9

TIMSS & PIRLS INTERNATIONAL STUDY CENTER, LYNCH SCHOOL OF EDUCATION, BOSTON COLLEGE

Chapter 9

TIMSS 2003 Sampling Weights and Participation Rates

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9.1 Overview

As described in Chapter 5, TIMSS uses rigorous sampling of schools and students to provide valid and efficient estimates of mathematics and science achievement in the fourth- and eighth- grade student populations of participating countries. The accuracy of these estimates depends to a great extent on the quality of the sampling in each country, which in turn is determined by the quality of the sampling information available in designing the sampling plan and the care with which the sampling activities are conducted. For TIMSS 2003, National Research Coordinators (NRCs) worked on all phases of sampling, in conjunction with staff from Statistics Canada and the IEA Data Processing Centre (DPC). NRCs were trained in how to select the school and student samples, and in how to use the sampling software provided by the IEA Data Processing Centre. This chapter summarizes major characteristics of the national samples, and describes the procedure for computing sampling weights and participation rates for each country. In consultation with the TIMSS 2003 sampling referee[1], staff from Statistics Canada and the IEA DPC reviewed the national sampling plans, sampling data, sampling frames, and sample selection. The TIMSS & PIRLS International Study Centre (ISC) at Boston College, jointly with Statistics Canada, the IEA DPC and the sampling referee, used this information to evaluate the quality of the samples. Summaries of the sample design for each country, including details of population coverage and exclusions, stratification variables, and participation rates, are provided in Appendix B.

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1   Keith Rust, Westat.

9.2   Sampling implementation

9.2.1   TIMSS 2003 Target Populations

In IEA studies, the target population for all countries is known as the international desired population. The *international desired populations* for TIMSS 2003 were defined as:

Population 1: All students enrolled in the upper of the two adjacent grades that contain the largest proportion of 9-year-olds at the time of testing. This grade level was intended to represent four years of schooling, counting from the first year of primary or elementary schooling, and was the fourth grade in most countries.

Population 2: All students enrolled in the upper of the two adjacent grades that contain the largest proportion of 13-year-olds at the time of testing. This grade level was intended to represent eight years of schooling, counting from the first year of primary or elementary schooling, and was the eighth grade in most countries.

To measure trends in student achievement, the TIMSS 2003 eighth- and fourth-grade target populations were intended to correspond to the upper grades of the TIMSS 1995 population definitions, and the TIMSS 2003 eighth-grade target population to the eighth-grade population in TIMSS 1999.

Exhibits 9.1 and 9.2 summarize the grades identified as the target grades for sampling in all participating countries and Benchmarking entities for the eighth and fourth grades, respectively. For most countries, the target grades did indeed turn out to be the grades with eight and four years of schooling. A number of countries decided to target the eighth or fourth grades even though their students were somewhat older as a result. These included Botswana, Estonia, Ghana, Latvia, Morocco, Romania, and South Africa at the eighth grade and Latvia, Moldova, Morocco, and Yemen at the fourth grade.

Exhibit 9.1   **National Grade Definitions – Eighth Grade**

Country	Country's Name for Grade Tested	Years of Formal Schooling	Mean Age of Students Tested
Armenia	Grade 8	8	14.9
Australia	Year 8	8 or 9	13.9
Bahrain	Second Intermediate	8	14.1
Belgium (Flemish)	2nd Grade of Secondary Education	8	14.1
Botswana	Grade 8 (Form 1)	8	15.1
Bulgaria	Grade 8	8	14.9
Chile	Eighth Grade of Basic Education	8	14.2
Chinese Taipei	2nd Grade Junior High School	8	14.2
Cyprus	2nd Grade Gymnasium	8	13.8
Egypt	Preparatory 3	8	14.4
England	Year 9	9	14.3
Estonia	Grade 8	8	15.2
Ghana	Junior Secondary School II (JSS II)	8	15.5
Hong Kong, SAR	Secondary 2 (S2)	8	14.4
Hungary	Grade 8	8	14.5
Indonesia	2nd Grade Junior Secondary School	8	14.5
Iran, Islamic Rep. of	Third Grade of Guidance School	8	14.4
Israel	Grade 8	8	14.0
Italy	Grade 8 (III Media)	8	13.9
Japan	2nd Grade Lower Secondary School	8	14.4
Jordan	Grade 8	8	13.9
Korea, Rep. of	2nd Grade Middle School	8	14.6
Latvia	Grade 8	8	15.0
Lebanon	Grade 8	8	14.6
Lithuania	Grade 8	8	14.9
Macedonia, Rep. of	Grade 8	8	14.6
Malaysia	Form 2	8	14.3
Moldova, Rep. of	Grade VIII	8	14.9
Morocco	2nd Secondary	8	15.2
Netherlands	Grade 8	8	14.3
New Zealand	Year 9	8.5 - 9.5	14.1
Norway	Grade 8 (these students started in Grade 2)	7	13.8
Palestinian Nat'l Auth.	Grade 8	8	14.1
Philippines	2nd Year High School	8	14.8
Romania	Grade 8	8	15.0
Russian Federation	Grade 8	7 or 8	14.2
Saudi Arabia	2nd Year of Middle School	8	14.1

Exhibit 9.1   **National Grade Definitions – Eighth Grade** (...Continued)

Country	Country's Name for Grade Tested	Years of Formal Schooling	Mean Age of Students Tested
Scotland	Secondary 2 (S2)	9	13.7
Serbia	8th grade of Primary School	8	14.9
Singapore	Secondary 2	8	14.3
Slovak Republic	Grade 8	8	14.3
Slovenia	Grade 7 of 8-year elementary school, Grade 8 of 9-year elementary school	7 or 8	13.8
South Africa	Grade 8	8	15.1
Sweden	Year 8	8	14.9
Syrian Arab Republic	Grade 8	8	14.0
Tunisia	8th year of basic school	8	14.8
United States	Grade 8	8	14.2
Benchmarking Participants			
Basque Country, Spain	2nd Course of ESO	8	14.1
Indiana State, US	Grade 8	8	13.5
Ontario Province, Can.	Grade 8	8	13.8
Quebec Province, Can.	Secondary II	8	14.2

9.2.2   Population Coverage and Exclusions

Exhibit 9.3 and 9.4 summarize population coverage and exclusions for the TIMSS 2003 target populations. National coverage of the international desired target population was generally comprehensive. For example, at the eighth grade as shown in Exhibit 9.3, all but Indonesia, Lithuania, Morocco and Serbia sampled from 100% of their international desired population.[2] Since coverage was below 100% of the international desired population, the results for these countries were footnoted in the TIMSS 2003 international reports to reflect this. At fourth grade (Exhibit 9.4), only Lithuania chose a national desired population less than the international desired population[3]. Since coverage was below 100%, the Lithuanian fourth-grade results were footnoted in the international reports.

Within the national desired population, it was possible to exclude certain school types, such as very small or very remote schools, and certain types of students, such as those with a disability that prevented them from participating in the assessment. For most part, school-level exclusions consisted of schools for the disabled and very small schools; however, there were some exceptions that are documented in Appendix B. Within-school exclu-

2   The Indonesian population included Non-Islamic schools only, the Lithuanian population included schools catering to Lithuanian-speaking student only, Morocco included schools from all provinces except Souss Massa Draa, Casablanca and Gharb-Chrarda, and Serbia included schools from all provinces except Kosovo.

3   The Lithuanian population was restricted to schools catering to Lithuanian-speaking student only.

sions generally consisted of disabled students and students who could not be assessed in the language of the test. At fourth grade, the percentage of excluded students was less than 10% in every country, and at eighth grade only in Israel and Macedonia did the level of excluded students exceed this figure. Results for these countries were annotated in the international reports. A few countries had no within-school exclusions.

