57	0.75	0.68
New Zealand	0.84	51	0.75	0.69	0.80	0.58	0.66	0.81	0.71
Norway (9)	0.84	52	0.74	0.75	0.81	0.60	0.66	0.75	0.70
Oman	0.80	45	0.66	0.69	0.74	0.53	0.64	0.76	0.67
Qatar	0.87	56	0.76	0.76	0.81	0.57	0.70	0.84	0.75
Russian Federation	0.81	48	0.72	0.71	0.74	0.58	0.63	0.77	0.65
Saudi Arabia	0.82	48	0.71	0.72	0.79	0.50	0.61	0.79	0.69
Singapore	0.86	54	0.77	0.75	0.83	0.62	0.63	0.82	0.71
Slovenia	0.84	52	0.70	0.75	0.76	0.51	0.69	0.83	0.74
South Africa (9)	0.72	38	0.63	0.63	0.72	0.50	0.45	0.73	0.61
Sweden	0.83	49	0.72	0.68	0.78	0.57	0.66	0.78	0.68
Thailand	0.76	42	0.62	0.65	0.65	0.47	0.68	0.72	0.69
Turkey	0.78	44	0.70	0.73	0.69	0.55	0.52	0.74	0.68
United Arab Emirates	0.88	58	0.72	0.78	0.78	0.72	0.70	0.82	0.81
United States	0.84	52	0.70	0.71	0.79	0.59	0.69	0.82	0.71
Benchmarking Participants									
Buenos Aires, Argentina	0.80	46	0.68	0.68	0.71	0.59	0.59	0.78	0.70
Ontario, Canada	0.84	51	0.71	0.72	0.77	0.60	0.64	0.82	0.70
Quebec, Canada	0.80	45	0.68	0.72	0.71	0.57	0.59	0.76	0.67
Norway (8)	0.84	52	0.71	0.74	0.81	0.63	0.64	0.78	0.70
Abu Dhabi, UAE	0.88	57	0.73	0.78	0.77	0.71	0.69	0.81	0.79
Dubai, UAE	0.86	55	0.69	0.75	0.76	0.68	0.67	0.82	0.79
Florida, US	0.85	52	0.72	0.72	0.78	0.59	0.67	0.84	0.73

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students' Sense of School Belonging Scale, Eighth Grade, and TIMSS 2015 Achievement

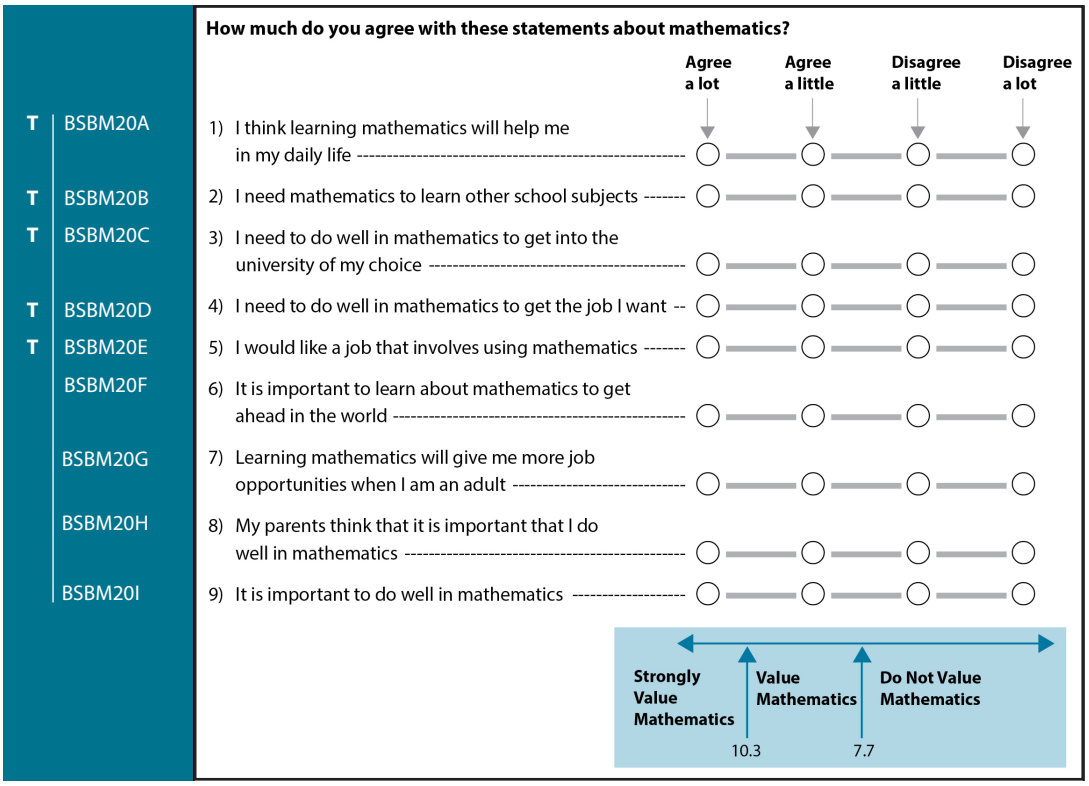
Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.29	0.29	0.08	0.09	0.07	0.07
Bahrain	0.15	0.15	0.02	0.02	0.02	0.02
Botswana (9)	0.16	0.19	0.02	0.04	0.02	0.03
Canada	0.16	0.16	0.03	0.03	0.03	0.02
Chile	0.12	0.11	0.01	0.01	0.01	0.01
Chinese Taipei	0.15	0.15	0.02	0.02	0.02	0.02
Egypt	0.07	0.07	0.00	0.01	0.00	0.01
England	0.27	0.27	0.08	0.07	0.06	0.06
Georgia	0.08	0.09	0.01	0.01	0.01	0.01
Hong Kong SAR	0.23	0.19	0.05	0.04	0.05	0.03
Hungary	0.17	0.15	0.03	0.02	0.02	0.01
Iran, Islamic Rep. of	0.02	0.02	0.00	0.00	0.00	0.00
Ireland	0.20	0.21	0.04	0.04	0.04	0.04
Israel	0.03	0.06	0.00	0.00	0.01	0.01
Italy	0.09	0.06	0.01	0.00	0.01	0.00
Japan	0.12	0.10	0.02	0.01	0.01	0.01
Jordan	0.01	0.04	0.00	0.00	0.00	0.00
Kazakhstan	0.07	0.05	0.01	0.00	0.00	0.00
Korea, Rep. of	0.13	0.11	0.02	0.01	0.02	0.01
Kuwait	0.10	0.06	0.01	0.00	0.01	0.01
Lebanon	0.02	0.06	0.00	0.00	0.00	0.01
Lithuania	0.02	0.02	0.00	0.00	0.00	0.00
Malaysia	0.03	0.15	0.00	0.02	0.01	0.04
Malta	0.26	0.24	0.07	0.06	0.07	0.05
Morocco	-0.01	0.02	0.00	0.00	0.00	0.00
New Zealand	0.20	0.18	0.04	0.03	0.03	0.03
Norway (9)	0.16	0.16	0.03	0.02	0.03	0.03
Oman	0.10	0.11	0.01	0.01	0.01	0.01
Qatar	0.20	0.22	0.04	0.05	0.04	0.05
Russian Federation	0.07	0.03	0.01	0.00	0.00	0.00
Saudi Arabia	0.04	0.08	0.00	0.01	0.01	0.01
Singapore	0.19	0.18	0.04	0.03	0.03	0.03
Slovenia	0.12	0.14	0.02	0.02	0.01	0.02
South Africa (9)	0.03	0.03	0.00	0.00	0.00	0.00
Sweden	0.18	0.17	0.03	0.03	0.03	0.03
Thailand	0.04	0.02	0.00	0.00	0.00	0.00
Turkey	-0.01	0.01	0.00	0.00	0.00	0.00
United Arab Emirates	0.29	0.30	0.09	0.09	0.08	0.08
United States	0.23	0.21	0.05	0.05	0.05	0.04
International Median	0.12	0.11	0.02	0.01	0.01	0.01
Benchmarking Participants						
Buenos Aires, Argentina	0.12	0.11	0.02	0.01	0.01	0.01
Ontario, Canada	0.17	0.16	0.03	0.03	0.03	0.03
Quebec, Canada	0.20	0.17	0.04	0.03	0.03	0.03
Norway (8)	0.17	0.15	0.03	0.02	0.03	0.03
Abu Dhabi, UAE	0.24	0.22	0.06	0.05	0.06	0.05
Dubai, UAE	0.28	0.29	0.08	0.09	0.08	0.08
Florida, US	0.17	0.17	0.03	0.03	0.03	0.03

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students Value Mathematics Scale, Eighth Grade

The Students Value Mathematics (SVM) scale was created based on students' degree of agreement with the nine statements described below.

Items in the TIMSS 2015 Students Value Mathematics Scale, Eighth Grade



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Students Value Mathematics Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBM20A	-0.09861	-0.83768	-0.54142	1.37910	1.06
BSBM20B	0.18629	-1.33201	-0.44135	1.77336	1.09
BSBM20C	-0.25501	-0.94177	-0.29071	1.23248	0.97
BSBM20D	-0.04767	-1.09264	-0.15715	1.24979	0.90
BSBM20E	1.50538	-1.33717	-0.05987	1.39704	1.32
BSBM20F	0.03583	-1.16694	-0.36329	1.53023	0.86
BSBM20G	-0.24374	-1.00834	-0.47571	1.48405	0.85
BSBM20H	-0.52892	-0.96883	-0.41750	1.38633	1.17
BSBM20I	-0.55355	-0.78232	-0.54990	1.33222	0.91

Scale Transformation Constants for the TIMSS 2015 Students Value Mathematics Scale, Eighth Grade

Scale Transformation Constants	
A = 7.964227	Transformed Scale Score = 7.964227 + 1.234642 • Logit Scale Score
B = 1.234642	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students Value Mathematics Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	2.99893	
1	4.33377	
2	4.96171	
3	5.38958	
4	5.72259	
5	6.00170	
6	6.24837	
7	6.47387	
8	6.68550	
9	6.88836	
10	7.08629	
11	7.28237	
12	7.48033	
13	7.67979	7.7
14	7.88500	
15	8.09804	
16	8.32084	
17	8.55527	
18	8.80299	
19	9.06690	
20	9.34984	
21	9.65639	
22	9.99387	
23	10.37453	10.3
24	10.81825	
25	11.37143	
26	12.14660	
27	13.65262	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students Value Mathematics Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item								
			BSBM20A	BSBM20B	BSBM20C	BSBM20D	BSBM20E	BSBM20F	BSBM20G	BSBM20H	BSBM20I
Australia	0.90	58	0.77	0.73	0.79	0.80	0.65	0.82	0.81	0.64	0.80
Bahrain	0.90	57	0.72	0.73	0.80	0.78	0.62	0.82	0.82	0.67	0.78
Botswana (9)	0.81	42	0.64	0.61	0.70	0.73	0.48	0.72	0.70	0.56	0.68
Canada	0.88	52	0.71	0.68	0.75	0.76	0.63	0.77	0.79	0.62	0.78
Chile	0.89	55	0.74	0.70	0.77	0.79	0.59	0.82	0.82	0.67	0.76
Chinese Taipei	0.90	56	0.68	0.67	0.78	0.82	0.70	0.80	0.84	0.61	0.79
Egypt	0.87	49	0.64	0.71	0.75	0.74	0.61	0.73	0.73	0.64	0.71
England	0.87	51	0.71	0.69	0.71	0.75	0.60	0.79	0.78	0.61	0.76
Georgia	0.88	54	0.72	0.68	0.73	0.77	0.57	0.80	0.78	0.69	0.81
Hong Kong SAR	0.91	57	0.69	0.73	0.77	0.83	0.68	0.82	0.85	0.62	0.79
Hungary	0.87	51	0.72	0.67	0.66	0.75	0.65	0.78	0.75	0.66	0.75
Iran, Islamic Rep. of	0.88	51	0.66	0.64	0.77	0.78	0.67	0.78	0.75	0.60	0.74
Ireland	0.87	51	0.68	0.66	0.74	0.77	0.63	0.79	0.77	0.59	0.75
Israel	0.88	54	0.70	0.69	0.75	0.77	0.58	0.83	0.81	0.64	0.79
Italy	0.86	47	0.71	0.63	0.68	0.74	0.65	0.79	0.78	0.56	0.61
Japan	0.86	47	0.63	0.66	0.72	0.76	0.57	0.81	0.78	0.58	0.66
Jordan	0.89	54	0.68	0.71	0.78	0.78	0.57	0.79	0.79	0.70	0.77
Kazakhstan	0.91	58	0.73	0.67	0.82	0.83	0.70	0.78	0.83	0.70	0.77
Korea, Rep. of	0.88	52	0.60	0.68	0.77	0.80	0.60	0.77	0.81	0.63	0.80
Kuwait	0.86	49	0.68	0.66	0.74	0.73	0.64	0.76	0.76	0.58	0.73
Lebanon	0.88	51	0.68	0.69	0.74	0.76	0.63	0.80	0.75	0.60	0.73
Lithuania	0.88	52	0.71	0.69	0.73	0.79	0.60	0.73	0.78	0.63	0.78
Malaysia	0.89	53	0.69	0.64	0.79	0.77	0.59	0.78	0.77	0.72	0.79
Malta	0.88	52	0.70	0.70	0.73	0.76	0.59	0.80	0.79	0.61	0.75
Morocco	0.85	47	0.64	0.67	0.74	0.75	0.60	0.71	0.72	0.60	0.72
New Zealand	0.89	56	0.74	0.72	0.77	0.78	0.59	0.81	0.81	0.68	0.79
Norway (9)	0.89	55	0.73	0.70	0.78	0.79	0.66	0.81	0.80	0.62	0.77
Oman	0.85	46	0.65	0.63	0.72	0.70	0.57	0.74	0.73	0.65	0.70
Qatar	0.91	60	0.73	0.75	0.81	0.80	0.64	0.84	0.83	0.73	0.81
Russian Federation	0.89	55	0.72	0.69	0.78	0.80	0.67	0.79	0.80	0.61	0.75
Saudi Arabia	0.89	55	0.72	0.74	0.78	0.77	0.61	0.81	0.80	0.64	0.75
Singapore	0.87	50	0.68	0.64	0.74	0.76	0.60	0.79	0.78	0.59	0.75
Slovenia	0.88	52	0.69	0.66	0.72	0.77	0.60	0.80	0.81	0.64	0.74
South Africa (9)	0.82	44	0.65	0.57	0.73	0.75	0.50	0.71	0.72	0.57	0.70
Sweden	0.88	51	0.64	0.65	0.80	0.80	0.64	0.75	0.77	0.64	0.72
Thailand	0.88	53	0.61	0.66	0.75	0.79	0.60	0.80	0.79	0.74	0.77
Turkey	0.87	50	0.63	0.68	0.74	0.77	0.65	0.81	0.77	0.55	0.73
United Arab Emirates	0.90	56	0.72	0.70	0.79	0.79	0.62	0.81	0.81	0.68	0.77
United States	0.89	54	0.72	0.70	0.73	0.77	0.60	0.83	0.82	0.65	0.78
Benchmarking Participants											
Buenos Aires, Argentina	0.86	48	0.72	0.66	0.66	0.73	0.56	0.78	0.78	0.58	0.71
Ontario, Canada	0.88	53	0.70	0.67	0.75	0.75	0.64	0.80	0.78	0.63	0.78
Quebec, Canada	0.86	50	0.67	0.64	0.74	0.77	0.61	0.71	0.80	0.64	0.75
Norway (8)	0.88	54	0.73	0.69	0.79	0.77	0.62	0.80	0.80	0.60	0.77
Abu Dhabi, UAE	0.90	57	0.73	0.72	0.80	0.80	0.62	0.81	0.82	0.70	0.78
Dubai, UAE	0.89	54	0.71	0.65	0.78	0.78	0.65	0.81	0.81	0.65	0.75
Florida, US	0.89	56	0.74	0.70	0.73	0.79	0.59	0.84	0.83	0.67	0.80

