

Appendix B

THE TEST-CURRICULUM MATCHING ANALYSIS

When comparing student achievement across countries, it is important that the comparisons be as “fair” as possible. TIMSS has worked towards this goal in a number of ways, including providing detailed procedures for standardizing the population definitions, sampling, test translations, test administration, scoring, and database formation. Developing the TIMSS tests involved the interaction of experts in the field of mathematics with representatives of the participating countries and testing specialists.¹ The National Research Coordinators (NRCs) from each country formally approved the TIMSS test, thus accepting it as being sufficiently fair to compare their students’ mathematics achievement with that of students from other countries.

Although the TIMSS test was developed to represent a set of agreed-upon mathematics content areas, there are differences among the curricula of participating countries that result in various mathematics topics being taught at different grades. To restrict test items not only to those topics in the curricula of all countries but also to those covered in the same sequence in all participating countries would severely limit test coverage and restrict the research questions about international differences that TIMSS is designed to address. The TIMSS tests, therefore, inevitably contain some items measuring topics unfamiliar to some students in some countries.

The Test-Curriculum Matching Analysis (TCMA) was developed and conducted to investigate the appropriateness of the TIMSS mathematics test for seventh- and eighth-grade students in the participating countries, and to show how student performance for individual countries varied when based only on the test questions that were judged to be relevant to their own curriculum.²

To gather data about the extent to which the TIMSS tests were relevant to the curriculum of the participating countries, TIMSS asked the NRC of each country to report whether or not each item was in the country’s intended curriculum at each of the two grades being tested. The NRC was asked to choose a person or persons who were very familiar with the curricula at the grades being tested to make the determination. Since an item might be in the curriculum for some but not all students in a country, an item was determined appropriate if it was in the intended curriculum for more than 50% of the students. The NRCs had considerable flexibility in selecting items and may have considered items inappropriate for other reasons. All participating countries except Thailand returned the information for analysis.

¹ See Appendix A for more information on the test development.

² Because there also may be curriculum areas covered in some countries that are not covered by the TIMSS tests, the TCMA does not provide complete information about how well the TIMSS tests cover the curricula of the countries.

Tables B.1 and B.2 present the TCMA results for the eighth and seventh grades, respectively. The first row of each table indicates that at both grades the countries varied substantially in the number of items considered appropriate. At the eighth grade, half of the countries indicated that items representing 90% or more of the score points (145 out of a possible 162) were appropriate,³ with the percent ranging from 100% in Hungary and the United States to 47% (76 score points) in Greece. Although, in general, fewer items were selected at the seventh grade than at the eighth grade, nearly half of the countries selected items representing at least three-quarters of the score points (121), and several countries selected items representing 90% or more. The number of score points represented by the selected items for the seventh grade ranged from 59 (36%) in Denmark to 162 (100%) in the United States. That somewhat lower percentages of items were selected for the TCMA at the seventh grade is consistent with the instrument-development process, which put more emphasis on the upper-grade curriculum.

Since most countries indicated that some items were not included in their intended curricula at the two grades tested, the question becomes whether the inclusion of these items had any effect on the international performance comparisons.⁴ The TCMA results provide a method for answering this question, providing evidence that it is reasonable to make cross-national comparisons on the basis of the TIMSS mathematics test.

Each of the first columns in Tables B.1 and B.2 shows the overall average percent correct for each country (as discussed in Chapter 2 and reproduced here for convenience in making comparisons). The countries are presented in the order of their overall performance, from highest to lowest. To interpret these tables, reading across a row provides the average percent correct for the students in the country identified by that row on the items selected by each of the countries named across the top of the table. For example, eighth-grade Korean students had an average of 71% correct on the items that Singapore selected as appropriate for the Singaporean students, an average of 72% percent correct on the items selected for the Japanese students, 73% correct for its own items, 72% on the items selected by Hong Kong, and so forth. The column for a country shows how each of the other countries performed on the subset of items selected for its own students. Using the set of items selected by Switzerland as an example, on average, 80% of these items were answered correctly by the Singaporean students, 75% by the Japanese students, 72% by the students from Hong Kong, 71% by the Belgian (Flemish) students, and so forth. The shaded diagonal elements in

³ Of the 151 items in the test, some items were assigned more score points than others. In particular, some items had two parts, and some extended-response items were scored on a two-point scale and others on a three-point scale. The total number of score points available for analysis was 162. The TCMA uses the score points in order to give the same importance to items that they received in the test scoring.