Exhibit 9. 2   **National Grade Definitions – Fourth Grade**

Country	Country's Name for Grade Tested	Years of Formal Schooling	Mean Age of Students Tested
Armenia	Grade 4	4	10.9
Australia	Year 4	4	9.9
Belgium (Flemish)	Grade 4 primary education	4	10.0
Chinese Taipei	Elementary School, Grade 4	4	10.2
Cyprus	4th grade Primary	4	9.9
England	Year 5	5	10.3
Hong Kong, SAR	Primary 4 (P4)	4	10.2
Hungary	Grade 4	4	10.5
Iran, Islamic Rep. of	4th Grade of Primary School	4	10.4
Italy	Grade 4 (IV Elementare)	4	9.8
Japan	4th Grade at the Elementary School	4	10.4
Latvia	Grade 4	4	11.1
Lithuania	Grade 4	4	10.9
Moldova, Rep. of	Grade IV	4	11.0
Morocco	Grade 4 Primary	4	11.0
Netherlands	Grade 4	4	10.2
New Zealand	Year 5	4.5 - 5.5	10.0
Norway	Grade 4	3	9.8
Philippines	Grade 4	4	10.8
Russian Federation	Fourth grade for 4-year primary school; Third grade for 3-year primary school	3 or 4	10.6
Scotland	Primary 5 (P5)	5	9.7
Singapore	Primary 4	4	10.3
Slovenia	Grade 3 of 8-year elementary school; Grade 4 of 9-year elementary school	3 or 4	9.8
Tunisia	4th year of basic school	4	10.4
United States	Grade 4	4	10.2
Yemen	Grade 4	4	11.0
Benchmarking Participants			
Indiana State, US	Grade 4	4	9.5
Ontario Province, Can.	Grade 4	4	9.8
Quebec Province, Can.	2nd Year of 2nd Cycle	4	10.1

Within the national desired population, it was possible to exclude certain school types, such as very small or very remote schools, and certain types of students, such as those with a disability that prevented them from participating in the assessment. For most part, school-level exclusions consisted of schools for the disabled and very small schools; however, there were some exceptions that are documented in Appendix B. Within-school exclusions generally consisted of disabled students and students who could not be assessed in the language of the test. At fourth grade, the percentage of excluded students was less than 10% in every country, and at eighth grade only in Israel and Macedonia did the level of excluded students exceed this figure. Results for these countries were annotated in the international reports. A few countries had no within-school exclusions.

9.2.3   General Sample design

The basic design of the sample used in TIMSS 2003 was a two-stage stratified cluster design.[4] The first stage consisted of a sample of schools, and the second stage of a sample of intact classrooms (usually mathematics classes) from the target grades in the sampled schools. Countries could, with approval from the sampling consultants, adapt the basic design to their particular situation. For example, the Russian Federation introduced an extra stage where regions were sampled first, and then schools sampled from within the sampled regions, and in Egypt, Morocco, Singapore, South Africa and Yemen, student sub-sampling occurred within sampled classrooms.

The TIMSS 2003 design allowed countries to stratify the school sampling frame in order to improve the precision of survey results. Countries could use an explicit stratification procedure, by which schools were categorized according to some criterion (e.g., regions of the country), ensuring a predetermined number of schools would be selected from each stratum. Countries could also use an implicit stratification procedure, by which schools were sorted according to a set of stratification variables prior to sampling. This approach provided an efficient method of allocating the school sample in proportion to the size of the implicit stratum, when used in conjunction with a systematic probability-proportional-to-size (PPS) sampling method. Stratification variables and procedures for each country are described in Appendix B.

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4   The TIMSS 2003 sample design is described in Chapter 5.

Exhibit 9. 3   **National Coverage and Overall Exclusion Rates – Eighth Grade**

Country	International Desired Population		National Desired Population		
	Coverage	Notes on Coverage	School-Level Exclusions	Within-Sample Exclusions	Overall Exclusions
Armenia	100%		2.9%	0.0%	2.9%
Australia	100%		0.4%	0.9%	1.3%
Bahrain	100%		0.0%	0.0%	0.0%
Belgium (Flemish)	100%		3.1%	0.1%	3.2%
Botswana	100%		0.8%	2.2%	3.0%
Bulgaria	100%		0.5%	0.0%	0.5%
Chile	100%		1.6%	0.7%	2.2%
Chinese Taipei	100%		0.2%	4.6%	4.8%
Cyprus	100%		1.1%	1.5%	2.5%
Egypt	100%		3.4%	0.0%	3.4%
England	100%		2.1%	0.0%	2.1%
Estonia	100%		2.6%	0.8%	3.4%
Ghana	100%		0.9%	0.0%	0.9%
Hong Kong, SAR	100%		3.3%	0.1%	3.4%
Hungary	100%		5.5%	3.2%	8.5%
Indonesia	80%	Non-islamic schools	0.1%	0.3%	0.4%
Iran, Islamic Rep. of	100%		5.5%	1.1%	6.5%
Israel	100%		15.2%	8.6%	22.5%
Italy	100%		0.0%	3.6%	3.6%
Japan	100%		0.5%	0.1%	0.6%
Jordan	100%		0.5%	0.8%	1.3%
Korea, Rep. of	100%		1.5%	3.4%	4.9%
Latvia	100%		3.6%	0.1%	3.7%
Lebanon	100%		1.4%	0.0%	1.4%
Lithuania	89%	Students taught in Lithuanian	1.4%	1.2%	2.6%
Macedonia, Rep. of	100%		12.5%	0.0%	12.5%
Malaysia	100%		4.0%	0.0%	4.0%
Moldova, Rep. of	100%		0.7%	0.5%	1.2%
Morocco	69%	All students but Souss Massa Draa, Casablanca, Gharb-Chrarda	1.5%	0.0%	1.5%
Netherlands	100%		3.0%	0.0%	3.0%
New Zealand	100%		1.7%	2.7%	4.4%
Norway	100%		0.9%	1.5%	2.3%
Palestinian Nat'l Auth.	100%		0.2%	0.3%	0.5%

Exhibit 9. 3   **National Coverage and Overall Exclusion Rates – Eighth Grade** *(...Continued)*

Country	International Desired Population		National Desired Population		
	Coverage	Notes on Coverage	School-Level Exclusions	Within-Sample Exclusions	Overall Exclusions
Philippines	100%		1.5%	0.0%	1.5%
Romania	100%		0.4%	0.1%	0.5%
Russian Federation	100%		1.7%	3.9%	5.5%
Saudi Arabia	100%		0.3%	0.2%	0.5%
Scotland	100%		0.0%	0.0%	0.0%
Serbia	81%	Serbia without Kosovo	2.4%	0.6%	2.9%
Singapore	100%		0.0%	0.0%	0.0%
Slovak Republic	100%		5.0%	0.0%	5.0%
Slovenia	100%		1.3%	0.1%	1.4%
South Africa	100%		0.6%	0.0%	0.6%
Sweden	100%		0.3%	2.5%	2.8%
Syrian Arab Republic	100%		18.7%	0.0%	18.8%
Tunisia	100%		1.8%	0.0%	1.8%
United States	100%		0.0%	4.9%	4.9%
Benchmarking Participants					
Basque Country, Spain	100%		2.1%	3.8%	5.8%
Indiana State, US	100%		0.0%	7.8%	7.8%
Ontario Province, Can.	100%		1.0%	5.0%	6.0%
Quebec Province, Can.	100%		1.4%	3.5%	4.8%

Exhibit 9. 4   **National Coverage and Overall Exclusion Rates – Fourth Grade**

Country	International Desired Population		National Desired Population		
	Coverage	Notes on Coverage	School-Level Exclusions	Within-Sample Exclusions	Overall Exclusions
Armenia	100%		2.9%	0.0%	2.9%
Australia	100%		1.2%	1.6%	2.7%
Belgium (Flemish)	100%		5.9%	0.4%	6.3%
Chinese Taipei	100%		0.3%	2.8%	3.1%
Cyprus	100%		1.5%	1.4%	2.9%
England	100%		1.9%	0.0%	1.9%
Hong Kong, SAR	100%		3.7%	0.1%	3.8%
Hungary	100%		4.4%	3.9%	8.1%
Iran, Islamic Rep. of	100%		3.6%	2.1%	5.7%
Italy	100%		0.1%	4.1%	4.2%
Japan	100%		0.4%	0.3%	0.8%
Latvia	100%		4.3%	0.1%	4.4%
Lithuania	92%	Students taught in Lithuanian	2.1%	2.6%	4.6%
Moldova, Rep. of	100%		2.0%	1.6%	3.6%
Morocco	100%		2.2%	0.0%	2.2%
Netherlands	100%		4.1%	1.1%	5.2%
New Zealand	100%		1.5%	2.5%	4.0%
Norway	100%		1.7%	2.7%	4.4%
Philippines	100%		3.8%	0.7%	4.5%
Russian Federation	100%		2.2%	4.7%	6.8%
Scotland	100%		1.5%	0.0%	1.5%
Singapore	100%		0.0%	0.0%	0.0%
Slovenia	100%		0.8%	0.5%	1.3%
Tunisia	100%		0.9%	0.0%	0.9%
United States	100%		0.0%	5.1%	5.1%
Yemen	100%		0.6%	8.9%	9.5%
Benchmarking Participants					
Indiana State, US	100%		0.0%	7.2%	7.2%
Ontario Province, Can.	100%		1.3%	3.5%	4.8%
Quebec Province, Can.	100%		2.7%	0.9%	3.6%

Most countries sampled 150 schools and one intact classroom (i.e., including all of its students) within each school. Classrooms within schools generally were selected with equal probabilities. However, as described

above, some countries where large classrooms are the norm sampled students within classrooms was a means of reducing the data collection effort. In these cases, classrooms were sampled with PPS, and then a fixed number of students (with equal probabilities) were sampled from within the sampled classrooms. With the approval of the sampling consultants, several countries chose to sample more than one classroom from each sampled school. Details of the sampling of schools and students for each country are provided in Appendix B

The TIMSS 2003 sample designs were implemented in an acceptable manner by all participating countries except Yemen and the Syrian Arab Republic. Both adopted classroom sampling procedures that did not meet the TIMSS sampling standards and so could not be approved by the International Study Centre. As a result, data for these two countries were summarized in an appendix to the international reports.