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students Value Mathematics Scale, Eighth Grade, and TIMSS 2015 Mathematics Achievement

Country	Pearson's Correlation with Mathematics Achievement		Variance in Mathematics Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.23	0.05	0.05
Bahrain	0.23	0.05	0.05
Botswana (9)	0.34	0.12	0.11
Canada	0.22	0.05	0.05
Chile	0.12	0.01	0.01
Chinese Taipei	0.36	0.13	0.12
Egypt	0.18	0.03	0.03
England	0.12	0.01	0.01
Georgia	0.11	0.01	0.02
Hong Kong SAR	0.24	0.06	0.06
Hungary	0.18	0.03	0.03
Iran, Islamic Rep. of	0.12	0.01	0.02
Ireland	0.15	0.02	0.02
Israel	0.16	0.02	0.03
Italy	0.19	0.04	0.03
Japan	0.24	0.06	0.04
Jordan	0.14	0.02	0.03
Kazakhstan	0.09	0.01	0.01
Korea, Rep. of	0.38	0.14	0.13
Kuwait	0.15	0.02	0.02
Lebanon	0.14	0.02	0.02
Lithuania	0.15	0.02	0.02
Malaysia	0.22	0.05	0.05
Malta	0.17	0.03	0.03
Morocco	0.19	0.03	0.03
New Zealand	0.16	0.02	0.02
Norway (9)	0.23	0.06	0.05
Oman	0.21	0.04	0.05
Qatar	0.27	0.07	0.07
Russian Federation	0.10	0.01	0.01
Saudi Arabia	0.12	0.02	0.02
Singapore	0.11	0.01	0.02
Slovenia	0.18	0.03	0.02
South Africa (9)	0.15	0.02	0.02
Sweden	0.20	0.04	0.04
Thailand	0.19	0.03	0.03
Turkey	0.14	0.02	0.02
United Arab Emirates	0.22	0.05	0.05
United States	0.17	0.03	0.02
International Median	0.18	0.03	0.03
Benchmarking Participants			
Buenos Aires, Argentina	0.02	0.00	0.00
Ontario, Canada	0.25	0.06	0.05
Quebec, Canada	0.24	0.06	0.05
Norway (8)	0.17	0.03	0.03
Abu Dhabi, UAE	0.19	0.04	0.05
Dubai, UAE	0.25	0.06	0.05
Florida, US	0.07	0.01	0.00

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

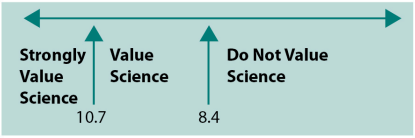
Students Value Science Scale, Eighth Grade

The Students Value Science (SVS) scale was created based on students' degree of agreement with the nine statements described below.

Items in the TIMSS 2015 Students Value Science Scale, Eighth Grade

How much do you agree with these statements about science?

		Agree a lot	Agree a little	Disagree a little	Disagree a lot
T	BSBS24A	1) I think learning science will help me in my daily life	○	○	○	○
T	BSBS24B	2) I need science to learn other school subjects	○	○	○	○
T	BSBS24C	3) I need to do well in science to get into the university of my choice	○	○	○	○
T	BSBS24D	4) I need to do well in science to get the job I want	○	○	○	○
T	BSBS24E	5) I would like a job that involves using science	○	○	○	○
	BSBS24F	6) It is important to learn about science to get ahead in the world	○	○	○	○
	BSBS24G	7) Learning science will give me more job opportunities when I am an adult	○	○	○	○
	BSBS24H	8) My parents think that it is important that I do well in science	○	○	○	○
	BSBS24I	9) It is important to do well in science	○	○	○	○



T Trend item—item was included in the same scale in TIMSS 2011 and was used for linking the TIMSS 2011 and TIMSS 2015 scales.

Item Parameters for the TIMSS 2015 Students Value Science Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBS24A	-0.49782	-1.43829	-0.52891	1.96720	1.12
BSBS24B	0.23455	-1.99011	-0.10911	2.09922	1.17
BSBS24C	-0.05110	-1.63211	-0.09250	1.72461	0.92
BSBS24D	0.24137	-1.62498	0.02997	1.59501	0.91
BSBS24E	0.99622	-1.64483	0.11575	1.52908	1.21
BSBS24F	-0.02119	-1.69905	-0.26791	1.96696	0.92
BSBS24G	-0.07333	-1.66588	-0.23263	1.89851	0.90
BSBS24H	-0.25840	-1.75651	-0.24059	1.99710	1.28
BSBS24I	-0.57030	-1.49224	-0.39374	1.88598	1.07

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Students Value Science Scale, Eighth Grade

Scale Transformation Constants	
A = 8.556049	Transformed Scale Score = 8.556049 + 0.9487 • Logit Scale Score
B = 0.9487	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students Value Science Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	4.14796	
1	5.24468	
2	5.78617	
3	6.16816	
4	6.47284	
5	6.73402	
6	6.97032	
7	7.18668	
8	7.39377	
9	7.59437	
10	7.79236	
11	7.98819	
12	8.18496	
13	8.38409	8.4
14	8.58656	
15	8.79310	
16	9.00422	
17	9.22038	
18	9.44187	
19	9.67007	
20	9.90677	
21	10.15530	
22	10.42118	
23	10.71378	10.7
24	11.04984	
25	11.45997	
26	12.03246	
27	13.15815	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students Value Science Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item								
			BSBS24A	BSBS24B	BSBS24C	BSBS24D	BSBS24E	BSBS24F	BSBS24G	BSBS24H	BSBS24I
Australia	0.94	67	0.82	0.79	0.86	0.85	0.79	0.85	0.86	0.72	0.83
Bahrain	0.93	63	0.77	0.78	0.83	0.83	0.76	0.83	0.83	0.72	0.79
Botswana (9)	0.86	48	0.65	0.65	0.76	0.75	0.64	0.72	0.74	0.60	0.70
Canada	0.92	63	0.79	0.76	0.84	0.83	0.76	0.82	0.83	0.70	0.78
Chile	0.93	65	0.79	0.76	0.86	0.86	0.80	0.85	0.87	0.71	0.72
Chinese Taipei	0.92	63	0.71	0.75	0.83	0.86	0.79	0.83	0.86	0.68	0.79
Egypt	0.89	53	0.64	0.71	0.78	0.77	0.71	0.76	0.76	0.70	0.73
England	0.92	63	0.79	0.75	0.82	0.83	0.75	0.85	0.84	0.70	0.81
Georgia	0.91	60	0.71	0.75	0.79	0.81	0.69	0.82	0.83	0.75	0.80
Hong Kong SAR	0.94	67	0.70	0.78	0.87	0.88	0.81	0.84	0.88	0.74	0.82
Hungary	0.91	57	0.73	0.74	0.78	0.82	0.75	0.79	0.79	0.73	0.65
Iran, Islamic Rep. of	0.91	59	0.72	0.72	0.82	0.82	0.78	0.82	0.81	0.68	0.75
Ireland	0.92	62	0.78	0.73	0.84	0.82	0.77	0.82	0.82	0.71	0.81
Israel	0.94	67	0.82	0.84	0.86	0.86	0.78	0.89	0.86	0.65	0.81
Italy	0.89	55	0.73	0.68	0.77	0.79	0.78	0.80	0.81	0.62	0.62
Japan	0.90	55	0.68	0.71	0.80	0.83	0.67	0.84	0.81	0.64	0.63
Jordan	0.92	60	0.71	0.76	0.83	0.83	0.70	0.83	0.81	0.74	0.77
Kazakhstan	0.94	66	0.75	0.79	0.86	0.86	0.78	0.84	0.86	0.82	0.77
Korea, Rep. of	0.92	61	0.73	0.77	0.84	0.83	0.67	0.78	0.84	0.71	0.84
Kuwait	0.89	54	0.69	0.67	0.79	0.78	0.71	0.79	0.79	0.64	0.71
Lebanon	0.91	58	0.67	0.72	0.80	0.81	0.76	0.80	0.81	0.73	0.74
Lithuania	0.91	59	0.71	0.74	0.81	0.82	0.71	0.76	0.82	0.73	0.80
Malaysia	0.90	56	0.71	0.68	0.81	0.80	0.66	0.78	0.79	0.75	0.77
Malta	0.94	67	0.78	0.77	0.84	0.84	0.77	0.84	0.86	0.79	0.84
Morocco	0.89	54	0.65	0.72	0.79	0.78	0.73	0.76	0.76	0.69	0.75
New Zealand	0.93	65	0.81	0.78	0.84	0.83	0.76	0.84	0.84	0.75	0.82
Norway (9)	0.92	60	0.78	0.75	0.83	0.82	0.77	0.80	0.81	0.62	0.77
Oman	0.88	52	0.67	0.68	0.76	0.77	0.69	0.76	0.78	0.69	0.68
Qatar	0.94	67	0.79	0.78	0.86	0.85	0.79	0.86	0.87	0.78	0.81
Russian Federation	0.91	59	0.71	0.73	0.82	0.83	0.74	0.79	0.81	0.70	0.78
Saudi Arabia	0.93	62	0.75	0.77	0.82	0.82	0.74	0.83	0.84	0.74	0.79
Singapore	0.90	57	0.72	0.65	0.82	0.82	0.71	0.80	0.84	0.66	0.77
Slovenia	0.93	64	0.73	0.72	0.83	0.85	0.77	0.84	0.86	0.75	0.82
South Africa (9)	0.92	60	0.73	0.71	0.84	0.84	0.78	0.78	0.81	0.69	0.76
Sweden	0.92	60	0.70	0.72	0.85	0.85	0.77	0.82	0.81	0.70	0.75
Thailand	0.91	59	0.70	0.74	0.80	0.81	0.69	0.82	0.81	0.76	0.78
Turkey	0.90	55	0.64	0.72	0.79	0.81	0.75	0.82	0.79	0.62	0.71
United Arab Emirates	0.93	64	0.79	0.74	0.85	0.84	0.77	0.84	0.84	0.74	0.79
United States	0.92	62	0.79	0.75	0.82	0.83	0.76	0.85	0.85	0.68	0.77
Benchmarking Participants											
Buenos Aires, Argentina	0.91	58	0.75	0.77	0.80	0.82	0.75	0.74	0.83	0.65	0.71
Ontario, Canada	0.93	64	0.79	0.76	0.85	0.84	0.78	0.84	0.84	0.71	0.78
Quebec, Canada	0.92	60	0.77	0.75	0.84	0.83	0.74	0.76	0.82	0.69	0.78
Norway (8)	0.92	62	0.79	0.76	0.85	0.84	0.75	0.82	0.81	0.65	0.77
Abu Dhabi, UAE	0.94	66	0.81	0.77	0.86	0.84	0.76	0.86	0.86	0.77	0.80
Dubai, UAE	0.92	62	0.77	0.71	0.84	0.84	0.79	0.82	0.85	0.70	0.78
Florida, US	0.92	63	0.79	0.76	0.83	0.82	0.75	0.85	0.85	0.70	0.79

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students Value Science Scale, Eighth Grade, and TIMSS 2015 Science Achievement

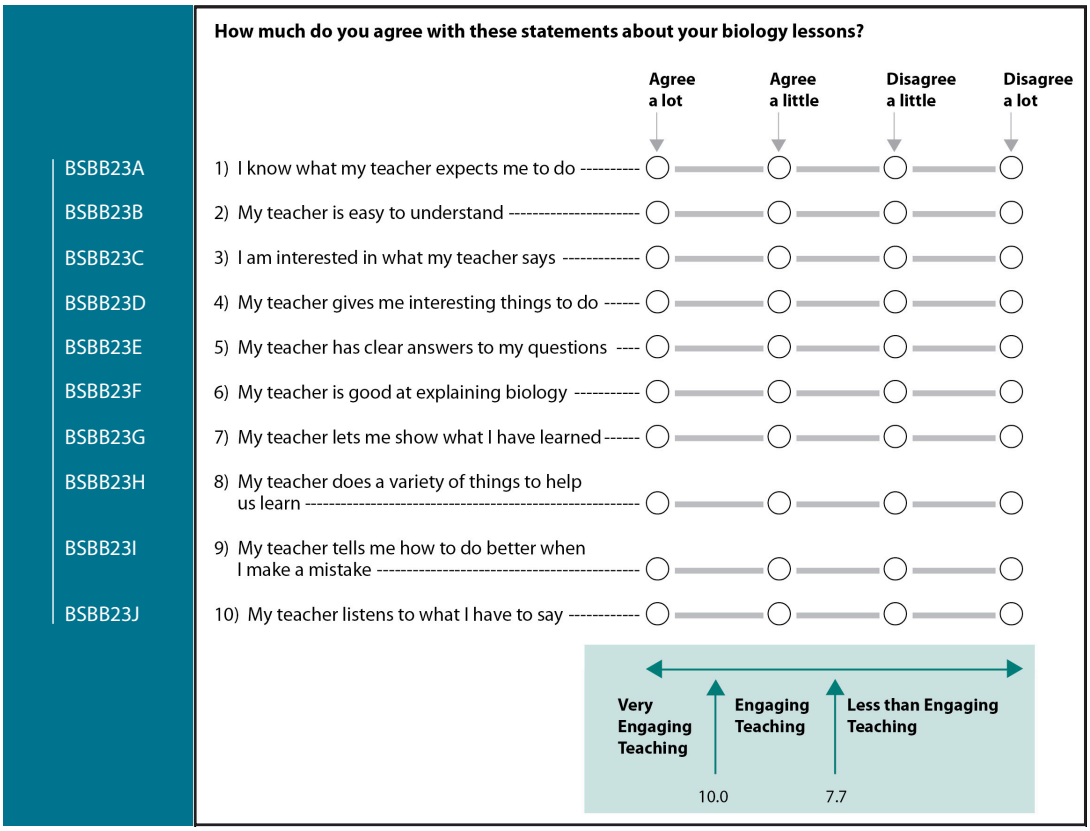
Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.32	0.10	0.09
Bahrain	0.20	0.04	0.03
Botswana (9)	0.43	0.18	0.16
Canada	0.24	0.06	0.05
Chile	0.03	0.00	0.00
Chinese Taipei	0.35	0.12	0.10
Egypt	0.21	0.05	0.04
England	0.24	0.06	0.06
Georgia	0.09	0.01	0.01
Hong Kong SAR	0.21	0.04	0.04
Hungary	0.07	0.01	0.01
Iran, Islamic Rep. of	0.11	0.01	0.01
Ireland	0.31	0.10	0.08
Israel	0.17	0.03	0.03
Italy	0.15	0.02	0.01
Japan	0.32	0.10	0.07
Jordan	0.16	0.02	0.03
Kazakhstan	0.10	0.01	0.01
Korea, Rep. of	0.38	0.15	0.13
Kuwait	0.14	0.02	0.01
Lebanon	0.22	0.05	0.05
Lithuania	0.06	0.00	0.00
Malaysia	0.20	0.04	0.08
Malta	0.43	0.18	0.15
Morocco	0.09	0.01	0.01
New Zealand	0.22	0.05	0.04
Norway (9)	0.18	0.03	0.03
Oman	0.18	0.03	0.03
Qatar	0.26	0.07	0.06
Russian Federation	0.01	0.00	0.00
Saudi Arabia	0.13	0.02	0.02
Singapore	0.25	0.06	0.07
Slovenia	0.24	0.06	0.06
South Africa (9)	0.02	0.00	0.01
Sweden	0.13	0.02	0.03
Thailand	0.21	0.04	0.04
Turkey	0.10	0.01	0.01
United Arab Emirates	0.24	0.06	0.06
United States	0.21	0.04	0.05
International Median	0.20	0.04	0.04
Benchmarking Participants			
Buenos Aires, Argentina	-0.01	0.00	0.00
Ontario, Canada	0.24	0.06	0.05
Quebec, Canada	0.24	0.06	0.06
Norway (8)	0.13	0.02	0.01
Abu Dhabi, UAE	0.23	0.05	0.06
Dubai, UAE	0.23	0.05	0.05
Florida, US	0.18	0.03	0.03

