Chapter 4
TIMSS Advanced 2008 Sampling

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4.1 Overview

This chapter describes the sample design developed and implemented for TIMSS Advanced 2008 and the derivation of sampling weights for the study. It explains how the target populations were defined in the participating countries and how the national sample designs were developed and implemented. It also explains how the sampling weights and participation rates were calculated. To complement the general information in this chapter, Appendix B provides specific details about the national sample designs and their implementation, including details of population coverage and exclusions, stratification variables, and sample size allocation.

TIMSS Advanced 2008 proposed a uniform sample design to all participants to ensure that differences in survey results were not attributable to the use of different sampling methodologies. This uniform sample design was flexible enough to accommodate the distinctiveness of national school systems at the upper secondary level and how the target populations were defined across participating countries. The TIMSS Advanced 2008 National Research Coordinators (NRCs) were responsible for developing their national sample designs and implementing them in their own countries, with the support of the sampling consultants.[1]

4.2 The TIMSS Advanced 2008 Target Populations

TIMSS Advanced 2008 measured student achievement in two student populations at the end of secondary schooling: advanced mathematics students and physics students. To allow for meaningful interpretation of the TIMSS Advanced 2008 data, and to ensure the comparability of the results across the participating countries, it was important that both target populations be accurately and consistently defined.

The TIMSS Advanced 2008 target population for advanced mathematics was defined as *the students in the final year of secondary schooling who have taken courses in advanced mathematics.* For physics, the TIMSS Advanced 2008 target population was defined as *the students in the final year of secondary schooling who have taken courses in physics.*

4.2.1 Courses in Advanced Mathematics and Physics

The courses that would define the target populations had to cover most, if not all, of the advanced mathematics and physics topics that were outlined in the *TIMSS Advanced 2008 Assessment Frameworks* (Garden, et al., 2006). The students attending these courses were likely to be the most advanced mathematics or physics students in the final year of upper secondary school in the participating countries. It was the responsibility of the NRCs to identify these advanced mathematics courses and physics courses. In many cases, the courses were found in specific academic programs, or tracks, in upper secondary schools.

1 The team of statisticians from Statistics Canada and the Sampling Unit of the IEA Data Processing and Research Center (DPC)–under the responsibility of Statistics Canada–served as sampling consultants for TIMSS Advanced 2008.

Exhibit 4.1 and Exhibit 4.2 give an overview of the national target population definitions for advanced mathematics and physics, respectively, in terms of the courses or programs in which the eligible students would be found. In all instances, these students were in their final year of secondary schooling; although this meant the students had varied numbers of years of schooling across the participating countries and were of different average age. Chapter 1 and Chapter 7 of the *TIMSS Advanced 2008 International Report* (Mullis, Martin, Robitaille, & Foy, 2009) provide descriptions of the upper secondary educational systems in the participating countries and how the national target populations were ultimately defined.

EXHIBIT 4.1 – TIMSS Advanced 2008 Advanced Mathematics Populations

Country	Advanced Mathematics Population
Armenia*	Students in the 11th grade in "Physmat" schools
Iran, Islamic Rep. of	Students in the 12th grade in the advanced mathematics and physics track in the pre-university stage
Italy	Students in the 13th grade in an advanced mathematics program or an advanced mathematics and physics program, found in Liceo Scientifico (general schools with scientific focus), Liceo Scientifico Tecnologico (general schools with focus on technology) and Instituti Technici (vocational full time training)
Lebanon	Students in the 12th grade in the general science program
Netherlands	Students in the 12th grade who had taken the advanced mathematics course Math B2 in the pre-university track (VWO)
Norway**	Students in the 13th grade who had taken the 3MX advanced mathematics course in the natural science program of the academic track
Philippines	Students in the 10th grade who had taken advanced mathematics courses and attended either a "science and technology oriented" high school, a regional science high school, a university rural high school and laboratory school, or other public science high school
Russian Federation	Students in the 11th grade who had taken 6 hours or more per week of instruction in mathematics
Slovenia	Students in the 12th grade in general gymnasia programs
Sweden	Students in the 12th grade in the natural science program and the technology program who had taken the mathematics D course and may have taken the mathematics E course

* As a result of recent reforms to increase the number of years of school, Armenian students were assessed in what is now called the 11th grade. However, since the assessed students skipped a grade as part of implementing the reforms, they have had 10 years of formal schooling.