9.2.4   Target Population Sizes

Exhibits 9.5 and 9.6 summarize for eighth and fourth grade, respectively, the number of schools and students in each country's target populations, as well as the number of sampled schools and students that participated in the study. The population figures for schools and students were derived from the sampling frames that countries used to draw their TIMSS samples.[5] As a check on the sampling procedure, TIMSS used the sampling weights computed for each country (see Section 9.3) to derive an estimate of the student population size. In most cases, the estimated population size closely matched the actual population size from the sampling frame, as shown in Exhibits 9.5 and 9.6.

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5   The school and student population sizes for Russian Federation, however, were not computed from the sampling frame, but were provided by the NRC.

Exhibit 9. 5   **Population and Sample Sizes – Eighth Grade**

Country	Population		Sample			Mean Age of Students Tested
	Schools	**Students**	**Schools**	**Students**	**Est. Pop.**	
Armenia	1,439	56,841	149	5,726	54,502	14.9
Australia	2,297	253,522	207	4,791	257,407	13.9
Bahrain	67	10,581	67	4,199	10,543	14.1
Belgium (Flemish)	1,084	70,204	148	4,970	70,637	14.1
Botswana	215	37,975	146	5,150	36,142	15.1
Bulgaria	2,360	83,202	164	4,117	87,603	14.9
Chile	5,165	286,050	195	6,377	265,749	14.2
Chinese Taipei	863	318,196	150	5,379	297,842	14.2
Cyprus	59	9,700	59	4,002	9,231	13.8
Egypt	7,586	1,503,480	217	7,095	1,365,244	14.4
England	3,912	615,535	87	2,830	662,049	14.3
Estonia	517	21,419	151	4,040	20,995	15.2
Ghana	6,533	280,912	150	5,100	276,427	15.5
Hong Kong, SAR	423	84,898	125	4,972	82,693	14.4
Hungary	2,563	114,364	155	3,302	100,609	14.5
Indonesia	19,864	2,836,390	150	5,762	2,318,021	14.5
Iran, Islamic Rep. of	22,227	1,639,906	181	4,942	1,369,991	14.4
Israel	816	110,284	146	4,318	85,689	14.0
Italy	5,778	591,400	171	4,278	567,587	13.9
Japan	10,859	1,298,927	146	4,856	1,269,256	14.4
Jordan	1,676	106,875	140	4,489	96,297	13.9
Korea, Rep. of	2,593	610,271	149	5,309	570,771	14.6
Latvia	831	33,255	140	3,630	33,708	15.0
Lebanon	1,567	56,689	152	3,814	57,789	14.6
Lithuania	1,077	54,081	143	4,964	46,940	14.9
Macedonia, Rep. of	338	30,814	149	3,893	25,963	14.6
Malaysia	1,641	435,722	150	5,314	414,259	14.3
Moldova, Rep. of	1,352	61,158	149	4,033	61,669	14.9
Morocco	1,371	387,115	131	2,943	209,164	15.2
Netherlands	1,109	198,171	130	3,065	188,992	14.3
New Zealand	407	57,454	169	3,801	57,392	14.1
Norway	1,076	55,559	138	4,133	61,222	13.8
Palestinian Nat'l Auth.	872	69,210	145	5,357	64,860	14.1
Philippines	7,073	1,393,428	137	6,917	1,395,144	14.8
Romania	7,324	316,441	148	4,104	294,631	15.0

Exhibit 9. 5   **Population and Sample Sizes – Eighth Grade** *(...Continued)*

Country	Population		Sample			Mean Age of Students Tested
	Schools	Students	Schools	Students	Est. Pop.	
Russian Federation	58,595	2,081,919	214	4,667	1,923,173	14.2
Saudi Arabia	6,224	355,676	155	4,295	326,754	14.1
Scotland	425	63,795	128	3,516	58,824	13.7
Serbia	1,100	92,261	149	4,296	87,330	14.9
Singapore	164	53,100	164	6,018	53,292	14.3
Slovak Republic	1,646	85,465	179	4,215	75,718	14.3
Slovenia	444	24,637	174	3,578	22,972	13.8
South Africa	8,926	1,009,215	255	8,952	783,951	15.1
Sweden	1,467	110,121	159	4,256	108,760	14.9
Syrian Arab Republic	1,687	243,356	134	4,895	201,972	14.0
Tunisia	740	196,012	150	4,931	184,104	14.8
United States	45,472	3,911,458	232	8,912	3,447,236	14.2
Benchmarking Participants						
Basque Country, Spain	448	16,803	120	2,514	18,710	14.1
Indiana State, US	937	84,499	54	2,188	76,051	13.5
Ontario Province, Can.	2,919	144,603	186	4,217	145,430	13.8
Quebec Province, Can.	639	91,687	175	4,411	82,209	14.2

Exhibit 9. 6   **Population and Sample Sizes – Fourth Grade**

Country	Population		Sample			Mean Age of Students Tested
	Schools	Students	Schools	Students	Est. Pop.	
Armenia	1,439	56,841	148	5,674	51,844	10.9
Australia	6,779	263,710	204	4,321	257,221	9.9
Belgium (Flemish)	2,154	73,232	149	4,712	66,236	10.0
Chinese Taipei	2,436	318,173	150	4,661	311,390	10.2
Cyprus	256	10,322	150	4,328	9,946	9.9
England	15,341	646,863	123	3,585	588,366	10.3
Hong Kong, SAR	756	85,364	132	4,608	79,039	10.2
Hungary	2,563	116,580	157	3,319	101,631	10.5
Iran, Islamic Rep. of	47,274	1,668,358	171	4,352	1,322,801	10.4
Italy	7,504	555,270	171	4,282	513,655	9.8
Japan	20,256	1,185,936	150	4,535	1,172,766	10.4
Latvia	890	34,775	140	3,687	29,607	11.1
Lithuania	1,554	52,679	153	4,422	45,123	10.9
Moldova, Rep. of	1,425	58,467	151	3,981	56,649	11.0
Morocco	14,219	567,743	197	4,264	632,376	11.0
Netherlands	6,668	198,775	130	2,937	170,068	10.2
New Zealand	1,944	60,410	220	4,308	59,301	10.0
Norway	2,330	62,344	139	4,342	60,354	9.8
Philippines	34,127	2,040,230	135	4,572	1,805,303	10.8
Russian Federation	63,641	1,312,450	205	3,963	1,138,069	10.6
Scotland	1,870	63,879	125	3,936	56,191	9.7
Singapore	182	49,900	182	6,668	49,994	10.3
Slovenia	444	19,826	174	3,126	18,750	9.8
Tunisia	3,944	222,537	150	4,334	216,491	10.4
United States	71,863	4,143,117	248	9,829	3,518,039	10.2
Yemen	5,748	526,954	150	4,205	445,965	11.0
Benchmarking Participants						
Indiana State, US	1,675	88,487	56	2,233	80,151	9.5
Ontario Province, Can.	3,770	153,625	189	4,362	142,180	9.8
Quebec Province, Can.	1,879	98,326	193	4,350	85,895	10.1

9.3   Calculating Sampling Weights

While the TIMSS 2003 multistage stratified cluster design provided very economical and effective data collection in a school environment, it resulted in differential probabilities of selection of the students. Individual country designs could be quite complex, as may be seen from Appendix B showing how the design was implemented in each country. To adjust for these differential selection probabilities and ensure accurate survey estimates, TIMSS 2003 computed a sampling weight for each participant student. Because appropriate sampling weights were essential for the computation of accurate survey results, the capacity to provide proper sampling weights was an essential requirement of an acceptable sample design. This section describes the procedures for calculating sampling weights for the TIMSS 2003 data.