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students' Views on Engaging Teaching in Biology Lessons Scale, Eighth Grade

The Students' Views on Engaging Teaching in Biology Lessons (EBL) scale was created based on students' degree of agreement with the ten statements described below.

Items in the TIMSS 2015 Students' Views on Engaging Teaching in Biology Lessons Scale, Eighth Grade



Item Parameters for the TIMSS 2015 Students' Views on Engaging Teaching in Biology Lessons Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBB23A	0.23712	-1.80522	-0.57382	2.37904	1.35
BSBB23B	0.09871	-1.66400	-0.60548	2.26948	0.89
BSBB23C	-0.05390	-1.55671	-0.51000	2.06671	1.04
BSBB23D	0.50295	-1.83407	-0.36609	2.20016	1.04
BSBB23E	-0.13674	-1.46308	-0.64174	2.10482	0.78
BSBB23F	-0.40148	-1.23377	-0.73035	1.96412	0.79
BSBB23G	0.15844	-1.78687	-0.61699	2.40386	1.00
BSBB23H	-0.16665	-1.62319	-0.56659	2.18978	0.88
BSBB23I	-0.01693	-1.59071	-0.58844	2.17915	0.91
BSBB23J	-0.22152	-1.30447	-0.81869	2.12316	0.93

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Students' Views on Engaging Teaching in Biology Lessons Scale, Eighth Grade

Scale Transformation Constants	
A = 7.952108	Transformed Scale Score = 7.952108 + 0.927987 • Logit Scale Score
B = 0.927987	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students' Views on Engaging Teaching in Biology Lessons Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.68279	
1	4.72056	
2	5.21810	
3	5.55682	
4	5.82253	
5	6.04443	
6	6.23952	
7	6.41702	
8	6.58151	
9	6.74042	
10	6.89504	
11	7.04799	
12	7.20164	
13	7.35828	
14	7.52021	
15	7.69015	7.7
16	7.86991	
17	8.06292	
18	8.27115	
19	8.49677	
20	8.73848	
21	8.99364	
22	9.25822	
23	9.52944	
24	9.80777	
25	10.09786	10.0
26	10.40930	
27	10.75637	
28	11.17501	
29	11.74935	
30	12.86128	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students' Views on Engaging Teaching in Biology Lessons Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item									
			BSBBZ3A	BSBBZ3B	BSBBZ3C	BSBBZ3D	BSBBZ3E	BSBBZ3F	BSBBZ3G	BSBBZ3H	BSBBZ3I	BSBBZ3J
Georgia	0.92	61	0.61	0.81	0.64	0.72	0.84	0.83	0.83	0.83	0.81	0.81
Hungary	0.92	59	0.72	0.78	0.77	0.68	0.82	0.83	0.76	0.76	0.78	0.79
Kazakhstan	0.94	66	0.66	0.79	0.84	0.82	0.85	0.83	0.83	0.81	0.84	0.82
Lebanon	0.93	61	0.64	0.79	0.78	0.78	0.81	0.80	0.78	0.81	0.81	0.79
Lithuania	0.94	65	0.73	0.83	0.80	0.79	0.85	0.84	0.74	0.82	0.82	0.82
Malta	0.95	67	0.74	0.86	0.82	0.84	0.86	0.85	0.76	0.80	0.82	0.82
Morocco	0.90	53	0.52	0.64	0.70	0.73	0.79	0.78	0.79	0.79	0.75	0.75
Russian Federation	0.93	62	0.65	0.79	0.82	0.78	0.83	0.81	0.74	0.81	0.81	0.78
Slovenia	0.95	67	0.76	0.81	0.80	0.82	0.87	0.86	0.80	0.84	0.82	0.81
Sweden	0.94	65	0.66	0.85	0.77	0.79	0.87	0.86	0.78	0.84	0.79	0.80

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students' Views on Engaging Teaching in Biology Lessons Scale, Eighth Grade, and TIMSS 2015 Science Achievement

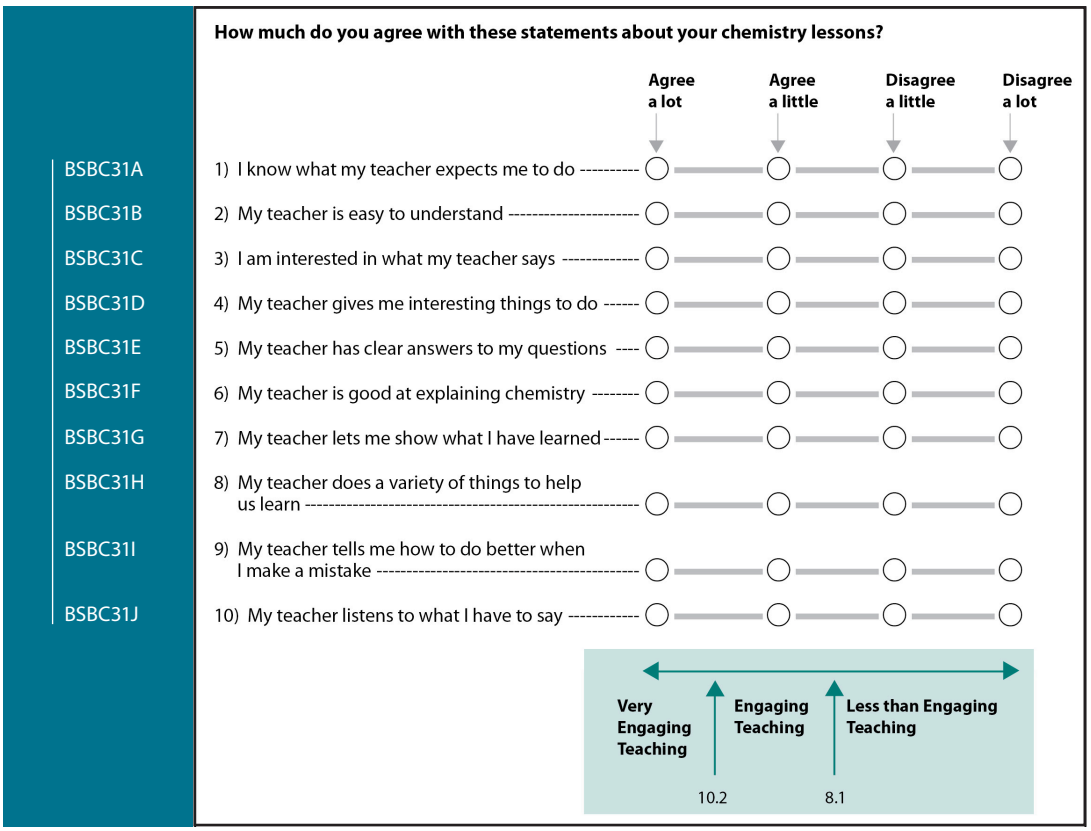
Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Georgia	0.17	0.03	0.02
Hungary	0.03	0.00	0.01
Kazakhstan	0.12	0.01	0.01
Lebanon	0.17	0.03	0.03
Lithuania	-0.06	0.00	0.00
Malta	0.21	0.04	0.05
Morocco	0.06	0.00	0.00
Russian Federation	0.03	0.00	0.00
Slovenia	0.04	0.00	0.00
Sweden	0.07	0.01	0.01
International Median	0.07	0.00	0.01

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students' Views on Engaging Teaching in Chemistry Lessons Scale, Eighth Grade

The Students' Views on Engaging Teaching in Chemistry Lessons (ECL) scale was created based on students' degree of agreement with the ten statements described below.

Items in the TIMSS 2015 Students' Views on Engaging Teaching in Chemistry Lessons Scale, Eighth Grade



Item Parameters for the TIMSS 2015 Students' Views on Engaging Teaching in Chemistry Lessons Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBC31A	0.07176	-1.72687	-0.68347	2.41034	1.45
BSBC31B	0.30353	-1.76760	-0.59269	2.36029	0.92
BSBC31C	0.02753	-1.65415	-0.55147	2.20562	1.06
BSBC31D	0.40206	-1.79741	-0.49080	2.28821	0.99
BSBC31E	-0.12482	-1.51666	-0.72854	2.24520	0.76
BSBC31F	-0.24239	-1.32402	-0.74195	2.06597	0.79
BSBC31G	0.09528	-1.85543	-0.68204	2.53747	0.99
BSBC31H	-0.14875	-1.57374	-0.70570	2.27944	0.91
BSBC31I	-0.13601	-1.57060	-0.74049	2.31109	0.90
BSBC31J	-0.24819	-1.29577	-0.93241	2.22818	0.98

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Scale Transformation Constants for the TIMSS 2015 Students' Views on Engaging Teaching in Chemistry Lessons Scale, Eighth Grade

Scale Transformation Constants	
A = 8.279016	Transformed Scale Score = 8.279016 + 0.837128 • Logit Scale Score
B = 0.837128	

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students' Views on Engaging Teaching in Chemistry Lessons Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	4.41027	
1	5.34346	
2	5.78855	
3	6.09314	
4	6.32976	
5	6.52799	
6	6.70220	
7	6.86069	
8	7.00882	
9	7.15041	
10	7.28758	
11	7.42475	
12	7.56282	
13	7.70401	
14	7.85062	
15	8.00558	8.1
16	8.17066	
17	8.35004	
18	8.54624	
19	8.76229	
20	8.99643	
21	9.24435	
22	9.49933	
23	9.75669	
24	10.01650	
25	10.28369	10.2
26	10.56787	
27	10.88289	
28	11.26098	
29	11.77870	
30	12.78091	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students' Views on Engaging Teaching in Chemistry Lessons Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item									
			BSBC31A	BSBC31B	BSBC31C	BSBC31D	BSBC31E	BSBC31F	BSBC31G	BSBC31H	BSBC31I	BSBC31J
Georgia	0.94	68	0.67	0.85	0.74	0.81	0.87	0.86	0.86	0.86	0.85	0.85
Hungary	0.95	67	0.75	0.83	0.80	0.82	0.86	0.86	0.81	0.81	0.84	0.79
Kazakhstan	0.95	70	0.69	0.81	0.86	0.85	0.88	0.86	0.87	0.83	0.87	0.85
Lebanon	0.94	64	0.67	0.82	0.81	0.81	0.83	0.82	0.82	0.81	0.82	0.80
Lithuania	0.95	70	0.76	0.86	0.84	0.83	0.89	0.87	0.79	0.85	0.84	0.83
Malta	0.95	70	0.74	0.87	0.82	0.85	0.88	0.87	0.81	0.83	0.86	0.80
Morocco	0.91	56	0.56	0.69	0.71	0.77	0.80	0.79	0.77	0.81	0.77	0.77
Russian Federation	0.95	69	0.72	0.83	0.85	0.84	0.88	0.87	0.82	0.84	0.85	0.82
Slovenia	0.95	69	0.78	0.81	0.81	0.83	0.88	0.86	0.83	0.86	0.83	0.83
Sweden	0.94	66	0.70	0.86	0.76	0.80	0.87	0.86	0.80	0.84	0.81	0.79

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students' Views on Engaging Teaching in Chemistry Lessons Scale, Eighth Grade, and TIMSS 2015 Science Achievement

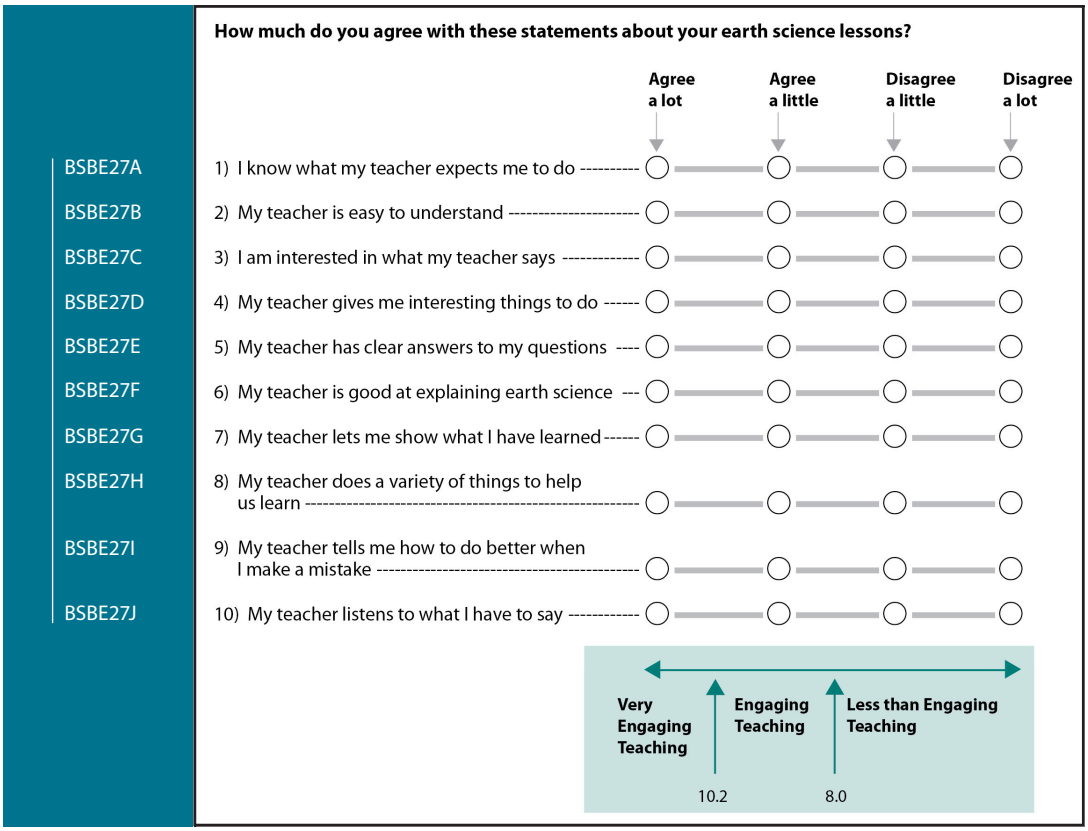
Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Georgia	0.17	0.03	0.03
Hungary	0.01	0.00	0.00
Kazakhstan	0.14	0.02	0.02
Lebanon	0.17	0.03	0.03
Lithuania	0.05	0.00	0.01
Malta	0.20	0.04	0.03
Morocco	0.08	0.01	0.00
Russian Federation	0.12	0.02	0.01
Slovenia	0.17	0.03	0.03
Sweden	0.09	0.01	0.01
International Median	0.13	0.02	0.02

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students' Views on Engaging Teaching in Earth Science Lessons Scale, Eighth Grade

The Students' Views on Engaging Teaching in Earth Science Lessons (EEL) scale was created based on students' degree of agreement with the ten statements described below.