** After implementing a curriculum reform, the Norwegian school system consists of 13 years of schooling. However, having started school before the reform was implemented, the students in the TIMSS Advanced 2008 target population, although in the 13th grade, had just 12 years of schooling.

Exhibit 4.2 TIMSS Advanced 2008 Physics Populations

Country	Physics Population
Armenia*	Students in the 11th grade in "Physmat" schools
Iran, Islamic Rep. of	Students in the 12th grade in the advanced mathematics and physics track in the pre-university stage
Italy	Students in the 13th grade in an advanced mathematics and physics program, found in Liceo Scientifico (general schools with scientific focus), Liceo Scientifico Tecnologico (general schools with focus on technology) and Instituti Technici (vocational full time training)
Lebanon	Students in the 12th grade in the general science program
Netherlands	Students in the 12th grade who had taken the Physics 2 course in the pre-university track (VWO)
Norway**	Students in the 13th grade who had taken the 3FY physics course in the natural science program of the academic track
Russian Federation	Students in the 11th grade who had taken 3 hours or more per week of instruction in physics
Slovenia	Students in the 12th grade in general gymnasia programs who chose to take an additional physics course in their final year
Sweden	Students in the 12th grade in the natural science program and the technology program who had taken the physics B course

* As a result of recent reforms to increase the number of years of school, Armenian students were assessed in what is now called the 11th grade. However, since the assessed students skipped a grade as part of implementing the reforms, they have had 10 years of formal schooling.

** After implementing a curriculum reform, the Norwegian school system consists of 13 years of schooling. However, having started school before the reform was implemented, the students in the TIMSS Advanced 2008 target population, although in the 13th grade, had just 12 years of schooling.

4.2.2 TIMSS Advanced Coverage Indices

In order to quantify the proportion of the school-leaving age cohort taking advanced mathematics and physics courses, TIMSS Advanced computed a TIMSS Advanced Mathematics Coverage Index (TAMCI) and a TIMSS Advanced Physics Coverage Index (TAPCI) for each participating country. In part, these indices reflect the overall sampling coverage of the respective populations in each country; but, more importantly, they show that only a very select group of final-year students were considered eligible for TIMSS Advanced 2008, and that the percentages of these students varied across countries.

The TIMSS Advanced coverage indices for advanced mathematics and physics were defined as follows:

$$TAMCI = \frac{\text{Estimated total number of students in the advanced mathematics population}}{\text{Total national population in the corresponding age cohort}} \times 100\%$$

$$TAPCI = \frac{\text{Estimated total number of students in the physics population}}{\text{Total national population in the corresponding age cohort}} \times 100\%$$

The numerator in each index is the total number of students eligible for TIMSS Advanced 2008, either for advanced mathematics or physics, as estimated from the weighted samples. The denominator is an estimate of the size of the eligible age cohort size in 2008 corresponding to the mean age of the target population. The TIMSS Advanced coverage indices are presented in Exhibit 4.3. The final-year age cohort for each country was defined to be the age corresponding to its average age at the time of testing, as estimated from the weighted samples, and its size was estimated from national census figures. The estimated target populations were estimated from the weighted samples.