⁴ It should be noted that the performance levels presented in Tables B.1 and B.2 are based on average percents correct as was done in Chapter 2, which is different from the average scale scores that were presented in Chapter 1. The cost and delay of scaling would have been prohibitive for the TCMA analyses.

Table B.1 Test-Curriculum Matching Analysis Results - Mathematics - Upper Grade (Eighth Grade*)

Average Percent Correct Based on Subsets of Items Specially Identified by Each Country as Addressing Its Curriculum (See Table B.3 for corresponding standard errors)

Instructions: Read across the row to compare that country's performance based on the test items included by each of the countries across the top. Read down the column under a country name to compare the performance of the country down the left on the items included by the country listed on the top. Read along the diagonal to compare performance for each different country based on its own decisions about the test items to include.

Country	Average Percent Correct on All Items		(Number of Score Points Included)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
			Singapore	Japan	Korea	Hong Kong (FI)	Belgium (FI)	Czech Republic	Slovak Republic	Switzerland	Austria	Hungary	France	Slovenia	Russian Federation	Netherlands	Bulgaria	Canada	Ireland	Belgium (FI)	Australia	Israel	Sweden	New Zealand	Norway	England	United States	Denmark	Scotland	Latvia (LSS)	Spain	Iceland	Greece	Romania	Lithuania	Cyprus	Portugal	Iran, Islamic Rep.	Kuwait	Colombia	South Africa																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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*Eighth grade in most countries; see Table 2 for more information about the grades tested in each country.

**Of the 151 items in the mathematics test, some items had two parts and some extended-response items were scored on a two- or three-point scale, resulting in 162 total score points.

() Standard errors for the average percent of correct responses on all items appear in parentheses. Standard errors for scores based on subsets of items are provided in Table B.3.

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

Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3 for details).

Because population coverage falls below 65% Latvia is annotated LSS for Latvian Speaking Schools only.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Table B.2 Test-Curriculum Matching Analysis Results - Lower Grade (Seventh Grade*)
Average Percent Correct Based on Subsets of Items Specially Identified by Each Country as Addressing Its Curriculum (See Table B.4 for corresponding standard errors)

Instructions: Read *across* the row to compare that country's performance based on the test items included by each of the countries across the top.
Read *down* the column under a country name to compare the performance of the country down the left on the items included by the country listed on the top.
Read along the *diagonal* to compare performance for each different country based on its own decisions about the test items to include.