Sampling weights were calculated according to a three-step procedure involving selection probabilities for schools, classrooms, and students. The first step consisted of calculating a school weight, which also incorporated weighting factors from any additional front-end sampling stages such regions. A school-level participation adjustment was then made in the school weight to compensate for any sampled schools that did not participate. That adjustment was calculated independently for each explicit stratum.

In the second step, a classroom weight reflecting the probability of the sampled classroom(s) being selected from among all the classrooms in the school at the target grade level was calculated. This classroom weight was calculated independently for each school. A classroom-level participation adjustment was then made in the class weight to compensate for any sampled classrooms that did not participate, or for classrooms where the participation rate among students fell below 50 percent. This participation adjustment was set to unity in cases where a single classroom was sampled in each school. If a school agreed to take part in the study but the classroom (i.e., the classroom teacher) refused to participate, adjustment for non-participation was made at the school level. If one of two (or more) selected classrooms in a school did not participate, the classroom participation adjustment was calculated for that school, independently for each explicit stratum.

The third and final step consisted of calculating a student weight. For most countries, because intact classrooms were sampled, each student in the sampled classrooms was certain of selection, and so the student weight was 1.0. When students were further sampled within classrooms, a student weight reflecting the probability of being sampled from the classroom was calculated. A non-participation adjustment was then made to compensate for students who did not take part in the testing. This was calculated independently for each sampled classroom.

The basic sampling weight attached to each student record was the product of the three weights described above: the first stage (school) weight, the second stage (classroom) weight, and the third stage (student) weight. The overall student sampling weight was the product of the three weights including non-participation adjustments.

9.3.1 The First Stage (School) Weight

Essentially, the first stage weight represented the inverse of the probability of a school being sampled at the first stage. The TIMSS 2003 sample design required that school selection probabilities be proportional to the school size, generally defined as enrolment in the target grade. The basic first stage weight for the ith sampled school was thus defined as:

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

where n was the number of sampled schools, m_i was the measure of size for the ith school, and

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

where N was the total number of schools in the explicit stratum.

For countries such as the Russian Federation that included region as a preliminary sampling step, the basic first stage weight also incorporated the probability of selection in this stage. The first stage weight in this case was simply the product of the "region" weight and the first stage weight, as described above.

In some countries, schools were selected with equal probabilities. This generally occurred when a large sampling ratio was used. In some countries also, explicit or implicit strata were defined to deal with very large schools or small schools. Equal probability sampling was necessary in these strata.

Under equal probability sampling, the basic first stage weight for the ith sampled school was defined as

$$BW_{sc}^i = \frac{N}{n}$$

where n was the number of sampled schools and N was the total number of schools in the explicit stratum. The basic weight for all sampled schools in a stratum was identical in this context.

9.3.2 School Non-Participation Adjustment

First stage weights were calculated for all sampled and replacement schools that participated. A school-level participation adjustment was applied to compensate for schools that were sampled but did not participate, and were not replaced. Sampled schools that were found to be ineligible[6] were removed from the calculation of this adjustment. The school-level participation adjustment was calculated separately for each explicit stratum for all participants except England at the eighth grade.[7]

The adjustment was calculated as follows:

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

where n_s was 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} the number of schools that did not participate.

The final first stage weight for the ith school, corrected for non-participating schools, thus became:

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

9.3.3 The Second Stage (Classroom) Weight

The second stage weight represented the inverse of the probability of a classroom within a sampled school being selected. Although most countries sampled classrooms within schools with equal probability, when student sub-sampling was involved, countries had to sample classrooms using PPS techniques. Procedures for calculating sampling weights are presented below for both approaches.

Equal Probability Weighting: For the ith school, let C^i be the total number of classrooms and c^i the number of sampled classrooms in the study. Using equal probability sampling, the basic second stage weight assigned to all sampled classrooms in the ith school was:

$$BW_{cl1}^i = \frac{C^i}{c^i}$$

For most countries, c^i took the values 1, 2 or 3. Some countries sampled all classrooms in a selected school.

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6   A sampled school was ineligible if it was found to contain no eligible (i.e. eighth- or fourth-grade students). Such schools usually were in the sampling frame by mistake, or schools that had recently closed.

7   The sampling plan for England included implicit stratification of schools by a measure of school academic performance. Because the school participation rate even after including replacement schools was relatively low (54%), it was decided to apply the school non-participation adjustment separately for each implicit stratum. Since the measure of academic performance used for stratification was strongly related to average school mathematics and science achievement on TIMSS, this served to reduce the potential for bias introduced by low school participation.

Probability Proportional to Size Weighting: For the ith school, let $k^{i,j}$ be the size of the jth classroom. Using PPS sampling, the final second stage weight assigned to the jth sampled classroom in the ith school was

$$BW_{cl2}^{i,j} = \frac{K^i}{c^i \cdot k^{i,j}}$$

where c^i was the number of sampled classrooms in the ith school, as defined earlier, and

$$K^i = \sum_{j=1}^{c^i} k^{i,j}$$

For most countries, c^i took the values 1 or 2. Some countries sampled all classrooms in a selected school.

9.3.4   Classroom Non-Participation Adjustment

Second stage weights were calculated for all sampled classrooms in the sampled schools and replacement schools that participated. A classroom-level participation adjustment was applied to compensate for classrooms that did not participate or where student participation rate was below 50 percent. Sampled classrooms with student participation below 50 percent were given a weight of zero and considered to be non-participating. The classroom-level participation adjustment was calculated separately for each explicit stratum.

The adjustment was calculated as follows:

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

where c^i was the number of sampled classrooms in the ith school, as defined earlier, and c_*^i was the number of sampled classrooms in the ith school that participated.

When no subsampling of classrooms was involved, the final second stage weight assigned to all sampled classrooms in the ith school became:

$$FW_{cl1}^i = A_{cl} \cdot BW_{cl1}^i$$

When classrooms were subsampled within schools, the final second stage weight assigned to the jth sampled classroom in the ith school became:

$$FW_{cl2}^{i,j} = A_{cl} \cdot BW_{cl2}^{i,j}$$

9.3.5   The Third Stage (Student) Weight

The third stage weight represented the inverse of the probability of a student in a sampled class being selected. Where intact classrooms that included all students were sampled, as was the case in most participating countries, this probability was unity. However, the probability of selection varied when students were sampled within classrooms. Procedures for calculating weights are presented below for both sampling approaches. The third stage weight is calculated independently for each sampled classroom.

Sampling Intact Classrooms: The basic third stage weight for the jth classroom in the ith school was simply:

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

Subsampling Students: The basic third stage weight for the jth classroom in the ith school was :

$$BW_{st2}^{i,j} = \frac{k^{i,j}}{s^{i,j}}$$

where $k^{i,j}$ was the size of the jth classroom in the ith school, as defined earlier, and $s^{i,j}$ was the number of sampled students per sampled classroom. The latter number usually remained constant for all sampled classrooms.

9.3.6   Adjustment for Student Non-Participation

The student non-participation adjustment was calculated for each participating classroom as follows:

$$A_{st}^{i,j} = \frac{s_{rs}^{i,j} + s_{nr}^{i,j}}{s_{rs}^{i,j}}$$

where $s_{rs}^{i,j}$ was the number of eligible students that participated in the jth classroom of the ith school and $s_{nr}^{i,j}$ was the number of eligible students that did not participate in the jth classroom of the ith school.

The third and final stage weight for students the jth classroom in the ith school thus became

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

where Δ equals one when there was no student subsampling and 2 when students were subsampled within classrooms.