Exhibit 4.3 TIMSS Advanced 2008 Coverage Indices

Country	Years of Formal Schooling	Final-year Age Cohort	Estimated Size of Final-year Age Cohort	Estimated Target Population		TIMSS Advanced Coverage Indices	
				Advanced Mathematics	Physics	Advanced Mathematics	Physics
Armenia	10	18	62,758	2,684	2,684	4.3%	4.3%
Iran, Islamic Rep. of	12	18	1,705,000	111,298	111,908	6.5%	6.6%
Italy	13	19	605,507	119,162	23,176	19.7%	3.8%
Lebanon	12	18	79,784	4,702	4,724	5.9%	5.9%
Netherlands	12	18	205,200	7,091	6,889	3.5%	3.4%
Norway	12	19	61,093	6,668	4,181	10.9%	6.8%
Philippines	10	16	1,900,656	14,007	—	0.7%	—
Russian Federation	10/11	17	2,073,041	29,672	52,934	1.4%	2.6%
Slovenia	12	19	21,815	8,836	1,635	40.5%	7.5%
Sweden	12	19	125,923	16,116	13,873	12.8%	11.0%

4.3 The Sample Design

The basic TIMSS Advanced 2008 sample design consisted of two sampling stages: schools were sampled at the first stage, and one or more intact classes of students were sampled from a list of eligible classes within a selected school at the second stage. Two methods were used to sample schools in TIMSS Advanced 2008. In countries where the number of schools in the population greatly exceeded the number required in the sample, a systematic probability-proportional-to-size (PPS) sampling method was used. This method, followed by the selection of classes within the selected schools in a second sampling stage, is often referred to as systematic two-stage *PPS* sampling and is described in most sampling textbooks (*e.g.*, Cochran 1977, Lohr 1999). The PPS sampling approach was used in Iran, Italy and the Russian Federation. In other countries where the number of schools to sample from was relatively small, schools were sampled with equal probabilities. This was the case in Lebanon, the Netherlands, Norway, the Philippines and Sweden. In Armenia and Slovenia, a census of schools was taken. In all countries, classes were sampled within selected schools using a random systematic sampling method.

National sample designs had to take into account the expected overlap across the advanced mathematics and physics populations. In some countries, students in a specific program belonged to both advanced mathematics and physics populations. In other countries, eligible students were found in two programs: students in one program belonged to both populations, while students from the other program belonged only to the advanced mathematics population. Finally, in a third category of countries students were free to choose the courses they were to attend and thus the degree of overlap between the two populations could not be predicted. Thus, two principal sample designs—a single school sample and separate school samples—were developed. While countries that participated in TIMSS Advanced 2008 adopted one of these two sample designs, some opted for slight modifications to account for particular national circumstances. Since the Philippines participated only in advanced mathematics, a single school sample was sufficient.

Countries were encouraged to use explicit and implicit stratification to ensure good representation of specific population groups in the national samples and to increase the efficiency of the national sample designs. Explicit stratification was often required to separate schools according to the populations found in schools—schools with advanced mathematics only, physics only, or with both populations. For example, the sampling frame for Norway was divided into a total of six explicit strata based on the populations present and the size of the schools. Appendix B describes the use of explicit and implicit stratification in the participating countries.

4.3.1 Sample Design for Completely Overlapping Populations

This sample design was implemented in countries where there was complete overlap of both the advanced mathematics and physics populations and consisted of selecting a single sample of schools and one or more classes for both populations. Students in each sampled class were randomly assigned an advanced mathematics booklet or a physics booklet. Consequently, about half of the students received an advanced mathematics test booklet while the other half received a physics test booklet. Armenia, Iran and Lebanon implemented this design.

4.3.2 Sample Design for Partially Overlapping Populations

This sample design was implemented in countries where students belonged to either, or even both, populations with no discernible pattern as students were free to choose which courses they would attend. In order to streamline the within-school operations and avoid testing students twice, this sample design consisted of selecting two separate school samples. Both samples of schools were selected simultaneously to prevent overlap. In one school sample, only the advanced mathematics classes were listed for class sampling, and students in the sampled classes were assigned one of the four advanced mathematics test booklets. In the other school sample, only physics classes were listed for class sampling, and students in the sampled classes were assigned one of the four physics test booklets. The Netherlands, Norway and Sweden used this sample design.