Country	Average Percent Correct on All Items		(Number of Score Points Included)																																					
	126	145	144	139	104	Belgium (Fl)	Czech Republic	Austria	Bulgaria	Netherlands	Belgium (Fr)	Slovak Republic	Hungary	Ireland	Switzerland	Russian Federation	Slovenia	Australia	Canada	France	Germany	United States	England	Sweden	New Zealand	Scotland	Norway	Latvia (LSS)	Denmark	Romania	Iceland	Spain	Cyprus	Greece	Lithuania	Portugal	Iran, Islamic Rep.	Colombia	South Africa	
Singapore	73	126	74	74	77	74	73	76	74	76	74	73	73	75	77	75	121	144	114	87	128	132	162	93	100	115	76	118	150	59	87	102	150	101	108	146	148	128	89	81
Japan	67	68	68	68	70	67	68	67	69	66	67	67	68	67	70	68	71	69	73	74	73	74	73	76	73	75	78	74	73	78	75	74	72	75	76	73	74	73	77	70
Korea	67	67	68	68	69	67	68	67	67	65	67	67	68	66	70	68	71	69	71	74	67	68	67	72	68	71	71	69	67	74	73	70	67	67	68	67	67	66	70	69
Hong Kong	65	65	66	66	68	65	66	67	66	67	64	65	66	69	65	67	66	65	68	69	65	65	65	69	68	70	66	65	65	72	66	66	65	65	65	65	65	64	69	68
Belgium (Fl)	65	66	66	65	69	65	67	65	67	66	64	65	66	71	66	65	65	70	73	66	66	65	72	67	70	74	68	65	76	66	69	65	65	68	65	64	69	68		
Czech Republic	57	58	59	59	61	58	59	56	58	58	57	58	57	63	58	57	61	65	58	58	57	63	59	61	64	60	57	69	60	61	57	56	59	57	58	57	62	62		
Austria	56	56	56	56	59	56	57	54	57	56	55	55	56	62	56	55	60	64	56	57	56	62	59	61	64	59	56	68	57	59	55	55	56	56	54	61	60	57		
Bulgaria	55	55	57	57	59	55	57	57	53	55	55	55	56	55	57	55	58	60	55	55	55	58	54	58	60	55	55	63	58	57	55	53	56	56	56	56	56	60	57	
Netherlands	55	55	56	54	57	55	56	53	59	56	54	55	54	62	55	55	60	63	55	58	65	60	62	65	62	55	62	55	69	54	60	56	54	56	54	55	53	59	59	
Belgium (Fr)	54	55	55	57	54	56	53	56	56	54	54	55	55	55	54	55	54	60	63	55	57	54	62	58	60	64	59	54	68	55	59	54	54	56	54	54	54	50	59	
Slovak Republic	54	55	56	56	58	55	56	54	54	54	54	55	54	59	56	54	58	62	54	55	54	55	58	60	56	54	55	54	65	57	57	54	53	56	54	55	54	59	59	
Hungary	53	54	55	54	57	54	54	53	54	53	53	54	53	58	55	53	58	61	53	55	54	60	55	58	60	56	54	64	55	57	53	52	55	53	54	53	58	58		
Ireland	53	53	54	54	56	53	54	52	55	54	53	54	55	54	53	55	53	58	61	53	55	53	60	55	58	61	56	54	64	54	56	53	53	55	53	53	52	56	58	
Switzerland	53	53	53	55	53	54	50	57	55	52	53	54	62	53	54	62	53	60	63	54	56	53	62	59	60	65	60	54	68	52	58	53	55	53	55	53	52	58	59	
Russian Federation	53	53	54	54	56	53	54	53	52	53	53	53	53	57	55	53	56	59	54	53	57	53	55	55	54	53	64	56	55	53	54	56	55	53	52	55	53	57	56	
Slovenia	53	53	53	53	55	53	53	53	51	53	52	53	52	58	54	52	57	60	52	54	52	58	54	57	59	55	53	65	55	56	53	51	54	52	53	51	58	56		
Australia	52	52	53	55	52	53	50	54	52	52	52	53	52	59	52	52	57	60	53	54	52	61	57	59	61	57	53	65	51	57	52	51	54	52	51	56	56	60		