9.3.7   Overall Sampling Weight

The overall sampling weight was simply the product of the final first stage weight, the final second stage weight, and the final third stage weight. For example, when no subsampling of classrooms was involved, this product is given by

$$W^{i,j} = FW^i_{sc} \cdot FW^i_{cl1} \cdot FW^{i,j}_{st\Delta}$$

or

$$W^{i,j} = A_{sc} \cdot BW^i_{sc} \cdot FW^i_{cl1} \cdot A^{i,j}_{st} BW^{i,j}_{st\Delta}$$

When classrooms were subsampled within schools, the overall sampling weight was

$$W^{i,j} = FW^i_{sc} \cdot FW^{i,j}_{cl2} \cdot FW^{i,j}_{st\Delta}$$

or

$$W^{i,j} = A_{sc} \cdot BW^i_{sc} \cdot FW^{i,j}_{cl2} \cdot A^{i,j}_{st} BW^{i,j}_{st\Delta}$$

It is important to note that sampling weights vary by school and classroom, but that students within the same classroom have the same sampling weights. It is also important to note that sampling weights were calculated separately by explicit strata.[8]

9.4   Calculating School and Student Participation Rates

Since non-participation by sampled schools or students can lead to bias in the study results, a variety of participation rates were computed to show the level of success each country achieved in securing participation from their sampled schools and students. To monitor school participation, three school participation rates were computed: one based on originally sampled schools only; one based on originally sampled and first replacement schools; and one based on originally sampled and both first and second replacement schools. Classroom and student participation rates were also computed, as were overall participation rates.

9.4.1   Unweighted School Participation Rates

The three unweighted school participation rates that were computed were the following:

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

$R^{sc-r1}_{unw} =$ unweighted school participation rate, including sampled and first replacement schools,

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8   Overall sampling weights for Malaysia were modified to allow sampling estimate of national gender ratio to equal the ratio observed on the sampling frame. This was accomplished by multiplying all male (female) student weights by the desired constant.

R_{unw}^{sc-r2} = unweighted school participation rate, including sampled, first and second replacement schools.

Each unweighted school participation rate was defined as the ratio of the number of participating schools to the number of originally sampled schools, excluding any ineligible schools. A school was labelled as "participating school" if at least one of its sampled classrooms had at least a 50 percent student participation rate. The rates were calculated as follows:

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

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

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

9.4.2 Unweighted Classroom Participation Rates

The unweighted classroom participation rate was computed as follows (see section 9.3.4 for a complete definition of A_{cl}):

$$R_{unw}^{cl} = \frac{1}{A_{cl}}$$

9.4.3 Unweighted Student Participation Rates

The unweighted student participation rate was computed as follows where summations are done over all participating schools and over all classrooms with at least 50 percent of its students participating in the study:

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

9.4.4 Unweighted Overall Participation Rates

Three unweighted overall participation rates were computed for each country. They were as follows:

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

R_{unw}^{ov-r1} = unweighted overall participation rate, including sampled and first replacement schools,

R_{unw}^{ov-r2} = unweighted overall participation rate, including sampled, first and second replacement schools.

For each country, the overall participation rate was defined as the product of the unweighted school participation rate, unweighted classroom participation rate and the unweighted student participation rate. They were calculated as follows:

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

$$R_{unw}^{ov-r1} = R_{unw}^{sc-r1} \cdot R_{unw}^{cl} \cdot R_{unw}^{st}$$

$$R_{unw}^{ov-r2} = R_{unw}^{sc-r2} \cdot R_{unw}^{cl} \cdot R_{unw}^{st}$$

9.4.5 Weighted School Participation Rates

Three weighted school-level participation rates were computed for each country. They were as follows:

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

R_{wtd}^{sc-r1} = weighted school participation rate, including sampled and first replacement schools,

R_{wtd}^{sc-r2} = weighted school participation rate, including sampled, first and second replacement schools.

The weighted school participation rates were calculated as follows:

$$R_{wtd}^{sc-s} = \frac{\sum_{i,j}^{s} BW_{sc}^{i} \cdot FW_{cl\Omega}^{i,j} \cdot FW_{st\Delta}^{i,j}}{\sum_{i,j}^{s+r1+r2} FW_{sc}^{i} \cdot FW_{cl\Omega}^{i,j} \cdot FW_{st\Delta}^{i,j}}$$

$$R_{wtd}^{sc-r1} = \frac{\sum_{i,j}^{s+r1} BW_{sc}^{i} \cdot FW_{cl\Omega}^{i,j} \cdot FW_{st\Delta}^{i,j}}{\sum_{i,j}^{s+r1+r2} FW_{sc}^{i} \cdot FW_{cl\Omega}^{i,j} \cdot FW_{st\Delta}^{i,j}}$$

$$R_{wtd}^{sc-r2} = \frac{\sum\limits_{i,j}^{s+r1+r2} BW_{sc}^{i} \cdot FW_{cl\Omega}^{i,j} \cdot FW_{st\Delta}^{i,j}}{\sum\limits_{i,j}^{s+r1+r2} FW_{sc}^{i} \cdot FW_{cl\Omega}^{i,j} \cdot FW_{st\Delta}^{i,j}}$$

where both the numerator and denominator were summations over all responding students and the appropriate classroom-level and student-level sampling weights were used. Ω and Δ take the value one when no sub-sampling was involved and two otherwise. Note that the basic school-level weight appears in the numerator, whereas the final school-level weight appears in the denominator.

The denominator remains unchanged in all three equations and is the weighted estimate of the total enrolment in the target population. The numerator, however, changes from one equation to the next. Only students from originally sampled schools and from classrooms with at least 50 percent of their students participating in the study were included in the first equation. Students from first replacement schools were added in the second equation, and students from first and second replacement schools were added in the third equation.

9.4.6   Weighted Classroom Participation Rates

The weighted classroom participation rate was computed as follows:

$$R_{wtd}^{cl} = \frac{\sum\limits_{i,j}^{s+r1+r2} BW_{sc}^{i} \cdot BW_{cl\Omega}^{i,j} \cdot FW_{st\Delta}^{i,j}}{\sum\limits_{i,j}^{s+r1+r2} BW_{sc}^{i} \cdot FW_{cl\Omega}^{i,j} \cdot FW_{st\Delta}^{i,j}}$$

where both the numerator and denominator were summations over all responding students from classrooms with at least 50 percent of their students participating in the study, and the appropriate student-level sampling weights were used. Note that the basic classroom-level weight appears in the numerator, whereas the final classroom-level weight appears in the denominator. Furthermore, the denominator in this formula was the same quantity that appears in the numerator of the weighted school-level participation rate for all participating schools, sampled and replacement.

9.4.7   Weighted Student Participation Rates

The weighted student participation rate was computed as follows:

$$R_{wtd}^{st} = \frac{\sum_{i,j}^{s+r1+r2} BW_{sc}^{i} \cdot BW_{cl\Omega}^{i,j} \cdot BW_{st\Delta}^{i,j}}{\sum_{i,j}^{s+r1+r2} BW_{sc}^{i} \cdot BW_{cl\Omega}^{i,j} \cdot FW_{st\Delta}^{i,j}}$$

where both the numerator and denominator were summations over all responding students from participating schools. Note that the basic student-level weight appears in the numerator, whereas the final student-level weight appears in the denominator. Furthermore, the denominator in this formula was the same quantity that appears in the numerator of the weighted classroom-level participation rate for all participating schools, sampled and replacement.

9.4.8   Weighted Overall Participation Rates

Three weighted overall participation rates were computed. They were as follows:

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

R_{wtd}^{ov-r1} = weighted overall participation rate, including sampled and first replacement schools,

R_{wtd}^{ov-r2} = weighted overall participation rate, including sampled, first and second replacement schools.

Each weighted overall participation rate was defined as the product of the appropriate weighted school participation rate, weighted classroom participation rate and the weighted student participation rate. They were computed as follows:

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

$$R_{wtd}^{ov-r1} = R_{wtd}^{sc-r1} \cdot R_{wtd}^{cl} \cdot R_{wtd}^{st}$$

$$R_{wtd}^{ov-r2} = R_{wtd}^{sc-r2} \cdot R_{wtd}^{cl} \cdot R_{wtd}^{st}$$

Weighted school, classroom, student, and overall participation rates were computed for each participating country using these procedures.

9.5 Meeting TIMSS' Standards for Sampling Participation

Countries understood that the goal for sampling participation was 100 percent for all sampled schools and students. Guidelines for reporting achievement data for countries securing less than full participation were modelled after IEA's TIMSS previous studies. As summarized in Exhibit 9.7, countries were assigned to one of three categories on the basis of their sampling participation. Countries in Category 1 were considered to have met the TIMSS sampling requirement, and to have an acceptable participation rate. Countries in Category 2 met the sampling 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 2003 was to have as many countries as possible achieve Category 1 status.