Items in the TIMSS 2015 Students' Views on Engaging Teaching in Earth Science Lessons Scale, Eighth Grade



Item Parameters for the TIMSS 2015 Students' Views on Engaging Teaching in Earth Science Lessons Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBE27A	0.12956	-1.71093	-0.75256	2.46349	1.42
BSBE27B	0.04083	-1.71141	-0.72731	2.43872	0.93
BSBE27C	0.01333	-1.54955	-0.64003	2.18958	1.03
BSBE27D	0.54229	-1.90692	-0.45837	2.36529	1.01
BSBE27E	-0.17994	-1.42332	-0.85640	2.27972	0.78
BSBE27F	-0.40825	-1.23286	-0.88078	2.11364	0.81
BSBE27G	0.18214	-1.75319	-0.75123	2.50442	0.99
BSBE27H	-0.06175	-1.60758	-0.65571	2.26329	0.89
BSBE27I	-0.05005	-1.56783	-0.79721	2.36504	0.88
BSBE27J	-0.20816	-1.24758	-0.97820	2.22578	0.93

Scale Transformation Constants for the TIMSS 2015 Students' Views on Engaging Teaching in Earth Science Lessons Scale, Eighth Grade

Scale Transformation Constants	
A = 8.234304	Transformed Scale Score = 8.234304 + 0.852159 • Logit Scale Score
B = 0.852159	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students' Views on Engaging Teaching in Earth Science Lessons Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	4.33255	
1	5.27283	
2	5.71900	
3	6.02192	
4	6.25730	
5	6.45433	
6	6.62742	
7	6.78489	
8	6.93215	
9	7.07301	
10	7.20936	
11	7.34636	
12	7.48448	
13	7.62603	
14	7.77348	
15	7.93005	8.0
16	8.09752	
17	8.28072	
18	8.48271	
19	8.70699	
20	8.95182	
21	9.21199	
22	9.47927	
23	9.74797	
24	10.01797	
25	10.29453	10.2
26	10.58780	
27	10.91210	
28	11.30030	
29	11.83049	
30	12.85381	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students' Views on Engaging Teaching in Earth Science Lessons Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item									
			BSBEZ7A	BSBEZ7B	BSBEZ7C	BSBEZ7D	BSBEZ7E	BSBEZ7F	BSBEZ7G	BSBEZ7H	BSBEZ7I	BSBEZ7J
Georgia	0.93	63	0.64	0.82	0.71	0.76	0.85	0.82	0.83	0.81	0.83	0.82
Hungary	0.94	67	0.74	0.82	0.81	0.81	0.86	0.85	0.82	0.81	0.82	0.81
Kazakhstan	0.94	68	0.67	0.80	0.85	0.84	0.86	0.85	0.85	0.81	0.85	0.83
Lebanon	-	-	-	-	-	-	-	-	-	-	-	-
Lithuania	0.95	69	0.75	0.85	0.84	0.82	0.87	0.86	0.77	0.85	0.84	0.83
Malta	0.95	70	0.79	0.86	0.84	0.83	0.85	0.85	0.82	0.84	0.83	0.82
Morocco	0.91	54	0.56	0.66	0.70	0.75	0.80	0.78	0.76	0.80	0.76	0.76
Russian Federation	0.94	67	0.70	0.83	0.84	0.80	0.87	0.84	0.80	0.84	0.84	0.81
Slovenia	0.95	71	0.78	0.84	0.82	0.84	0.88	0.88	0.84	0.85	0.85	0.83
Sweden	-	-	-	-	-	-	-	-	-	-	-	-

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students' Views on Engaging Teaching in Earth Science Lessons Scale, Eighth Grade, and TIMSS 2015 Science Achievement

Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Georgia	0.14	0.02	0.02
Hungary	-0.01	0.00	0.00
Kazakhstan	0.10	0.01	0.01
Lebanon	-	-	-
Lithuania	0.08	0.01	0.01
Malta	0.11	0.01	0.01
Morocco	0.07	0.00	0.00
Russian Federation	0.03	0.00	0.00
Slovenia	0.06	0.00	0.00
Sweden	-	-	-
International Median	0.07	0.01	0.01

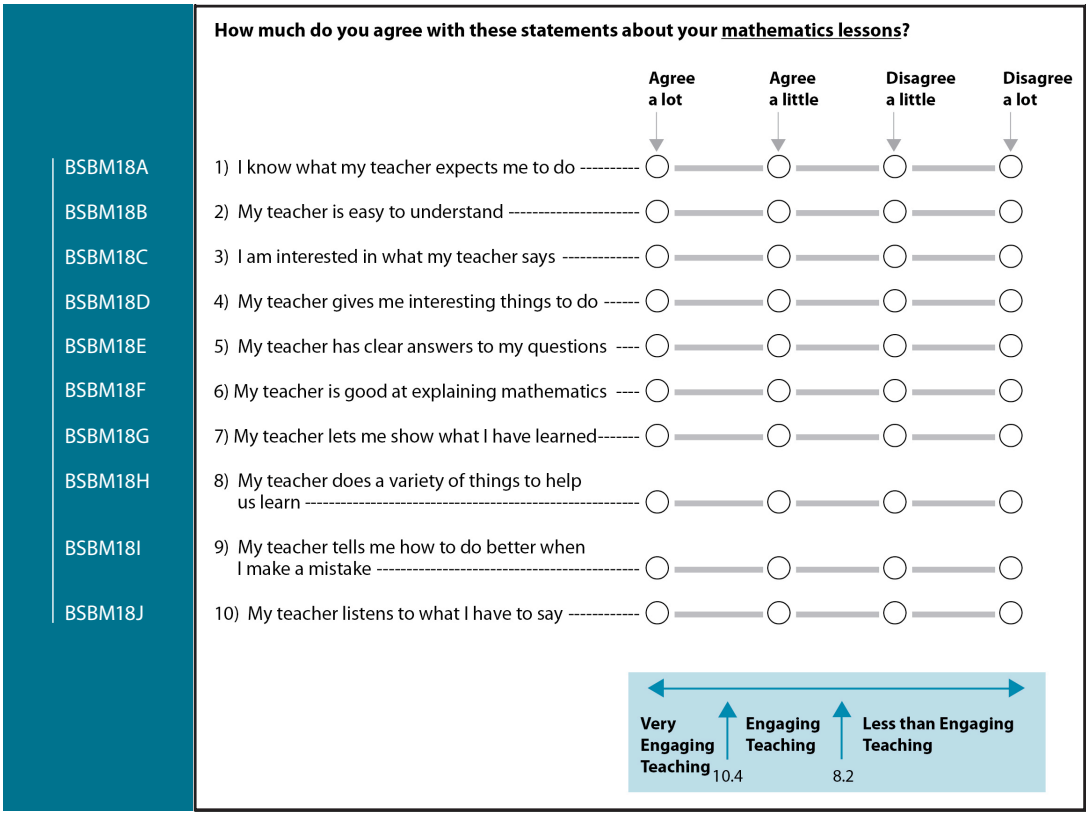
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students' Views on Engaging Teaching in Mathematics Lessons Scale, Eighth Grade

The Students' Views on Engaging Teaching in Mathematics Lessons (EML) scale was created based on students' degree of agreement with the ten statements described below.

Items in the TIMSS 2015 Students' Views on Engaging Teaching in Mathematics Lessons Scale, Eighth Grade



Item Parameters for the TIMSS 2015 Students' Views on Engaging Teaching in Mathematics Lessons Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBM18A	-0.20590	-1.33968	-0.59371	1.93339	1.39
BSBM18B	0.05569	-1.36981	-0.40937	1.77918	0.96
BSBM18C	0.09829	-1.52269	-0.25840	1.78109	1.06
BSBM18D	0.77545	-1.62386	-0.16029	1.78415	1.06
BSBM18E	-0.10037	-1.22616	-0.38485	1.61101	0.86
BSBM18F	-0.28381	-0.96873	-0.40509	1.37382	0.85
BSBM18G	0.25944	-1.42466	-0.37697	1.80163	1.05
BSBM18H	-0.15383	-1.17293	-0.38347	1.55640	0.94
BSBM18I	-0.30578	-1.07352	-0.46176	1.53528	0.93
BSBM18J	-0.13918	-1.03166	-0.50207	1.53373	0.99

Scale Transformation Constants for the TIMSS 2015 Students' Views on Engaging Teaching in Mathematics Lessons Scale, Eighth Grade

Scale Transformation Constants	
A = 8.296036	Transformed Scale Score = 8.296036 + 1.105518 • Logit Scale Score
B = 1.105518	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students' Views on Engaging Teaching in Mathematics Lessons Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.54710	
1	4.77380	
2	5.35650	
3	5.75348	
4	6.05996	
5	6.31688	
6	6.54073	
7	6.74318	
8	6.93105	
9	7.10903	
10	7.28056	
11	7.44836	
12	7.61467	
13	7.78151	
14	7.95117	
15	8.12401	8.2
16	8.30286	
17	8.48885	
18	8.68366	
19	8.88834	
20	9.10416	
21	9.33228	
22	9.57401	
23	9.83140	
24	10.10784	
25	10.40917	10.4
26	10.74435	
27	11.13328	
28	11.61366	
29	12.28584	
30	13.60366	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students' Views on Engaging Teaching in Mathematics Lessons Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item									
			BSBM18A	BSBM18B	BSBM18C	BSBM18D	BSBM18E	BSBM18F	BSBM18G	BSBM18H	BSBM18I	BSBM18J
Australia	0.94	64	0.68	0.84	0.80	0.79	0.85	0.86	0.75	0.81	0.82	0.80
Bahrain	0.92	59	0.64	0.79	0.71	0.77	0.82	0.82	0.74	0.80	0.80	0.78
Botswana (9)	0.86	44	0.52	0.68	0.67	0.67	0.72	0.72	0.65	0.65	0.67	0.67
Canada	0.93	61	0.66	0.83	0.76	0.76	0.83	0.85	0.75	0.79	0.78	0.78
Chile	0.94	64	0.68	0.81	0.76	0.79	0.85	0.84	0.78	0.82	0.82	0.82
Chinese Taipei	0.92	58	0.70	0.78	0.77	0.75	0.78	0.76	0.78	0.78	0.77	0.74
Egypt	0.88	48	0.49	0.62	0.70	0.73	0.76	0.74	0.68	0.72	0.71	0.71
England	0.93	61	0.67	0.82	0.77	0.78	0.83	0.85	0.73	0.79	0.78	0.78
Georgia	0.89	52	0.49	0.75	0.54	0.69	0.81	0.80	0.78	0.78	0.74	0.77
Hong Kong SAR	0.94	65	0.72	0.82	0.81	0.79	0.85	0.84	0.81	0.81	0.82	0.80
Hungary	0.91	55	0.63	0.76	0.70	0.74	0.79	0.81	0.74	0.77	0.77	0.72
Iran, Islamic Rep. of	0.90	52	0.54	0.72	0.74	0.70	0.77	0.78	0.75	0.73	0.74	0.72
Ireland	0.92	57	0.62	0.84	0.73	0.74	0.84	0.84	0.71	0.73	0.76	0.74
Israel	0.92	59	0.62	0.80	0.75	0.75	0.83	0.82	0.78	0.75	0.80	0.78
Italy	0.89	51	0.52	0.73	0.66	0.67	0.79	0.80	0.73	0.73	0.73	0.74
Japan	0.91	55	0.57	0.81	0.78	0.75	0.76	0.80	0.61	0.78	0.78	0.75
Jordan	0.89	50	0.51	0.69	0.66	0.71	0.79	0.77	0.69	0.77	0.75	0.71
Kazakhstan	0.92	59	0.57	0.76	0.79	0.78	0.81	0.79	0.80	0.78	0.80	0.79
Korea, Rep. of	0.92	58	0.61	0.77	0.78	0.77	0.78	0.80	0.65	0.81	0.82	0.81
Kuwait	0.89	49	0.52	0.71	0.67	0.72	0.79	0.77	0.68	0.73	0.69	0.71
Lebanon	0.91	55	0.56	0.76	0.74	0.72	0.80	0.77	0.75	0.77	0.78	0.76
Lithuania	0.91	56	0.60	0.80	0.73	0.72	0.81	0.80	0.67	0.78	0.76	0.77
Malaysia	0.91	55	0.62	0.78	0.78	0.73	0.77	0.79	0.70	0.77	0.75	0.72
Malta	0.93	61	0.69	0.81	0.77	0.78	0.82	0.84	0.74	0.78	0.79	0.77
Morocco	0.88	48	0.43	0.62	0.62	0.68	0.75	0.75	0.76	0.78	0.73	0.72
New Zealand	0.93	62	0.66	0.82	0.77	0.78	0.84	0.84	0.75	0.79	0.80	0.78
Norway (9)	0.92	59	0.60	0.82	0.72	0.75	0.81	0.83	0.76	0.77	0.79	0.78
Oman	0.86	45	0.44	0.66	0.69	0.61	0.74	0.73	0.68	0.71	0.71	0.69
Qatar	0.93	62	0.68	0.81	0.76	0.78	0.84	0.82	0.77	0.81	0.81	0.79
Russian Federation	0.91	56	0.57	0.75	0.77	0.74	0.81	0.80	0.73	0.80	0.77	0.75
Saudi Arabia	0.91	54	0.57	0.74	0.72	0.73	0.79	0.77	0.68	0.79	0.78	0.76
Singapore	0.92	59	0.68	0.81	0.79	0.77	0.81	0.82	0.74	0.74	0.78	0.75
Slovenia	0.91	56	0.65	0.73	0.65	0.72	0.81	0.82	0.75	0.78	0.78	0.77
South Africa (9)	0.86	44	0.49	0.70	0.67	0.69	0.68	0.73	0.68	0.64	0.68	0.68
Sweden	0.92	59	0.63	0.82	0.70	0.72	0.82	0.83	0.76	0.82	0.76	0.77
Thailand	0.90	52	0.51	0.76	0.71	0.76	0.75	0.76	0.73	0.76	0.73	0.72
Turkey	0.89	52	0.60	0.77	0.69	0.51	0.80	0.79	0.73	0.72	0.76	0.76
United Arab Emirates	0.92	59	0.62	0.80	0.74	0.76	0.82	0.81	0.77	0.76	0.78	0.77
United States	0.94	64	0.67	0.83	0.78	0.79	0.85	0.86	0.77	0.81	0.81	0.80
Benchmarking Participants												
Buenos Aires, Argentina	0.92	59	0.59	0.77	0.72	0.75	0.82	0.84	0.76	0.81	0.80	0.76
Ontario, Canada	0.93	61	0.67	0.82	0.78	0.77	0.83	0.84	0.75	0.80	0.78	0.79
Quebec, Canada	0.92	57	0.62	0.83	0.73	0.71	0.82	0.84	0.73	0.76	0.78	0.75
Norway (8)	0.91	57	0.58	0.80	0.71	0.74	0.80	0.83	0.74	0.77	0.77	0.77
Abu Dhabi, UAE	0.92	59	0.62	0.80	0.73	0.77	0.82	0.81	0.77	0.76	0.78	0.77
Dubai, UAE	0.92	59	0.63	0.80	0.76	0.78	0.82	0.82	0.75	0.75	0.78	0.77
Florida, US	0.93	62	0.65	0.83	0.78	0.77	0.84	0.84	0.75	0.79	0.81	0.78