Canada	52	52	52	52	54	52	51	52	49	54	52	51	52	51	59	51	51	57	61	51	54	52	50	58	60	56	52	65	51	56	51	53	51	51	50	55	56	56		
France	51	51	51	51	52	51	49	52	51	50	52	51	50	49	56	51	55	60	51	53	51	58	54	57	60	55	50	65	51	56	52	49	51	50	51	49	56	54		
Germany	49	49	49	49	52	49	50	47	51	50	48	49	49	49	49	49	55	59	49	51	49	57	53	56	58	53	49	64	50	54	49	48	51	49	47	54	54	54		
United States	48	48	48	48	50	48	48	46	50	47	47	48	47	47	47	47	52	56	48	49	48	55	50	54	55	52	48	59	48	52	47	46	49	47	48	46	51	51		
England	47	47	47	47	48	47	47	44	47	46	46	47	45	43	45	45	46	52	55	47	49	47	57	52	54	56	53	47	60	45	52	48	44	47	46	47	45	49		
Sweden	45	47	47	47	48	47	47	44	49	48	46	47	47	55	46	46	53	56	47	49	47	57	54	55	57	54	47	62	45	53	48	45	47	47	44	51	50			
New Zealand	44	46	46	46	48	46	47	43	48	47	45	47	45	45	45	45	46	51	54	46	48	46	56	51	53	55	52	46	59	44	51	47	44	46	46	45	49	49		
Scotland	44	44	44	44	46	44	45	41	46	45	41	46	45	43	41	43	44	50	53	45	46	44	55	50	51	54	51	44	58	42	45	42	44	43	44	43	47	47		
Norway	43	45	44	45	46	45	42	47	46	43	44	44	44	42	44	42	44	50	53	45	47	44	54	50	52	54	51	45	59	43	45	43	45	44	42	48	48			
Latvia (LSS)	43	45	45	45	46	44	45	44	43	44	44	44	43	49	45	44	48	50	45	44	44	50	46	48	50	46	44	56	47	47	44	42	45	44	44	43	49	47		
Denmark	42	44	44	44	45	44	41	45	44	41	45	43	44	43	43	43	49	53	44	46	44	44	49	51	54	50	44	60	44	49	44	41	44	43	44	42	48	46		
Romania	44	45	44	46	44	45	44	41	43	43	44	43	44	43	45	44	45	47	44	43	43	46	43	43	46	43	45	48	44	43	42	44	44	44	44	44	48	44		
Iceland	42	44	44	44	45	43	44	40	46	44	40	46	44	42	41	42	43	49	53	43	46	43	54	50	51	54	41	44	50	41	44	41	44	42	42	42	47	47		
Spain	42	43	43	44	42	42	41	41	42	41	41	42	43	41	47	43	42	46	48	43	43	42	49	44	47	49	46	42	55	43	46	43	40	43	42	41	47	44		
Cyprus	42	43	42	44	42	43	42	41	41	42	41	41	42	44	43	42	45	46	41	43	42	47	42	45	47	43	42	51	44	43	42	42	42	41	46	44	44			
Greece	40	41	41	41	43	41	40	42	42	40	41	41	41	46	41	41	47	41	47	40	46	42	45	47	44	41	40	42	41	40	41	40	41	39	45	45	45	45		
Lithuania	38	39	39	39	41	38	39	37	37	38	38	38	37	43	40	38	42	45	39	39	38	44	39	42	44	40	38	50	40	41	38	36	39	38	37	42	41			
Portugal	37	37	37	37	38	37	37	35	36	37	36	37	36	42	37	36	41	44	37	38	37	43	39	42	44	40	37	49	38	41	37	34	37	37	35	41	39			
Iran, Islamic Rep.	32	32	33	33	33	32	32	32	32	32	33	32	35	33	33	35	36	33	33	35	37	32	35	37	34	32	41	33	32	31	33	32	32	37	33	38	38			
Colombia	26	26	26	27	27	26	26	25	26	26	26	26	26	26	26	30	32	26	27	26	31	28	30	32	29	26	24	27	26	24	27	26	24	27	26	25	30	28		
South Africa	23	22	23	23	24	22	23	22	23	22	23	22	23	25	23	22	24	26	22	23	23	25	23	25	23	24	26	24	23	29	23	22	22	24	22	24	24	24		
International Average	49	48	49	50	50	49	50	48	50	49	49	49	49	55	50	49	53	56	49	51	49	56	52	54	56	53	49	61	50	49	48	50	49	48	53	52	52			