Exhibits 9.8 through 9.15 present the school, classroom, student, and overall participation rates (weighted and unweighted) and achieved sample sizes for each participating country. At the eighth grade, most countries had excellent participation rates and belong in Category 1. However, Hong Kong, the Netherlands, and Scotland met the sampling requirements only after including replacement schools, and therefore belong in Category 2. Although the United States and Morocco had overall participation rates after including replacement schools of just below 75 percent (73 percent and 71 percent, respectively) it was decided during the sampling adjudication that this rate did not warrant placement in Category 3. Instead, results for the two countries in the international reports were annotated with a double-obelisk indicating that they nearly satisfied the guidelines for sample participation rates after including replacement schools. Despite extraordinary efforts to secure full participation, England's participation fell below the minimum requirement of 50 percent, so its results were annotated accordingly and placed below a line in exhibits in the International Reports. As described earlier in this chapter, a special school-level participation adjustment that capitalized on the unique implicit stratification variables used by England was applied to England's data to reduce the risk of bias.

At the fourth grade, all participants achieved the minimum acceptable participation rates, although Australia, England, Hong Kong SAR, the Netherlands, Scotland and the United States did so only after including replacement schools, and so their results were annotated with an obelisk in the achievement exhibits in the international report.

Exhibit 9. 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 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 "dagger" 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 appear in a separate section of the achievement tables, below the other countries, in international reports. These countries would be presented in alphabetical order.

Exhibit 9. 8   School Participation Rates & Sample Sizes – Eighth Grade

Country	School Participation Before Replacement (Weighted Percentage)	School Participation After Replacement (Weighted Percentage)	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
Armenia	99.3%	99.3%	150	150	149	0	149
Australia	80.7%	90.1%	230	226	186	21	207
Bahrain	100.0%	100.0%	67	67	67	0	67
Belgium (Flemish)	81.5%	98.7%	150	150	122	26	148
Botswana	97.6%	97.6%	152	150	146	0	146
Bulgaria	96.7%	97.0%	170	169	163	1	164
Chile	98.1%	100.0%	195	195	191	4	195
Chinese Taipei	100.0%	100.0%	150	150	150	0	150
Cyprus	100.0%	100.0%	59	59	59	0	59
Egypt	99.3%	100.0%	217	217	215	2	217
England	39.6%	54.1%	160	160	62	25	87
Estonia	99.3%	99.3%	154	152	151	0	151
Ghana	100.0%	100.0%	150	150	150	0	150
Hong Kong, SAR	74.5%	83.3%	150	150	112	13	125
Hungary	98.2%	98.7%	160	157	154	1	155
Indonesia	98.1%	100.0%	150	150	148	2	150
Iran, Islamic Rep. of	100.0%	100.0%	188	181	181	0	181
Israel	97.7%	99.4%	150	147	143	3	146
Italy	95.9%	100.0%	172	171	164	7	171
Japan	97.3%	97.3%	150	150	146	0	146
Jordan	100.0%	100.0%	150	140	140	0	140
Korea, Rep. of	99.3%	99.3%	151	150	149	0	149
Latvia	91.6%	93.9%	150	149	137	3	140
Lebanon	93.2%	95.0%	160	160	148	4	152
Lithuania	91.5%	95.3%	150	150	137	6	143
Macedonia, Rep. of	93.9%	99.4%	150	150	142	7	149
Malaysia	100.0%	100.0%	150	150	150	0	150
Moldova, Rep. of	98.8%	100.0%	150	149	147	2	149
Morocco	78.5%	78.5%	227	165	131	0	131
Netherlands	78.7%	86.7%	150	150	118	12	130
New Zealand	85.9%	97.1%	175	174	149	20	169
Norway	91.9%	91.9%	150	150	138	0	138
Palestinian Nat'l Auth.	100.0%	100.0%	150	145	145	0	145

Note: Some percentages may appear inconsistent because of rounding.

Exhibit 9. 8   **School Participation Rates & Sample Sizes – Eighth Grade** (...Continued)

Country	School Participation Before Replacement (Weighted Percentage)	School Participation After Replacement (Weighted Percentage)	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
Philippines	81.4%	85.5%	160	160	132	5	137
Romania	99.3%	99.3%	150	149	148	0	148
Russian Federation	99.3%	99.3%	216	216	214	0	214
Saudi Arabia	95.1%	96.9%	160	160	154	1	155
Scotland	76.2%	85.3%	150	150	115	13	128
Serbia	99.3%	99.3%	150	150	149	0	149
Singapore	100.0%	100.0%	164	164	164	0	164
Slovak Republic	95.8%	100.0%	180	179	170	9	179
Slovenia	94.3%	98.7%	177	177	169	5	174
South Africa	89.4%	95.7%	265	265	241	14	255
Sweden	96.8%	99.4%	160	160	155	4	159
Syrian Arab Republic	81.0%	89.0%	150	150	121	13	134
Tunisia	100.0%	100.0%	150	150	150	0	150
United States	70.8%	78.4%	301	296	211	21	232
Benchmarking Participants							
Basque Country, Spain	99.6%	100.0%	120	120	119	1	120
Indiana State, US	96.6%	96.6%	56	56	54	0	54
Ontario Province, Can.	84.4%	93.4%	200	196	171	15	186
Quebec Province, Can.	91.2%	92.8%	199	185	173	2	175

Note: Some percentages may appear inconsistent because of rounding.

Exhibit 9. 9   **School Participation Rates & Sample Sizes – Fourth Grade**

Country	School Participation Before Replacement (Weighted Percentage)	School Participation After Replacement (Weighted Percentage)	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
Armenia	98.7%	98.7%	150	150	148	0	148
Australia	77.9%	90.3%	230	227	178	26	204
Belgium (Flemish)	88.9%	99.3%	150	150	133	16	149
Chinese Taipei	100.0%	100.0%	150	150	150	0	150
Cyprus	100.0%	100.0%	150	150	150	0	150
England	54.3%	82.0%	150	150	79	44	123
Hong Kong, SAR	77.3%	88.0%	150	150	116	16	132
Hungary	98.2%	98.7%	160	159	156	1	157
Iran, Islamic Rep. of	100.0%	100.0%	176	171	171	0	171
Italy	96.6%	100.0%	172	171	165	6	171
Japan	100.0%	100.0%	150	150	150	0	150
Latvia	91.2%	94.0%	150	149	137	3	140
Lithuania	91.6%	95.6%	160	160	147	6	153
Moldova, Rep. of	97.4%	100.0%	153	151	147	4	151
Morocco	86.8%	86.8%	227	225	197	0	197
Netherlands	51.7%	87.2%	150	149	77	53	130
New Zealand	87.0%	97.7%	228	228	194	26	220
Norway	89.3%	92.6%	150	150	134	5	139
Philippines	78.4%	85.0%	160	160	122	13	135
Russian Federation	99.4%	100.0%	206	205	204	1	205
Scotland	63.6%	83.3%	150	150	94	31	125
Singapore	100.0%	100.0%	182	182	182	0	182
Slovenia	94.6%	98.8%	177	177	169	5	174
Tunisia	100.0%	100.0%	150	150	150	0	150
United States	69.9%	82.1%	310	300	212	36	248
Yemen	100.0%	100.0%	150	150	150	0	150
Benchmarking Participants							
Indiana State, US	100.0%	100.0%	56	56	56	0	56
Ontario Province, Can.	88.9%	94.5%	200	196	179	10	189
Quebec Province, Can.	99.0%	99.9%	198	194	192	1	193

Note: Some percentages may appear inconsistent because of rounding.

Exhibit 9. 10   **Student Participation Rates & Sample Sizes - 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 Students Eligible	Number of Students Absent	Number of Students Assessed
Armenia	90.1%	6,388	56	0	6,332	606	5,726
Australia	92.6%	5,286	60	16	5,210	419	4,791
Bahrain	97.9%	4,351	64	0	4,287	88	4,199
Belgium (Flemish)	96.7%	5,161	19	7	5,135	165	4,970
Botswana	98.0%	5,388	70	70	5,248	98	5,150
Bulgaria	95.7%	4,489	167	0	4,322	205	4,117
Chile	98.5%	6,528	15	39	6,474	97	6,377
Chinese Taipei	99.0%	5,525	54	37	5,434	55	5,379
Cyprus	96.0%	4,314	79	66	4,169	167	4,002
Egypt	97.5%	7,259	0	0	7,259	164	7,095
England	86.1%	3,360	34	0	3,326	496	2,830
Estonia	96.1%	4,242	28	5	4,209	169	4,040
Ghana	93.0%	5,690	189	0	5,501	401	5,100
Hong Kong, SAR	96.8%	5,204	33	4	5,167	195	4,972
Hungary	95.4%	3,506	7	34	3,465	163	3,302
Indonesia	99.0%	5,884	61	0	5,823	61	5,762
Iran, Islamic Rep. of	97.9%	5,215	118	52	5,045	103	4,942
Israel	94.7%	4,880	2	319	4,559	241	4,318
Italy	96.9%	4,628	35	173	4,420	142	4,278
Japan	95.9%	5,121	51	5	5,065	209	4,856
Jordan	96.5%	4,871	176	41	4,654	165	4,489
Korea, Rep. of	98.6%	5,451	18	50	5,383	74	5,309
Latvia	89.0%	4,146	23	5	4,118	488	3,630
Lebanon	95.9%	4,030	64	0	3,966	152	3,814
Lithuania	88.9%	6,619	58	955	5,606	642	4,964
Macedonia, Rep. of	96.7%	4,028	0	0	4,028	135	3,893
Malaysia	98.2%	5,464	46	0	5,418	104	5,314
Moldova, Rep. of	96.2%	4,262	58	0	4,204	171	4,033
Morocco	90.8%	3,243	25	0	3,218	275	2,943
Netherlands	93.6%	3,283	2	0	3,281	216	3,065
New Zealand	92.8%	4,343	170	65	4,108	307	3,801
Norway	92.4%	4,569	24	61	4,484	351	4,133
Palestinian Nat'l Auth.	99.0%	5,543	117	14	5,412	55	5,357
Philippines	95.9%	7,498	288	0	7,210	293	6,917