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students' Views on Engaging Teaching in Mathematics Lessons Scale, Eighth Grade, and TIMSS 2015 Mathematics Achievement

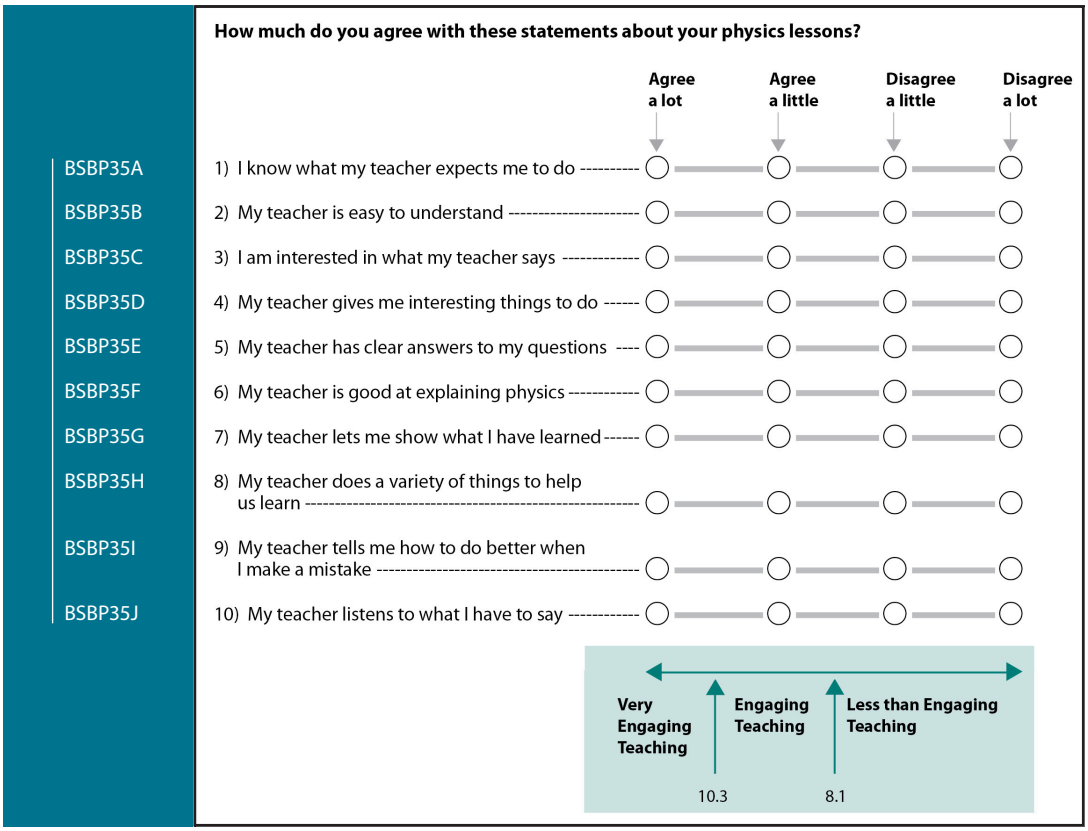
Country	Pearson's Correlation with Mathematics Achievement		Variance in Mathematics Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.16	0.03	0.03
Bahrain	0.13	0.02	0.02
Botswana (9)	0.18	0.03	0.04
Canada	0.10	0.01	0.01
Chile	0.12	0.01	0.01
Chinese Taipei	0.24	0.06	0.05
Egypt	0.13	0.02	0.02
England	0.14	0.02	0.02
Georgia	0.17	0.03	0.02
Hong Kong SAR	0.13	0.02	0.01
Hungary	0.10	0.01	0.01
Iran, Islamic Rep. of	0.07	0.01	0.01
Ireland	0.04	0.00	0.00
Israel	0.03	0.00	0.00
Italy	0.08	0.01	0.01
Japan	0.18	0.03	0.02
Jordan	0.09	0.01	0.01
Kazakhstan	0.16	0.03	0.02
Korea, Rep. of	0.23	0.05	0.03
Kuwait	0.05	0.00	0.00
Lebanon	0.11	0.01	0.01
Lithuania	0.12	0.01	0.01
Malaysia	0.12	0.01	0.01
Malta	0.12	0.01	0.01
Morocco	0.07	0.01	0.01
New Zealand	0.14	0.02	0.02
Norway (9)	0.19	0.04	0.03
Oman	0.16	0.03	0.03
Qatar	0.20	0.04	0.04
Russian Federation	0.13	0.02	0.01
Saudi Arabia	0.12	0.01	0.01
Singapore	0.13	0.02	0.02
Slovenia	0.20	0.04	0.03
South Africa (9)	0.04	0.00	0.00
Sweden	0.17	0.03	0.03
Thailand	0.01	0.00	0.00
Turkey	0.14	0.02	0.02
United Arab Emirates	0.19	0.04	0.03
United States	0.12	0.01	0.02
International Median	0.13	0.02	0.02
Benchmarking Participants			
Buenos Aires, Argentina	0.05	0.00	0.00
Ontario, Canada	0.11	0.01	0.02
Quebec, Canada	0.15	0.02	0.02
Norway (8)	0.14	0.02	0.02
Abu Dhabi, UAE	0.14	0.02	0.02
Dubai, UAE	0.16	0.03	0.02
Florida, US	0.08	0.01	0.01

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students' Views on Engaging Teaching in Physics Lessons Scale, Eighth Grade

The Students' Views on Engaging Teaching in Physics Lessons (EPL) scale was created based on students' degree of agreement with the ten statements described below.

Items in the TIMSS 2015 Students' Views on Engaging Teaching in Physics Lessons Scale, Eighth Grade



Item Parameters for the TIMSS 2015 Students' Views on Engaging Teaching in Physics Lessons Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBP35A	0.02582	-1.84518	-0.67504	2.52022	1.46
BSBP35B	0.22966	-1.85433	-0.64159	2.49592	0.96
BSBP35C	0.05918	-1.72396	-0.58921	2.31317	1.06
BSBP35D	0.44841	-1.95198	-0.48476	2.43674	1.03
BSBP35E	-0.08867	-1.60947	-0.74617	2.35564	0.81
BSBP35F	-0.23221	-1.42369	-0.73236	2.15605	0.85
BSBP35G	0.12388	-1.89124	-0.70918	2.60042	1.06
BSBP35H	-0.15481	-1.68435	-0.69214	2.37649	0.92
BSBP35I	-0.15098	-1.72057	-0.72485	2.44542	0.92
BSBP35J	-0.26028	-1.44319	-0.89555	2.33874	1.04

Scale Transformation Constants for the TIMSS 2015 Students' Views on Engaging Teaching in Physics Lessons Scale, Eighth Grade

Scale Transformation Constants	
A = 8.36096	Transformed Scale Score = 8.36096 + 0.800724 • Logit Scale Score
B = 0.800724	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students' Views on Engaging Teaching in Physics Lessons Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	4.57253	
1	5.47234	
2	5.90450	
3	6.20036	
4	6.43141	
5	6.62544	
6	6.79626	
7	6.95186	
8	7.09747	
9	7.23679	
10	7.37186	
11	7.50715	
12	7.64349	
13	7.78312	
14	7.92841	
15	8.08240	8.1
16	8.24702	
17	8.42679	
18	8.62451	
19	8.84363	
20	9.08172	
21	9.33294	
22	9.58877	
23	9.84380	
24	10.09848	
25	10.35833	10.3
26	10.63329	
27	10.93727	
28	11.30073	
29	11.79730	
30	12.75728	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students' Views on Engaging Teaching in Physics Lessons Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item									
			BSBP35A	BSBP35B	BSBP35C	BSBP35D	BSBP35E	BSBP35F	BSBP35G	BSBP35H	BSBP35I	BSBP35J
Georgia	0.95	69	0.68	0.84	0.76	0.82	0.87	0.87	0.86	0.87	0.88	0.85
Hungary	0.95	68	0.75	0.83	0.81	0.84	0.87	0.86	0.82	0.82	0.84	0.81
Kazakhstan	0.95	71	0.69	0.81	0.86	0.86	0.88	0.87	0.87	0.83	0.87	0.84
Lebanon	0.95	67	0.70	0.84	0.84	0.83	0.86	0.84	0.81	0.84	0.84	0.80
Lithuania	0.95	71	0.78	0.88	0.85	0.84	0.89	0.85	0.80	0.85	0.84	0.84
Malta	0.95	70	0.78	0.87	0.84	0.83	0.89	0.88	0.80	0.84	0.84	0.81
Morocco	0.92	58	0.56	0.70	0.73	0.78	0.82	0.81	0.80	0.82	0.78	0.78
Russian Federation	0.95	70	0.72	0.84	0.86	0.82	0.88	0.86	0.82	0.86	0.86	0.83
Slovenia	0.96	71	0.78	0.82	0.82	0.84	0.88	0.87	0.85	0.87	0.86	0.83
Sweden	0.94	66	0.72	0.86	0.75	0.79	0.87	0.86	0.79	0.85	0.80	0.81

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students' Views on Engaging Teaching in Physics Lessons Scale, Eighth Grade, and TIMSS 2015 Science Achievement

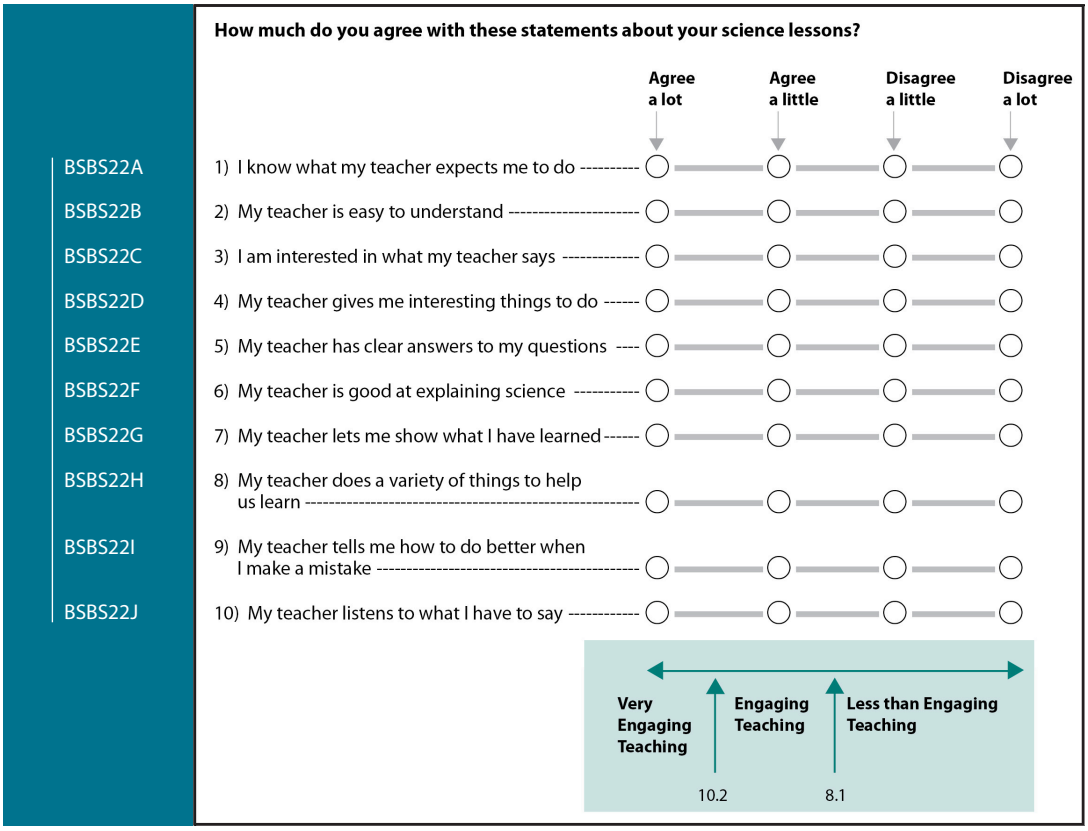
Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Georgia	0.13	0.02	0.02
Hungary	0.06	0.00	0.01
Kazakhstan	0.15	0.02	0.02
Lebanon	0.14	0.02	0.02
Lithuania	0.10	0.01	0.01
Malta	0.21	0.05	0.05
Morocco	0.08	0.01	0.01
Russian Federation	0.12	0.01	0.02
Slovenia	0.14	0.02	0.01
Sweden	0.09	0.01	0.01
International Median	0.12	0.02	0.01

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Students' Views on Engaging Teaching in Science Lessons Scale, Eighth Grade

The Students' Views on Engaging Teaching in Science Lessons (ESL) scale was created based on students' degree of agreement with the ten statements described below.