*Seventh grade in most countries; see Table 2 for more information about the grades tested in each country.

**Of the 151 items in the mathematics test, some items had two parts and some extended-response items were scored on a two- or three-point scale, resulting in 162 total score points.

(*) Standard errors for the average percent of correct responses on all items appear in parentheses. Standard errors for scores based on subsets of items are provided in Table B.4.

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

Countries shown in *italics* did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3 for details).

Because population coverage falls below 65% Latvia is annotated LSS for Latvian Speaking Schools only.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

each table show how each country performed on the subset of items that it selected based on its own curriculum. Thus, the Swiss students themselves averaged 64% correct responses on the items identified by Switzerland for the analysis.

The international averages presented across the last row of the tables show that the selection of items for the participating countries varied somewhat in average difficulty, ranging from 54% to 58% at the eighth grade and from 48% to 61% at the seventh grade. Despite these differences, the overall picture provided by both Tables B.1 and B.2 reveals that different item selections do not make a major difference in how well countries perform relative to each other. The items selected by some countries were more difficult than those selected by others. The relative performance of countries on the various item selections did vary somewhat, but generally not in a statistically significant manner.⁵

Comparing the diagonal element for a country with the overall average percentage correct shows the difference between performance on this subset of items and performance on the test as a whole. In general, there were small increases in each country's performance on its own subset of items. To illustrate, the average percent correct for eighth-grade students in the Russian Federation is 60%. The diagonal element shows that Russian students had about the same average percent correct (62%) based on the smaller set of items selected as relevant to the curriculum in the Russian Federation as they did overall. In the eighth grade, the differences were extremely small (2 average percentage points or less) for most countries. Only a few countries had an average percent correct on their own selected items more than 3 percentage points higher than their average on the test as a whole. Performance differences between the entire TIMSS test and the subset of items selected for the TCMA were, in general, somewhat larger for seventh-grade students, including several countries with average performance that was 5 to 10 percentage points higher on the items selected for the TCMA for their own students. The largest increase (16 average percentage points) was for the seventh-grade students in Denmark.

It is clear that the selection of items does not have a major effect on the general relationship among countries. Countries that had substantially higher or lower performance on the overall test in comparison to each other also had higher or lower relative performance on the different sets of items selected for the TCMA. At the eighth grade, Singapore, Japan, Korea, and Hong Kong were the highest-performing countries and in the same order of performance, both on the test as a whole and on all the different sets of item selections. At the seventh grade, Singapore had the highest average percent correct on the test as a whole and on all of the different item selections, with Japan, Korea, Hong Kong, and Belgium (Flemish) among the top five highest performing countries in all cases. Although there were some changes in

⁵ Small differences in performance in these tables are not statistically significant. The standard errors for the estimated average percent correct statistics can found in Tables B.3 and B.4. We can say with 95% confidence that the value for the entire population will fall between the sample estimate plus or minus two standard errors.

the ordering of countries based on the items selected for the TCMA, most of these differences are within the boundaries of sampling error. As the most extreme example, consider the 59 score points selected by Denmark for the seventh grade. Denmark did substantially better on these items than on the test as a whole, with 60% correct responses to these items, on average, compared to only 44% average correct on the test as a whole. However, all other countries also did better on these particular items, with an international average of 61% for the items selected by Denmark compared with 49% on the test as a whole. Also, for example, Scotland, Norway, and Latvia (LSS), which also averaged 44% correct over all items at the seventh grade, performed similarly to Denmark on the set of items selected by Denmark – 58%, 59%, and 56%, respectively.

The TCMA results provide evidence that the TIMSS mathematics test provides a reasonable basis for comparing achievement for the participating countries. This result is not unexpected, since making the test as fair as possible was a major consideration in test development. The fact that the majority of countries indicated that most items were appropriate for their students means that the different average percent correct estimates were based substantially on the same items. Insofar as countries rejected items that would be difficult for their own students, these items tended to be difficult for students in other countries as well. The analysis shows that omitting such items improves the results for that country, but also tends to improve the results for all other countries, so that the overall pattern of results is largely unaffected.

Table B.4 Standard Errors for the Test-Curriculum Matching Analysis Results - Lower Grade (Seventh Grade*)

Instructions: Read **across** the row for the standard error for the test items included by each of the countries across the top. Read **down** the column under a country name for the score of the country down the left on the items included by the country listed on the top. Read along the **diagonal** for the score for each different country based on its own decisions about the test items to include.

[illegible]

*Seventh grade in most countries; see Table 2 for more information about the grades tested in each country.

**Of the 151 items in the mathematics test, some items had two parts and some extended-response items were scored on a two- or three-point scale, resulting in 162 total score points.

(i) Standard errors for the average percent of correct responses on all items appear in parentheses. The matrix contains significant errors for the average percent of correct responses on all items appear inconsistent. As displayed in Table B.2. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Countries shown in *italics* did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures (see Figure A.3 for details).

Because population coverage falls below 65% Latvia is annotated LSS for Latvian Speaking Schools only.

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.