Note: Some percentages may appear inconsistent because of rounding.

Exhibit 9. 10   **Student Participation Rates & Sample Sizes - 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 Students Eligible	Number of Students Absent	Number of Students Assessed
Romania	98.2%	4,249	53	4	4,192	88	4,104
Russian Federation	97.0%	4,926	50	62	4,814	147	4,667
Saudi Arabia	97.5%	4,553	115	5	4,433	138	4,295
Scotland	89.5%	3,962	24	0	3,938	422	3,516
Serbia	96.3%	4,514	52	2	4,460	164	4,296
Singapore	96.7%	6,236	5	0	6,231	213	6,018
Slovak Republic	95.4%	4,428	16	0	4,412	197	4,215
Slovenia	92.5%	3,883	19	2	3,862	284	3,578
South Africa	92.1%	9,905	320	0	9,585	633	8,952
Sweden	89.0%	4,941	58	93	4,790	534	4,256
Syrian Arab Republic	98.0%	5,001	0	1	5,000	105	4,895
Tunisia	98.0%	5,106	74	0	5,032	101	4,931
United States	94.0%	9,891	90	279	9,522	610	8,912
Benchmarking Participants							
Basque Country, Spain	97.6%	2,736	41	113	2,582	68	2,514
Indiana State, US	97.1%	2,402	43	107	2,252	64	2,188
Ontario Province, Can.	95.1%	4,693	59	208	4,426	209	4,217
Quebec Province, Can.	91.8%	4,919	78	46	4,795	384	4,411

Note: Some percentages may appear inconsistent because of rounding.

Exhibit 9. 11   **Student Participation Rates & Sample Sizes - 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 Students Eligible	Number of Students Absent	Number of Students Assessed
Armenia	91.4%	6,275	57	0	6,218	544	5,674
Australia	94.2%	4,675	69	39	4,567	246	4,321
Belgium (Flemish)	97.7%	4,866	17	20	4,829	117	4,712
Chinese Taipei	99.3%	4,793	11	88	4,694	33	4,661
Cyprus	97.2%	4,536	27	60	4,449	121	4,328
England	92.8%	3,917	45	0	3,872	287	3,585
Hong Kong, SAR	94.9%	4,901	23	4	4,874	266	4,608
Hungary	94.0%	3,603	11	67	3,525	206	3,319
Iran, Islamic Rep. of	98.4%	4,587	83	80	4,424	72	4,352
Italy	96.7%	4,641	23	185	4,433	151	4,282
Japan	97.4%	4,690	16	16	4,658	123	4,535
Latvia	93.7%	3,980	16	4	3,960	273	3,687
Lithuania	92.0%	5,701	35	852	4,814	392	4,422
Moldova, Rep. of	97.0%	4,162	46	0	4,116	135	3,981
Morocco	93.0%	4,546	0	0	4,546	282	4,264
Netherlands	96.4%	3,080	0	30	3,050	113	2,937
New Zealand	94.8%	4,785	145	107	4,533	225	4,308
Norway	95.2%	4,706	22	107	4,577	235	4,342
Philippines	95.0%	5,225	40	31	5,154	582	4,572
Russian Federation	96.8%	4,229	54	66	4,109	146	3,963
Scotland	92.0%	4,283	34	0	4,249	313	3,936
Singapore	97.6%	6,851	16	0	6,835	167	6,668
Slovenia	91.7%	3,410	13	17	3,380	254	3,126
Tunisia	98.9%	4,408	23	0	4,385	51	4,334
United States	95.5%	10,795	49	429	10,317	488	9,829
Yemen	92.6%	4,550	0	0	4,550	345	4,205
Benchmarking Participants							
Indiana State, US	98.2%	2,472	44	151	2,277	44	2,233
Ontario Province, Can.	95.6%	4,813	91	158	4,564	202	4,362
Quebec Province, Can.	91.2%	4,864	51	73	4,740	390	4,350

Note: Some percentages may appear inconsistent because of rounding.

Exhibit 9. 12   **Unweighted School, Class, and Student Participation Rates – Eighth Grade**

Country	School Participation Before Replacement	School Participation After Replacement	Class Participation	Student Participation	Overall Participation Before Replacement	Overall Participation After Replacement
Armenia	99%	99%	99%	90%	89%	89%
Australia	82%	92%	100%	92%	76%	84%
Bahrain	100%	100%	100%	98%	98%	98%
Belgium (Flemish)	81%	99%	98%	97%	77%	94%
Botswana	97%	97%	100%	98%	96%	96%
Bulgaria	96%	97%	99%	95%	91%	92%
Chile	98%	100%	100%	99%	96%	99%
Chinese Taipei	100%	100%	100%	99%	99%	99%
Cyprus	100%	100%	100%	96%	96%	96%
Egypt	99%	100%	100%	98%	97%	98%
England	39%	54%	99%	85%	33%	46%
Estonia	99%	99%	100%	96%	95%	95%
Ghana	100%	100%	100%	93%	93%	93%
Hong Kong, SAR	75%	83%	99%	96%	71%	80%
Hungary	98%	99%	100%	95%	93%	94%
Indonesia	99%	100%	100%	99%	98%	99%
Iran, Islamic Rep. of	100%	100%	100%	98%	98%	98%
Israel	97%	99%	100%	95%	92%	94%
Italy	96%	100%	100%	97%	93%	97%
Japan	97%	97%	100%	96%	93%	93%
Jordan	100%	100%	100%	96%	96%	96%
Korea, Rep. of	99%	99%	100%	99%	98%	98%
Latvia	92%	94%	99%	88%	81%	82%
Lebanon	93%	95%	100%	96%	89%	91%
Lithuania	91%	95%	100%	89%	81%	84%
Macedonia, Rep. of	95%	99%	100%	97%	91%	96%
Malaysia	100%	100%	100%	98%	98%	98%
Moldova, Rep. of	99%	100%	100%	96%	95%	96%
Morocco	79%	79%	100%	91%	73%	73%
Netherlands	79%	87%	100%	93%	73%	81%
New Zealand	86%	97%	100%	93%	79%	90%
Norway	92%	92%	100%	92%	85%	85%
Palestinian Nat'l Auth.	100%	100%	100%	99%	99%	99%
Philippines	83%	86%	100%	96%	79%	82%
Romania	99%	99%	100%	98%	97%	97%
Russian Federation	99%	99%	100%	97%	96%	96%

Note: Some percentages may appear inconsistent because of rounding.

Exhibit 9. 12   **Unweighted School, Class, and Student Participation Rates – Eighth Grade** *(...Continued)*

Country	School Participation Before Replacement	School Participation After Replacement	Class Participation	Student Participation	Overall Participation Before Replacement	Overall Participation After Replacement
Saudi Arabia	96%	97%	100%	97%	93%	94%
Scotland	77%	85%	100%	89%	68%	76%
Serbia	99%	99%	100%	96%	96%	96%
Singapore	100%	100%	100%	97%	97%	97%
Slovak Republic	95%	100%	100%	96%	91%	96%
Slovenia	95%	98%	100%	93%	88%	91%
South Africa	91%	96%	100%	93%	85%	90%
Sweden	97%	99%	99%	89%	85%	87%
Syrian Arab Republic	81%	89%	100%	98%	79%	87%
Tunisia	100%	100%	100%	98%	98%	98%
United States	71%	78%	99%	94%	66%	73%
Benchmarking Participants						
Basque Country, Spain	99%	100%	100%	97%	97%	97%
Indiana State, US	96%	96%	100%	97%	94%	94%
Ontario Province, Can.	87%	95%	100%	95%	83%	90%
Quebec Province, Can.	94%	95%	100%	92%	86%	87%

Note: Some percentages may appear inconsistent because of rounding.