Items in the TIMSS 2015 Students' Views on Engaging Teaching in Science Lessons Scale, Eighth Grade



Item Parameters for the TIMSS 2015 Students' Views on Engaging Teaching in Science Lessons Scale, Eighth Grade

Item	delta	tau_1	tau_2	tau_3	Infit
BSBS22A	-0.04924	-1.64346	-0.54140	2.18486	1.40
BSBS22B	0.05145	-1.53889	-0.46940	2.00829	0.96
BSBS22C	-0.08308	-1.60569	-0.28773	1.89342	0.99
BSBS22D	0.38580	-1.67313	-0.26587	1.93900	1.04
BSBS22E	-0.12954	-1.48983	-0.40490	1.89473	0.86
BSBS22F	-0.32397	-1.28029	-0.44404	1.72433	0.85
BSBS22G	0.40041	-1.82277	-0.27075	2.09352	1.10
BSBS22H	-0.15706	-1.48381	-0.41006	1.89387	0.97
BSBS22I	-0.07063	-1.53419	-0.39286	1.92705	0.98
BSBS22J	-0.02414	-1.35914	-0.47354	1.83268	1.05

Scale Transformation Constants for the TIMSS 2015 Students' Views on Engaging Teaching in Science Lessons Scale, Eighth Grade

Scale Transformation Constants	
A = 8.256995	Transformed Scale Score = 8.256995 + 0.933751 • Logit Scale Score
B = 0.933751	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Students' Views on Engaging Teaching in Science Lessons Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	3.99370	
1	5.05193	
2	5.56338	
3	5.91581	
4	6.19102	
5	6.42207	
6	6.62528	
7	6.81001	
8	6.98219	
9	7.14596	
10	7.30443	
11	7.46008	
12	7.61501	
13	7.77116	
14	7.93069	
15	8.09420	8.1
16	8.26433	
17	8.44227	
18	8.62934	
19	8.82641	
20	9.03371	
21	9.25114	
22	9.47855	
23	9.71647	
24	9.96698	
25	10.23475	10.2
26	10.52856	
27	10.86204	
28	11.27059	
29	11.83812	
30	12.94849	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Students' Views on Engaging Teaching in Science Lessons Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item									
			BSBS22A	BSBS22B	BSBS22C	BSBS22D	BSBS22E	BSBS22F	BSBS22G	BSBS22H	BSBS22I	BSBS22J
Australia	0.95	69	0.74	0.86	0.83	0.84	0.88	0.84	0.79	0.85	0.84	0.84
Bahrain	0.94	64	0.67	0.81	0.78	0.82	0.85	0.83	0.76	0.81	0.83	0.80
Botswana (9)	0.89	51	0.57	0.74	0.70	0.73	0.77	0.76	0.70	0.69	0.72	0.71
Canada	0.95	68	0.72	0.86	0.83	0.82	0.87	0.87	0.81	0.84	0.83	0.81
Chile	0.95	68	0.72	0.80	0.82	0.83	0.87	0.85	0.82	0.84	0.85	0.84
Chinese Taipei	0.93	61	0.74	0.80	0.81	0.80	0.80	0.78	0.78	0.80	0.79	0.74
Egypt	0.89	51	0.50	0.66	0.74	0.75	0.77	0.77	0.66	0.77	0.74	0.71
England	0.94	66	0.77	0.83	0.81	0.84	0.86	0.86	0.76	0.81	0.80	0.82
Georgia	-	-	-	-	-	-	-	-	-	-	-	-
Hong Kong SAR	0.96	72	0.79	0.86	0.85	0.86	0.88	0.87	0.84	0.85	0.85	0.83
Hungary	-	-	-	-	-	-	-	-	-	-	-	-
Iran, Islamic Rep. of	0.92	59	0.63	0.79	0.80	0.72	0.81	0.79	0.78	0.77	0.78	0.77
Ireland	0.95	67	0.73	0.87	0.83	0.82	0.86	0.87	0.78	0.80	0.80	0.80
Israel	0.95	70	0.76	0.86	0.82	0.83	0.87	0.88	0.83	0.83	0.84	0.83
Italy	0.92	58	0.57	0.77	0.71	0.76	0.84	0.81	0.77	0.77	0.78	0.78
Japan	0.93	61	0.64	0.83	0.80	0.79	0.82	0.83	0.67	0.81	0.82	0.78
Jordan	0.92	58	0.57	0.73	0.75	0.78	0.82	0.82	0.74	0.83	0.78	0.76
Kazakhstan	-	-	-	-	-	-	-	-	-	-	-	-
Korea, Rep. of	0.94	65	0.72	0.82	0.83	0.83	0.83	0.83	0.70	0.83	0.84	0.84
Kuwait	0.90	54	0.59	0.73	0.73	0.74	0.81	0.79	0.71	0.78	0.74	0.72
Lebanon	-	-	-	-	-	-	-	-	-	-	-	-
Lithuania	-	-	-	-	-	-	-	-	-	-	-	-
Malaysia	0.93	62	0.70	0.80	0.83	0.80	0.82	0.83	0.76	0.79	0.81	0.76
Malta	-	-	-	-	-	-	-	-	-	-	-	-
Morocco	-	-	-	-	-	-	-	-	-	-	-	-
New Zealand	0.94	67	0.72	0.84	0.82	0.83	0.87	0.85	0.78	0.82	0.82	0.81
Norway (9)	0.94	66	0.67	0.86	0.79	0.82	0.85	0.86	0.79	0.82	0.82	0.80
Oman	0.89	51	0.51	0.74	0.73	0.73	0.78	0.76	0.72	0.76	0.72	0.70
Qatar	0.95	70	0.76	0.86	0.82	0.85	0.88	0.88	0.81	0.85	0.85	0.80
Russian Federation	-	-	-	-	-	-	-	-	-	-	-	-
Saudi Arabia	0.93	61	0.65	0.79	0.81	0.79	0.82	0.82	0.71	0.84	0.80	0.79
Singapore	0.93	63	0.73	0.82	0.81	0.81	0.83	0.83	0.75	0.78	0.79	0.77
Slovenia	-	-	-	-	-	-	-	-	-	-	-	-
South Africa (9)	0.89	51	0.60	0.74	0.72	0.74	0.72	0.75	0.73	0.68	0.74	0.70
Sweden	-	-	-	-	-	-	-	-	-	-	-	-
Thailand	0.92	59	0.55	0.81	0.76	0.81	0.80	0.82	0.77	0.80	0.76	0.75
Turkey	0.91	58	0.65	0.80	0.75	0.58	0.83	0.83	0.79	0.74	0.81	0.80
United Arab Emirates	0.95	67	0.71	0.84	0.80	0.82	0.86	0.85	0.82	0.81	0.83	0.81
United States	0.96	71	0.76	0.86	0.83	0.85	0.88	0.89	0.82	0.85	0.84	0.83
Benchmarking Participants												
Buenos Aires, Argentina	0.94	64	0.65	0.79	0.79	0.80	0.86	0.85	0.79	0.81	0.82	0.80
Ontario, Canada	0.95	70	0.73	0.86	0.83	0.83	0.87	0.88	0.81	0.85	0.84	0.83
Quebec, Canada	0.94	65	0.69	0.84	0.81	0.80	0.87	0.86	0.80	0.82	0.80	0.78
Norway (8)	0.94	63	0.65	0.84	0.76	0.80	0.84	0.85	0.79	0.81	0.81	0.80
Abu Dhabi, UAE	0.95	68	0.72	0.84	0.81	0.83	0.87	0.86	0.84	0.82	0.84	0.81
Dubai, UAE	0.94	64	0.70	0.83	0.78	0.81	0.84	0.85	0.78	0.80	0.81	0.80
Florida, US	0.96	72	0.76	0.86	0.85	0.86	0.89	0.89	0.83	0.87	0.86	0.84

A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Students' Views on Engaging Teaching in Science Lessons Scale, Eighth Grade, and TIMSS 2015 Science Achievement

Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.22	0.05	0.05
Bahrain	0.16	0.02	0.02
Botswana (9)	0.19	0.04	0.04
Canada	0.09	0.01	0.01
Chile	0.09	0.01	0.00
Chinese Taipei	0.21	0.04	0.03
Egypt	0.21	0.04	0.04
England	0.10	0.01	0.01
Georgia	-	-	-
Hong Kong SAR	0.16	0.03	0.02
Hungary	-	-	-
Iran, Islamic Rep. of	0.05	0.00	0.00
Ireland	0.19	0.04	0.03
Israel	0.12	0.01	0.01
Italy	0.03	0.00	0.00
Japan	0.21	0.04	0.04
Jordan	0.15	0.02	0.02
Kazakhstan	-	-	-
Korea, Rep. of	0.32	0.10	0.09
Kuwait	0.11	0.01	0.01
Lebanon	-	-	-
Lithuania	-	-	-
Malaysia	0.23	0.05	0.06
Malta	-	-	-
Morocco	-	-	-
New Zealand	0.15	0.02	0.02
Norway (9)	0.12	0.01	0.02
Oman	0.16	0.03	0.03
Qatar	0.20	0.04	0.04
Russian Federation	-	-	-
Saudi Arabia	0.16	0.03	0.02
Singapore	0.08	0.01	0.01
Slovenia	-	-	-
South Africa (9)	0.05	0.00	0.00
Sweden	-	-	-
Thailand	0.07	0.00	0.00
Turkey	0.17	0.03	0.03
United Arab Emirates	0.15	0.02	0.02
United States	0.11	0.01	0.01
International Median	0.15	0.02	0.02
Benchmarking Participants			
Buenos Aires, Argentina	0.03	0.00	0.00
Ontario, Canada	0.09	0.01	0.01
Quebec, Canada	0.11	0.01	0.01
Norway (8)	0.10	0.01	0.01
Abu Dhabi, UAE	0.13	0.02	0.02
Dubai, UAE	0.10	0.01	0.01
Florida, US	0.12	0.01	0.01

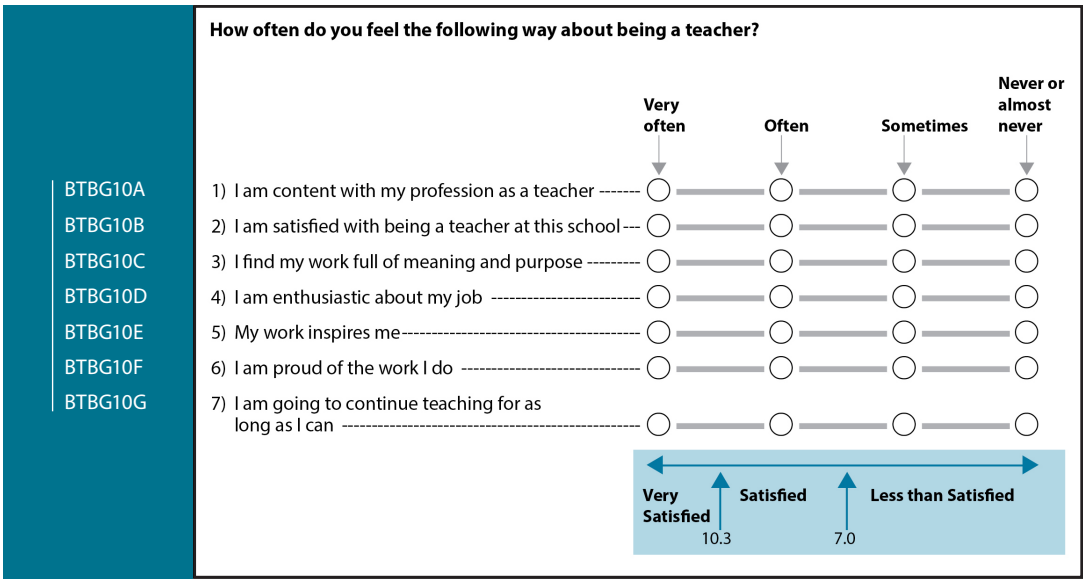
A dash (–) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Teacher Job Satisfaction Scale, Eighth Grade

The Teacher Job Satisfaction (TJS) scale was created based on how often teachers responded positively to the seven statements described below.

Items in the TIMSS 2015 Teacher Job Satisfaction Scale, Eighth Grade[1]



1 For the purpose of scaling, categories in which there were very few respondents were combined. The categories "Sometimes" and "Never or almost never" were combined for all variables. The scale statistics that are reported herein reflect analysis of the items following collapsing.

Item Parameters for the TIMSS 2015 Teacher Job Satisfaction Scale, Eighth Grade

Item	delta	tau_1	tau_2	Infit
BTBG10A	0.14816	-1.72080	1.72080	0.99
BTBG10B	0.39021	-1.65209	1.65209	1.34
BTBG10C	-0.51295	-1.72738	1.72738	1.06
BTBG10D	-0.27152	-1.81713	1.81713	0.85
BTBG10E	0.32148	-1.74038	1.74038	0.89
BTBG10F	-0.47731	-1.60579	1.60579	0.96
BTBG10G	0.40193	-1.26209	1.26209	1.27

Scale Transformation Constants for the TIMSS 2015 Teacher Job Satisfaction Scale, Eighth Grade

Scale Transformation Constants	
A = 8.635655	Transformed Scale Score = 8.635655 + 0.874431 • Logit Scale Score
B = 0.874431	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Teacher Job Satisfaction Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	4.73467	
1	5.83713	
2	6.44235	
3	6.91770	7.0
4	7.34908	
5	7.76911	
6	8.20415	
7	8.65502	
8	9.10176	
9	9.52415	
10	9.93219	
11	10.34781	10.3
12	10.80981	
13	11.40090	
14	12.49436	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Teacher Job Satisfaction Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item						
			BTBG10A	BTBG10B	BTBG10C	BTBG10D	BTBG10E	BTBG10F	BTBG10G
Australia	0.93	72	0.87	0.79	0.89	0.91	0.90	0.78	0.78
Bahrain	0.90	65	0.84	0.72	0.74	0.85	0.87	0.80	0.80
Botswana (9)	0.87	57	0.67	0.68	0.77	0.82	0.85	0.84	0.64
Canada	0.90	63	0.83	0.75	0.78	0.86	0.85	0.70	0.77
Chile	0.87	58	0.76	0.70	0.74	0.79	0.80	0.82	0.72
Chinese Taipei	0.93	72	0.85	0.77	0.87	0.90	0.83	0.88	0.81
Egypt	0.85	55	0.82	0.63	0.70	0.82	0.68	0.80	0.70
England	0.90	62	0.78	0.70	0.81	0.84	0.85	0.76	0.74
Georgia	0.87	56	0.76	0.69	0.67	0.72	0.78	0.85	0.76
Hong Kong SAR	0.93	69	0.83	0.81	0.82	0.85	0.85	0.88	0.79
Hungary	0.90	64	0.80	0.72	0.83	0.82	0.85	0.83	0.73
Iran, Islamic Rep. of	0.86	56	0.76	0.49	0.69	0.86	0.85	0.75	0.78
Ireland	0.91	67	0.84	0.74	0.87	0.87	0.85	0.79	0.75
Israel	0.92	68	0.84	0.74	0.83	0.87	0.85	0.84	0.79
Italy	0.89	62	0.80	0.74	0.67	0.85	0.82	0.84	0.75
Japan	0.91	65	0.83	0.75	0.84	0.81	0.88	0.79	0.72
Jordan	0.90	64	0.83	0.72	0.78	0.88	0.85	0.81	0.74
Kazakhstan	0.89	60	0.78	0.74	0.75	0.82	0.80	0.77	0.78
Korea, Rep. of	0.94	73	0.84	0.81	0.87	0.86	0.90	0.89	0.81
Kuwait	0.90	64	0.81	0.73	0.79	0.86	0.81	0.79	0.80
Lebanon	0.86	55	0.73	0.74	0.75	0.74	0.77	0.75	0.73
Lithuania	0.92	67	0.83	0.81	0.78	0.87	0.87	0.85	0.74
Malaysia	0.92	69	0.82	0.78	0.83	0.88	0.87	0.85	0.78
Malta	0.94	75	0.89	0.77	0.88	0.91	0.89	0.85	0.86
Morocco	0.88	58	0.77	0.69	0.74	0.84	0.83	0.80	0.65
New Zealand	0.91	67	0.81	0.75	0.84	0.87	0.86	0.81	0.76
Norway (9)	0.92	68	0.86	0.79	0.80	0.88	0.89	0.79	0.74
Oman	0.90	64	0.80	0.69	0.71	0.87	0.86	0.81	0.83
Qatar	0.88	58	0.80	0.73	0.74	0.82	0.84	0.74	0.67
Russian Federation	0.91	65	0.81	0.79	0.78	0.84	0.85	0.81	0.74
Saudi Arabia	0.85	56	0.80	0.51	0.70	0.87	0.80	0.78	0.72
Singapore	0.95	76	0.89	0.80	0.88	0.91	0.90	0.90	0.82
Slovenia	0.91	65	0.83	0.67	0.84	0.88	0.87	0.81	0.73
South Africa (9)	0.91	66	0.77	0.73	0.85	0.86	0.89	0.81	0.77
Sweden	0.89	61	0.83	0.74	0.69	0.84	0.84	0.75	0.74
Thailand	0.90	64	0.79	0.79	0.79	0.78	0.84	0.85	0.75
Turkey	0.88	59	0.79	0.54	0.74	0.88	0.84	0.78	0.75
United Arab Emirates	0.89	62	0.79	0.75	0.74	0.83	0.84	0.79	0.75
United States	0.92	69	0.84	0.78	0.87	0.88	0.88	0.76	0.79
Benchmarking Participants									
Buenos Aires, Argentina	0.86	55	0.79	0.50	0.82	0.80	0.86	0.77	0.57
Ontario, Canada	0.91	65	0.85	0.79	0.84	0.86	0.85	0.65	0.79
Quebec, Canada	0.89	61	0.83	0.66	0.70	0.86	0.86	0.79	0.75
Norway (8)	0.91	66	0.82	0.74	0.83	0.87	0.87	0.79	0.76
Abu Dhabi, UAE	0.89	62	0.81	0.77	0.69	0.82	0.84	0.82	0.75
Dubai, UAE	0.91	65	0.81	0.75	0.79	0.86	0.86	0.79	0.77
Florida, US	0.91	66	0.85	0.68	0.87	0.87	0.88	0.67	0.82

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Teacher Job Satisfaction Scale, Eighth Grade, and TIMSS 2015 Achievement

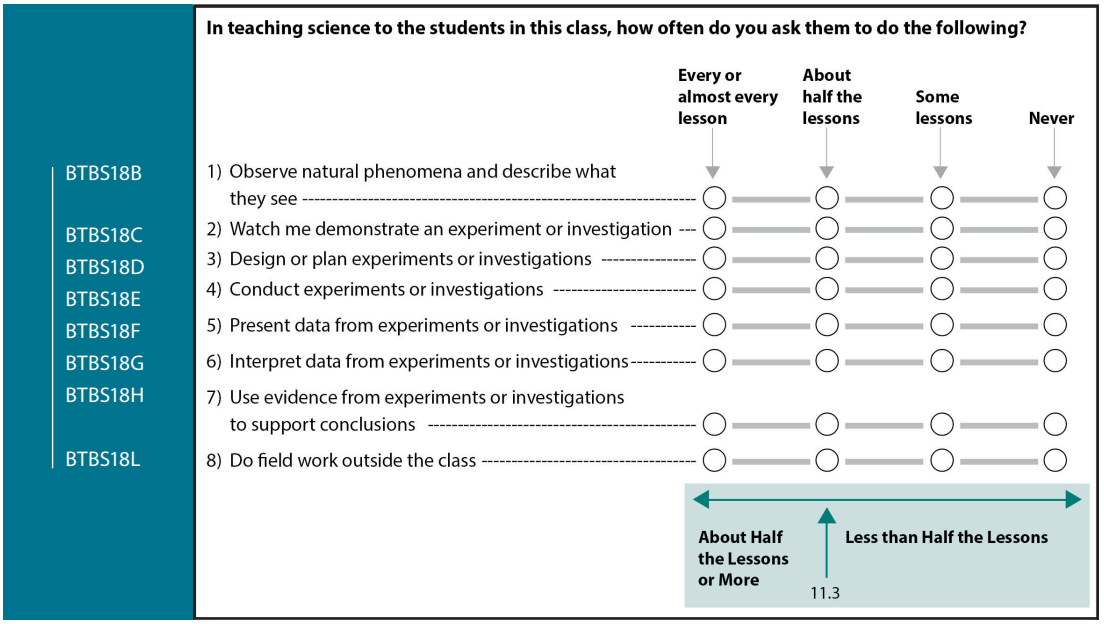
Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.10	0.08	0.01	0.01	0.01	0.01
Bahrain	0.07	0.06	0.00	0.00	0.00	0.00
Botswana (9)	0.03	0.02	0.00	0.00	0.00	0.00
Canada	-0.03	0.01	0.00	0.00	0.02	0.00
Chile	0.11	0.05	0.01	0.00	0.01	0.01
Chinese Taipei	0.08	0.08	0.01	0.01	0.01	0.00
Egypt	0.11	0.13	0.01	0.02	0.01	0.01
England	0.09	0.10	0.01	0.01	0.01	0.02
Georgia	0.04	0.05	0.00	0.00	0.01	0.00
Hong Kong SAR	0.18	0.19	0.03	0.04	0.03	0.04
Hungary	0.15	0.17	0.02	0.03	0.01	0.02
Iran, Islamic Rep. of	0.05	0.16	0.00	0.03	0.01	0.02
Ireland	0.15	0.11	0.02	0.01	0.02	0.01
Israel	0.06	-0.01	0.00	0.00	0.00	0.01
Italy	0.06	0.04	0.00	0.00	0.01	0.01
Japan	0.02	0.08	0.00	0.01	0.00	0.01
Jordan	0.06	0.17	0.00	0.03	0.01	0.02
Kazakhstan	0.06	-0.05	0.00	0.00	0.00	0.00
Korea, Rep. of	-0.01	0.01	0.00	0.00	0.00	0.00
Kuwait	0.06	0.10	0.00	0.01	0.00	0.02
Lebanon	0.09	0.07	0.01	0.01	0.02	0.01
Lithuania	0.04	0.01	0.00	0.00	0.01	0.00
Malaysia	0.02	-0.03	0.00	0.00	0.00	0.00
Malta	0.09	0.19	0.01	0.04	0.03	0.03
Morocco	0.08	0.07	0.01	0.00	0.01	0.00
New Zealand	0.02	0.05	0.00	0.00	0.01	0.00
Norway (9)	-0.03	-0.04	0.00	0.00	0.00	0.00
Oman	0.04	0.00	0.00	0.00	0.00	0.00
Qatar	-0.01	-0.08	0.00	0.01	0.01	0.01
Russian Federation	0.14	0.01	0.02	0.00	0.02	0.00
Saudi Arabia	0.05	0.17	0.00	0.03	0.00	0.03
Singapore	0.08	0.06	0.01	0.00	0.01	0.00
Slovenia	-0.01	0.00	0.00	0.00	0.00	0.00
South Africa (9)	0.09	0.16	0.01	0.02	0.01	0.02
Sweden	-0.02	0.04	0.00	0.00	0.00	0.00
Thailand	0.05	0.08	0.00	0.01	0.00	0.01
Turkey	0.13	0.17	0.02	0.03	0.01	0.02
United Arab Emirates	-0.01	0.12	0.00	0.01	0.00	0.01
United States	0.04	0.05	0.00	0.00	0.00	0.00
International Median	0.06	0.06	0.00	0.00	0.01	0.01
Benchmarking Participants						
Buenos Aires, Argentina	-0.14	-0.09	0.02	0.01	0.02	0.01
Ontario, Canada	0.03	-0.03	0.00	0.00	0.01	0.00
Quebec, Canada	-0.09	0.11	0.01	0.01	0.02	0.01
Norway (8)	0.01	0.03	0.00	0.00	0.00	0.01
Abu Dhabi, UAE	0.00	0.07	0.00	0.01	0.00	0.01
Dubai, UAE	-0.01	0.16	0.00	0.03	0.00	0.02
Florida, US	0.04	0.15	0.00	0.02	0.02	0.04

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Teachers Emphasize Science Investigation Scale, Eighth Grade

The Teachers Emphasize Science Investigation (ESI) scale was created based on teachers' responses to how often they used the eight instructional activities described below.

Items in the TIMSS 2015 Teachers Emphasize Science Investigation Scale, Eighth Grade[1]



1 For the purpose of scaling, categories in which there were very few respondents were combined. The categories "Some Lessons" and "Never" were combined for all variables. The scale statistics that are reported herein reflect analysis of the items following collapsing.

Item Parameters for the TIMSS 2015 Teachers Emphasize Science Investigation Scale, Eighth Grade

Item	delta	tau_1	tau_2	Infit
BTBS18B	-0.97437	-0.97800	0.97800	1.31
BTBS18C	-0.66109	-0.56569	0.56569	1.35
BTBS18D	0.26321	-0.86969	0.86969	0.88
BTBS18E	-0.08614	-1.06106	1.06106	0.91
BTBS18F	0.14856	-0.94708	0.94708	0.76
BTBS18G	-0.14686	-0.96567	0.96567	0.79
BTBS18H	-0.40814	-0.95404	0.95404	0.98
BTBS18L	1.86483	-0.38627	0.38627	1.30

Scale Transformation Constants for the TIMSS 2015 Teachers Emphasize Science Investigation Scale, Eighth Grade

Scale Transformation Constants	
A = 11.333349	Transformed Scale Score = 11.333349 + 1.121755 • Logit Scale Score
B = 1.121755	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Teachers Emphasize Science Investigation Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	6.89663	
1	8.25918	
2	8.96497	
3	9.47986	
4	9.90541	
5	10.28520	
6	10.63710	
7	10.97567	
8	11.31029	11.3
9	11.65165	
10	12.00438	
11	12.37727	
12	12.77796	
13	13.22328	
14	13.74474	
15	14.43167	
16	15.73375	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Teachers Emphasize Science Investigation Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item							
			BTBS18B	BTBS18C	BTBS18D	BTBS18E	BTBS18F	BTBS18G	BTBS18H	BTBS18L
Australia	0.85	49	0.60	0.60	0.76	0.73	0.83	0.84	0.77	0.36
Bahrain	0.89	58	0.59	0.56	0.83	0.86	0.88	0.87	0.83	0.55
Botswana (9)	0.87	54	0.56	0.55	0.78	0.84	0.89	0.88	0.83	0.40
Canada	0.83	48	0.55	0.45	0.74	0.83	0.86	0.84	0.81	0.16
Chile	0.87	53	0.76	0.71	0.75	0.78	0.83	0.77	0.72	0.48
Chinese Taipei	0.88	56	0.57	0.79	0.82	0.82	0.90	0.85	0.77	0.26
Egypt	0.85	51	0.51	0.54	0.80	0.82	0.87	0.82	0.73	0.49
England	0.81	44	0.39	0.45	0.67	0.79	0.87	0.85	0.79	0.13
Georgia	0.82	50	0.45	0.53	0.85	0.87	0.85	0.81	0.61	0.52
Hong Kong SAR	0.84	49	0.55	0.61	0.66	0.74	0.82	0.85	0.88	0.34
Hungary	0.83	48	0.64	0.63	0.73	0.79	0.79	0.75	0.68	0.53
Iran, Islamic Rep. of	0.85	51	0.56	0.48	0.69	0.80	0.86	0.86	0.78	0.59
Ireland	0.82	47	0.39	0.47	0.67	0.75	0.87	0.88	0.82	0.42
Israel	0.85	50	0.64	0.51	0.83	0.78	0.83	0.80	0.68	0.49
Italy	0.88	59	0.47	0.69	0.83	0.86	0.88	0.83	0.87	0.59
Japan	0.79	42	0.63	0.51	0.41	0.75	0.81	0.80	0.76	0.29
Jordan	0.85	50	0.50	0.57	0.77	0.82	0.87	0.83	0.69	0.48
Kazakhstan	0.88	55	0.62	0.66	0.79	0.86	0.81	0.79	0.66	0.67
Korea, Rep. of	0.87	55	0.69	0.69	0.84	0.84	0.87	0.83	0.51	0.58
Kuwait	0.86	52	0.61	0.48	0.83	0.79	0.87	0.86	0.78	0.42
Lebanon	0.82	46	0.56	0.65	0.74	0.82	0.79	0.70	0.57	0.50
Lithuania	0.87	57	0.59	0.63	0.83	0.88	0.88	0.85	0.72	0.55
Malaysia	0.86	53	0.45	0.55	0.72	0.77	0.85	0.87	0.89	0.60
Malta	0.81	49	0.38	0.54	0.71	0.83	0.88	0.89	0.72	0.44
Morocco	0.81	44	0.47	0.42	0.74	0.74	0.84	0.81	0.69	0.36
New Zealand	0.81	45	0.52	0.27	0.64	0.74	0.85	0.84	0.83	0.46
Norway (9)	0.86	51	0.74	0.69	0.74	0.73	0.80	0.78	0.68	0.51
Oman	0.83	47	0.59	0.61	0.71	0.80	0.80	0.79	0.65	0.41
Qatar	0.87	54	0.58	0.64	0.77	0.81	0.83	0.84	0.77	0.56
Russian Federation	0.86	53	0.55	0.61	0.78	0.87	0.86	0.85	0.79	0.39
Saudi Arabia	0.87	53	0.63	0.60	0.80	0.83	0.85	0.81	0.82	0.32
Singapore	0.82	48	0.48	0.66	0.71	0.76	0.83	0.80	0.70	0.48
Slovenia	0.87	56	0.48	0.62	0.81	0.88	0.91	0.89	0.73	0.56
South Africa (9)	0.91	63	0.64	0.75	0.85	0.88	0.86	0.88	0.84	0.58
Sweden	0.84	49	0.46	0.40	0.71	0.85	0.89	0.89	0.85	0.12
Thailand	0.90	59	0.51	0.57	0.84	0.88	0.90	0.89	0.86	0.54
Turkey	0.85	50	0.47	0.54	0.71	0.87	0.83	0.82	0.81	0.48
United Arab Emirates	0.87	54	0.56	0.61	0.78	0.85	0.86	0.85	0.82	0.40
United States	0.89	57	0.64	0.63	0.82	0.83	0.87	0.85	0.79	0.54
Benchmarking Participants										
Buenos Aires, Argentina	0.88	56	0.57	0.75	0.87	0.87	0.81	0.83	0.72	0.50
Ontario, Canada	0.84	49	0.56	0.50	0.74	0.82	0.82	0.83	0.76	0.40
Quebec, Canada	0.82	50	0.52	0.49	0.72	0.83	0.89	0.82	0.89	-0.01
Norway (8)	0.82	46	0.55	0.46	0.79	0.74	0.76	0.77	0.72	0.58
Abu Dhabi, UAE	0.88	57	0.44	0.65	0.83	0.88	0.91	0.87	0.84	0.43
Dubai, UAE	0.85	51	0.63	0.65	0.66	0.79	0.85	0.87	0.81	0.31
Florida, US	0.88	54	0.62	0.66	0.79	0.81	0.79	0.87	0.78	0.50