Exhibit 9. 13   **Unweighted School, Class, and Student Participation Rates – Fourth Grade**

Country	School Participation Before Replacement	School Participation After Replacement	Class Participation	Student Participation	Overall Participation Before Replacement	Overall Participation After Replacement
Armenia	99%	99%	100.0%	91%	90%	90%
Australia	78%	90%	100%	95%	74%	85%
Belgium (Flemish)	89%	99%	100%	98%	87%	97%
Chinese Taipei	100%	100%	100%	99%	99%	99%
Cyprus	100%	100%	100%	97%	97%	97%
England	53%	82%	100%	93%	49%	76%
Hong Kong, SAR	77%	88%	99%	95%	73%	83%
Hungary	98%	99%	100%	94%	92%	93%
Iran, Islamic Rep. of	100%	100%	100%	98%	98%	98%
Italy	96%	100%	100%	97%	93%	97%
Japan	100%	100%	100%	97%	97%	97%
Latvia	92%	94%	100%	93%	86%	87%
Lithuania	92%	96%	99%	92%	84%	87%
Moldova, Rep. of	97%	100%	100%	97%	94%	97%
Morocco	88%	88%	100%	94%	82%	82%
Netherlands	52%	87%	100%	96%	50%	84%
New Zealand	85%	96%	100%	95%	81%	92%
Norway	89%	93%	100%	95%	85%	88%
Philippines	76%	84%	100%	89%	68%	75%
Russian Federation	100%	100%	100%	96%	96%	96%
Scotland	63%	83%	100%	93%	58%	77%
Singapore	100%	100%	100%	98%	98%	98%
Slovenia	95%	98%	100%	92%	88%	91%
Tunisia	100%	100%	100%	99%	99%	99%
United States	71%	83%	99%	95%	67%	78%
Yemen	100%	100%	100%	92%	92%	92%
Benchmarking Participants						
Indiana State, US	100%	100%	100%	98%	98%	98%
Ontario Province, Can.	91%	96%	100%	96%	87%	92%
Quebec Province, Can.	99%	99%	100%	92%	91%	91%

Note: Some percentages may appear inconsistent because of rounding.

Exhibit 9. 14   **Weighted School, Class, and Student Participation Rates – Eighth Grade**

Country	School Participation Before Replacement	School Participation After Replacement	Class Participation	Student Participation	Overall Participation Before Replacement	Overall Participation After Replacement
Armenia	99%	99%	99%	90%	89%	89%
Australia	81%	90%	100%	93%	75%	83%
Bahrain	100%	100%	100%	98%	98%	98%
Belgium (Flemish)	82%	99%	98%	97%	77%	94%
Botswana	98%	98%	100%	98%	96%	96%
Bulgaria	97%	97%	99%	96%	92%	92%
Chile	98%	100%	100%	99%	97%	99%
Chinese Taipei	100%	100%	100%	99%	99%	99%
Cyprus	100%	100%	100%	96%	96%	96%
Egypt	99%	100%	100%	97%	97%	97%
England	40%	54%	99%	86%	34%	46%
Estonia	99%	99%	100%	96%	95%	95%
Ghana	100%	100%	100%	93%	93%	93%
Hong Kong, SAR	74%	83%	99%	97%	72%	80%
Hungary	98%	99%	100%	95%	94%	94%
Indonesia	98%	100%	100%	99%	97%	99%
Iran, Islamic Rep. of	100%	100%	100%	98%	98%	98%
Israel	98%	99%	100%	95%	93%	94%
Italy	96%	100%	100%	97%	93%	97%
Japan	97%	97%	100%	96%	93%	93%
Jordan	100%	100%	100%	96%	96%	96%
Korea, Rep. of	99%	99%	100%	99%	98%	98%
Latvia	92%	94%	100%	89%	81%	83%
Lebanon	93%	95%	100%	96%	89%	91%
Lithuania	92%	95%	100%	89%	81%	84%
Macedonia, Rep. of	94%	99%	100%	97%	91%	96%
Malaysia	100%	100%	100%	98%	98%	98%
Moldova, Rep. of	99%	100%	100%	96%	95%	96%
Morocco	79%	79%	100%	91%	71%	71%
Netherlands	79%	87%	100%	94%	74%	81%
New Zealand	86%	97%	100%	93%	80%	90%
Norway	92%	92%	100%	92%	85%	85%
Palestinian Nat'l Auth.	100%	100%	100%	99%	99%	99%
Philippines	81%	86%	100%	96%	78%	82%

Note: Some percentages may appear inconsistent because of rounding.

Exhibit 9. 14 **Weighted School, Class, and Student Participation Rates – Eighth Grade** *(...Continued)*

Country	School Participation Before Replacement	School Participation After Replacement	Class Participation	Student Participation	Overall Participation Before Replacement	Overall Participation After Replacement
Romania	99%	99%	100%	98%	98%	98%
Russian Federation	99%	99%	100%	97%	96%	96%
Saudi Arabia	95%	97%	100%	97%	93%	94%
Scotland	76%	85%	100%	89%	68%	76%
Serbia	99%	99%	100%	96%	96%	96%
Singapore	100%	100%	100%	97%	97%	97%
Slovak Republic	96%	100%	100%	95%	91%	95%
Slovenia	94%	99%	100%	93%	87%	91%
South Africa	89%	96%	100%	92%	82%	88%
Sweden	97%	99%	99%	89%	85%	87%
Syrian Arab Republic	81%	89%	100%	98%	79%	87%
Tunisia	100%	100%	100%	98%	98%	98%
United States	71%	78%	99%	94%	66%	73%
Benchmarking Participants						
Basque Country, Spain	100%	100%	100%	98%	97%	98%
Indiana State, US	97%	97%	100%	97%	94%	94%
Ontario Province, Can.	84%	93%	100%	95%	80%	89%
Quebec Province, Can.	91%	93%	100%	92%	84%	85%

Note: Some percentages may appear inconsistent because of rounding.

Exhibit 9. 15   **Weighted School, Class, and Student Participation Rates – Fourth Grade**

Country	School Participation Before Replacement	School Participation After Replacement	Class Participation	Student Participation	Overall Participation Before Replacement	Overall Participation After Replacement
Armenia	99%	99%	100%	91%	90%	90%
Australia	78%	90%	100%	94%	73%	85%
Belgium (Flemish)	89%	99%	100%	98%	87%	97%
Chinese Taipei	100%	100%	100%	99%	99%	99%
Cyprus	100%	100%	100%	97%	97%	97%
England	54%	82%	100%	93%	50%	76%
Hong Kong, SAR	77%	88%	99%	95%	73%	83%
Hungary	98%	99%	100%	94%	92%	93%
Iran, Islamic Rep. of	100%	100%	100%	98%	98%	98%
Italy	97%	100%	100%	97%	93%	97%
Japan	100%	100%	100%	97%	97%	97%
Latvia	91%	94%	100%	94%	85%	88%
Lithuania	92%	96%	99%	92%	84%	87%
Moldova, Rep. of	97%	100%	100%	97%	94%	97%
Morocco	87%	87%	100%	93%	81%	81%
Netherlands	52%	87%	100%	96%	50%	84%
New Zealand	87%	98%	100%	95%	82%	93%
Norway	89%	93%	100%	95%	85%	88%
Philippines	78%	85%	100%	95%	75%	81%
Russian Federation	99%	100%	100%	97%	96%	97%
Scotland	64%	83%	100%	92%	59%	77%
Singapore	100%	100%	100%	98%	98%	98%
Slovenia	95%	99%	100%	92%	87%	91%
Tunisia	100%	100%	100%	99%	99%	99%
United States	70%	82%	99%	95%	66%	78%
Yemen	100%	100%	100%	93%	93%	93%
Benchmarking Participants						
Indiana State, US	100%	100%	100%	98%	98%	98%
Ontario Province, Can.	89%	94%	100%	96%	85%	90%
Quebec Province, Can.	99%	100%	100%	91%	90%	91%

Note: Some percentages may appear inconsistent because of rounding.