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Teachers Emphasize Science Investigation Scale, Eighth Grade, and TIMSS 2015 Science Achievement

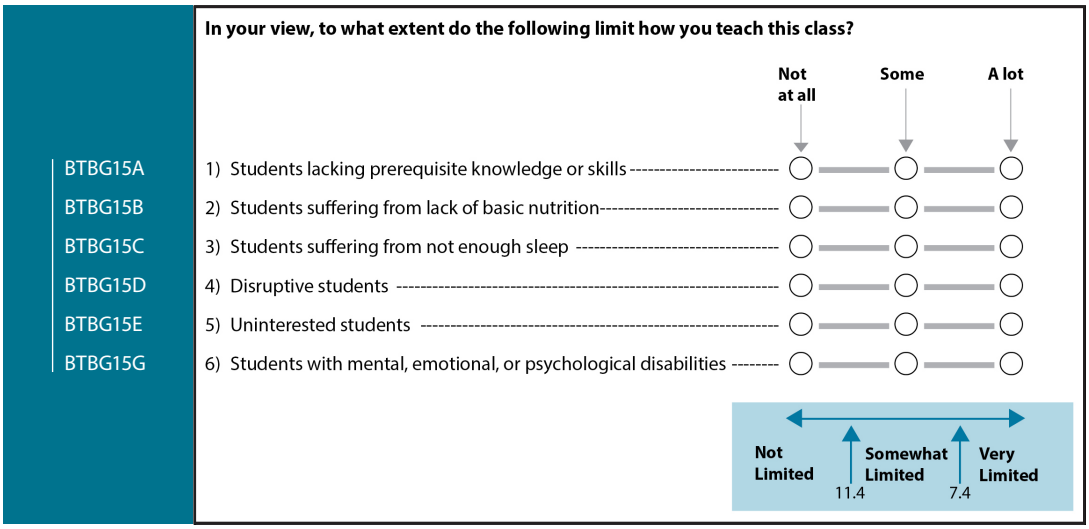
Country	Pearson's Correlation with Science Achievement		Variance in Science Achievement Accounted for by Difference Between Regions of the Scale (η^2)
	(r)	(r^2)	
Australia	0.08	0.01	0.00
Bahrain	0.08	0.01	0.01
Botswana (9)	0.03	0.00	0.00
Canada	-0.03	0.00	0.00
Chile	-0.11	0.01	0.01
Chinese Taipei	0.08	0.01	0.00
Egypt	0.03	0.00	0.00
England	0.11	0.01	0.00
Georgia	0.01	0.00	0.00
Hong Kong SAR	0.18	0.03	0.03
Hungary	0.09	0.01	0.01
Iran, Islamic Rep. of	0.10	0.01	0.01
Ireland	0.02	0.00	0.00
Israel	-0.11	0.01	0.00
Italy	-0.03	0.00	0.00
Japan	-0.03	0.00	0.00
Jordan	0.07	0.00	0.01
Kazakhstan	-0.05	0.00	0.00
Korea, Rep. of	0.03	0.00	0.00
Kuwait	0.03	0.00	0.00
Lebanon	0.05	0.00	0.00
Lithuania	-0.04	0.00	0.00
Malaysia	0.10	0.01	0.00
Malta	0.09	0.01	0.00
Morocco	0.03	0.00	0.00
New Zealand	0.02	0.00	0.00
Norway (9)	0.04	0.00	0.00
Oman	0.02	0.00	0.00
Qatar	-0.11	0.01	0.00
Russian Federation	0.06	0.00	0.00
Saudi Arabia	0.15	0.02	0.01
Singapore	0.00	0.00	0.00
Slovenia	0.01	0.00	0.00
South Africa (9)	0.05	0.00	0.00
Sweden	0.04	0.00	0.00
Thailand	0.12	0.01	0.01
Turkey	0.06	0.00	0.00
United Arab Emirates	0.07	0.00	0.00
United States	0.06	0.00	0.00
International Median	0.04	0.00	0.00
Benchmarking Participants			
Buenos Aires, Argentina	-0.09	0.01	0.00
Ontario, Canada	-0.04	0.00	0.00
Quebec, Canada	-0.02	0.00	0.01
Norway (8)	0.02	0.00	0.00
Abu Dhabi, UAE	0.02	0.00	0.00
Dubai, UAE	0.04	0.00	0.00
Florida, US	-0.05	0.00	0.01

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Teaching Limited by Student Needs Scale, Eighth Grade

The Teaching Limited by Student Needs (LSN) scale was created based on teachers' responses concerning six needs described below.

Items in the TIMSS 2015 Teaching Limited by Student Needs Scale, Eighth Grade



Item Parameters for the TIMSS 2015 Teaching Limited by Student Needs Scale, Eighth Grade

Item	delta	tau_1	tau_2	Infit
BTBG15A	1.14171	-1.83653	1.83653	1.03
BTBG15B	-1.14425	-1.12334	1.12334	1.09
BTBG15C	-0.16051	-1.68796	1.68796	1.04
BTBG15D	0.30396	-1.44379	1.44379	0.94
BTBG15E	0.86567	-1.84509	1.84509	0.89
BTBG15G	-1.00658	-1.45309	1.45309	1.07

Scale Transformation Constants for the TIMSS 2015 Teaching Limited by Student Needs Scale, Eighth Grade

Scale Transformation Constants	
A = 9.392409	Transformed Scale Score = 9.392409 + 1.217478 • Logit Scale Score
B = 1.217478	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Equivalence Table of Raw and Transformed Scale Scores for the TIMSS 2015 Teaching Limited by Student Needs Scale, Eighth Grade

Raw Score	Transformed Scale Score	Cutpoint
0	4.10087	
1	5.69119	
2	6.59237	
3	7.31350	7.4
4	7.96367	
5	8.59178	
6	9.23167	
7	9.91091	
8	10.64876	
9	11.44991	11.4
10	12.32894	
11	13.37525	
12	15.08058	

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Cronbach's Alpha Reliability Coefficient and Principal Components Analysis of the Items in the TIMSS 2015 Teaching Limited by Student Needs Scale, Eighth Grade

Country	Cronbach's Alpha Reliability Coefficient	Percent of Variance Explained	Component Loadings for Each Item					
			BTBG15A	BTBG15B	BTBG15C	BTBG15D	BTBG15E	BTBG15G
Australia	0.78	48	0.66	0.55	0.73	0.75	0.77	0.66
Bahrain	0.75	44	0.67	0.58	0.62	0.77	0.74	0.58
Botswana (9)	0.61	35	0.28	0.61	0.70	0.60	0.65	0.61
Canada	0.76	46	0.64	0.65	0.74	0.64	0.72	0.67
Chile	0.75	44	0.65	0.68	0.68	0.69	0.71	0.59
Chinese Taipei	0.75	45	0.65	0.65	0.61	0.71	0.70	0.69
Egypt	0.68	39	0.55	0.56	0.58	0.75	0.75	0.53
England	0.80	50	0.64	0.67	0.74	0.74	0.76	0.68
Georgia	0.65	37	0.60	0.49	0.56	0.65	0.69	0.63
Hong Kong SAR	0.71	41	0.62	0.47	0.64	0.73	0.67	0.69
Hungary	0.80	50	0.66	0.65	0.72	0.74	0.73	0.71
Iran, Islamic Rep. of	0.74	43	0.48	0.63	0.66	0.75	0.69	0.72
Ireland	0.76	45	0.56	0.65	0.68	0.72	0.76	0.66
Israel	0.82	52	0.69	0.67	0.72	0.77	0.78	0.69
Italy	0.70	41	0.69	0.64	0.69	0.69	0.69	0.39
Japan	0.75	44	0.76	0.21	0.72	0.68	0.80	0.65
Jordan	0.61	34	0.62	0.50	0.59	0.63	0.71	0.38
Kazakhstan	0.80	51	0.70	0.63	0.76	0.82	0.72	0.65
Korea, Rep. of	0.80	50	0.64	0.55	0.74	0.78	0.79	0.70
Kuwait	0.64	36	0.64	0.50	0.64	0.70	0.70	0.37
Lebanon	0.67	38	0.63	0.54	0.63	0.63	0.63	0.62
Lithuania	0.75	44	0.62	0.55	0.62	0.76	0.76	0.66
Malaysia	0.73	43	0.67	0.52	0.56	0.76	0.78	0.62
Malta	0.77	47	0.65	0.59	0.65	0.77	0.78	0.65
Morocco	0.66	38	0.34	0.51	0.64	0.75	0.74	0.63
New Zealand	0.79	49	0.70	0.65	0.69	0.76	0.78	0.63
Norway (9)	0.73	43	0.58	0.72	0.73	0.60	0.64	0.64
Oman	0.76	45	0.66	0.59	0.66	0.69	0.76	0.67
Qatar	0.76	47	0.65	0.65	0.65	0.80	0.79	0.49
Russian Federation	0.78	47	0.61	0.65	0.72	0.73	0.68	0.72
Saudi Arabia	0.66	37	0.62	0.55	0.61	0.66	0.70	0.52
Singapore	0.73	43	0.64	0.55	0.68	0.71	0.72	0.61
Slovenia	0.76	45	0.67	0.42	0.68	0.78	0.81	0.61
South Africa (9)	0.73	42	0.66	0.57	0.60	0.70	0.72	0.62
Sweden	0.77	47	0.68	0.61	0.70	0.72	0.74	0.64
Thailand	0.69	40	0.50	0.49	0.55	0.75	0.76	0.67
Turkey	0.71	41	0.67	0.56	0.55	0.74	0.69	0.60
United Arab Emirates	0.75	45	0.64	0.62	0.72	0.75	0.79	0.46
United States	0.74	44	0.61	0.62	0.66	0.71	0.68	0.68
Benchmarking Participants								
Buenos Aires, Argentina	0.78	49	0.49	0.72	0.81	0.70	0.69	0.74
Ontario, Canada	0.74	44	0.61	0.67	0.74	0.62	0.69	0.65
Quebec, Canada	0.80	51	0.71	0.63	0.74	0.70	0.77	0.72
Norway (8)	0.73	43	0.54	0.66	0.68	0.63	0.74	0.64
Abu Dhabi, UAE	0.74	43	0.67	0.63	0.67	0.68	0.78	0.49
Dubai, UAE	0.76	46	0.63	0.55	0.75	0.79	0.78	0.52
Florida, US	0.81	52	0.74	0.68	0.77	0.69	0.77	0.67

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2015

Relationship Between the TIMSS 2015 Teaching Limited by Student Needs Scale, Eighth Grade, and TIMSS 2015 Achievement

Country	Pearson's Correlation with Achievement				Variance in Achievement Accounted for by Difference Between Regions of the Scale (η^2)	
	(r)		(r^2)			
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Australia	0.45	0.27	0.20	0.07	0.18	0.06
Bahrain	0.16	0.18	0.03	0.03	0.02	0.03
Botswana (9)	0.11	0.09	0.01	0.01	0.00	0.00
Canada	0.26	0.18	0.07	0.03	0.05	0.02
Chile	0.32	0.38	0.10	0.15	0.09	0.11
Chinese Taipei	0.20	0.19	0.04	0.04	0.03	0.04
Egypt	0.11	0.10	0.01	0.01	0.01	0.01
England	0.51	0.44	0.26	0.19	0.18	0.17
Georgia	0.07	0.06	0.00	0.00	0.01	0.00
Hong Kong SAR	0.37	0.28	0.14	0.08	0.06	0.04
Hungary	0.37	0.31	0.14	0.10	0.12	0.07
Iran, Islamic Rep. of	0.16	0.17	0.02	0.03	0.04	0.03
Ireland	0.40	0.20	0.16	0.04	0.11	0.03
Israel	0.40	0.29	0.16	0.09	0.14	0.08
Italy	0.13	0.09	0.02	0.01	0.01	0.01
Japan	0.16	0.12	0.03	0.02	0.01	0.01
Jordan	0.11	0.17	0.01	0.03	0.01	0.03
Kazakhstan	0.08	0.10	0.01	0.01	0.00	0.01
Korea, Rep. of	0.11	0.05	0.01	0.00	0.01	0.00
Kuwait	0.20	0.09	0.04	0.01	0.04	0.01
Lebanon	0.02	-0.01	0.00	0.00	0.01	0.00
Lithuania	0.20	0.17	0.04	0.03	0.03	0.02
Malaysia	0.37	0.39	0.14	0.15	0.11	0.10
Malta	0.40	0.28	0.16	0.08	0.14	0.05
Morocco	0.04	0.12	0.00	0.01	0.00	0.01
New Zealand	0.45	0.41	0.21	0.17	0.13	0.13
Norway (9)	0.12	0.15	0.01	0.02	0.01	0.02
Oman	0.11	0.08	0.01	0.01	0.02	0.01
Qatar	0.33	0.33	0.11	0.11	0.12	0.09
Russian Federation	0.07	0.08	0.00	0.01	0.01	0.01
Saudi Arabia	0.25	0.09	0.06	0.01	0.06	0.01
Singapore	0.32	0.38	0.10	0.15	0.07	0.12
Slovenia	0.17	0.09	0.03	0.01	0.03	0.01
South Africa (9)	0.10	0.12	0.01	0.01	0.01	0.03
Sweden	0.25	0.17	0.06	0.03	0.05	0.02
Thailand	0.25	0.20	0.06	0.04	0.06	0.04
Turkey	0.22	0.27	0.05	0.07	0.04	0.06
United Arab Emirates	0.30	0.30	0.09	0.09	0.08	0.08
United States	0.30	0.21	0.09	0.04	0.08	0.03
International Median	0.20	0.17	0.04	0.03	0.04	0.03
Benchmarking Participants						
Buenos Aires, Argentina	0.17	0.22	0.03	0.05	0.04	0.04
Ontario, Canada	0.21	0.17	0.04	0.03	0.04	0.03
Quebec, Canada	0.34	0.19	0.12	0.04	0.09	0.02
Norway (8)	0.19	0.13	0.04	0.02	0.03	0.02
Abu Dhabi, UAE	0.28	0.21	0.08	0.04	0.06	0.05
Dubai, UAE	0.29	0.27	0.08	0.07	0.08	0.07
Florida, US	0.41	0.15	0.16	0.02	0.16	0.02

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