In Sweden, an additional sampling step was introduced after the selection of the school samples. In schools where the two programs of interest—natural science and technology—were present, classes from only one program were sampled to keep response burden to a minimum and simplify the within-school operations. Therefore, the sample of two-program schools was randomly divided into natural science and technology explicit strata and each school's sample of classes was drawn from the classes of the relevant program.

4.3.3 Special Adaptation for the Russian Federation

In the Russian Federation, a sample of regions was selected prior to the sampling of schools. Approximately half of the regions were sampled. Regions were selected with probability proportional to size, the largest regions being sampled with certainty. Thus, the sample of regions consisted of a group of certainty regions and a group of sampled regions. In a second stage, school samples were selected from the participating regions, with each school being assigned to only one population—advanced mathematics or physics.

From the group of certainty regions, all schools were grouped into three explicit strata, regardless of region, according to the TIMSS

Advanced populations found in the schools: schools with advanced mathematics classes, schools with advanced mathematics classes and physics classes, and schools with physics classes. Regions were used as implicit strata within each explicit stratum. The sample of schools for advanced mathematics was selected among the first two strata while the sample of schools for the physics sample was selected among the second and third strata. No overlap was allowed in the stratum of schools with both study populations; hence schools could be selected for only one population.

For the group of sampled regions, the sampling of schools was done within each sampled region individually—regions being the primary sample units—and schools within each sampled region were split into two groups. The sample of schools for advanced mathematics was selected from the first group of schools, comprising all schools with only the advanced mathematics population and half of the schools, randomly selected, where both populations were found. Conversely, the sample of schools for physics was selected from the second group of schools: all schools with only the physics population and the remaining half of the schools where both populations were found.

4.3.4 Special Adaptation for Italy

In Italy, the complex structure of advanced mathematics and physics education in the schools and classes required a combination of the two established sample designs, since the courses of interest were found in a program with advanced mathematics classes and another program with advanced mathematics classes and physics classes. Schools were stratified according to the three possible combinations: schools with the advanced mathematics program, schools with both programs, and schools with the advanced mathematics and physics program.

The sample design adopted for Italy mostly followed the sample design for partially overlapping populations, as described in section 4.3.2, whereby only one of the subjects would be assessed in most sampled schools. In order to meet the sample size requirements, however, both subjects were tested in some sampled schools where both populations could be found.

First, a sample of schools was selected from each of the three strata. Schools from the first stratum were eligible only for the advanced mathematics sample. Of the schools sampled from the second stratum, approximately half were randomly assigned to both the advanced mathematics and the physics samples, while the remaining schools were assigned only to the physics sample. In schools sampled for both populations, one class was sampled from a list of classes from the advanced mathematics program and one class was sampled from a list of classes from the advanced mathematics and physics program. While students from the sampled class of the advanced mathematics program received only advanced mathematics booklets, half of the students from the sampled class of the advanced mathematics and physics program received an advanced mathematics booklet and the other half received a physics booklet. Of the schools sampled from the third stratum, one sixth were randomly assigned to the advanced mathematics sample, while the remaining schools were assigned to the physics sample.

4.3.5 Special Adaptation for Slovenia

In Slovenia, the relatively small student populations made it impossible to meet the TIMSS Advanced 2008 student sample size requirements with either of the two standard sample designs. In particular, all physics students in the country had to be selected. Moreover, all schools were selected for both subjects given the small number of schools in the country.

In each school, the advanced mathematics classes and the physics classes were listed separately. A sample of classes was drawn from the list of advanced mathematics classes while all classes from the list of physics classes were selected. Since some students in the selected physics classes could have been sampled for advanced mathematics as well, some students were assessed for both subjects. The order in which the two assessments was administered was determined randomly in each school.

4.3.6 Replacement Schools

Although all participating countries strove to achieve participation rates of 100 percent, this was not always possible. To avoid sample losses, the TIMSS Advanced 2008 sample design identified replacement schools for each sampled school whenever possible. In general, the school immediately preceding and the school immediately following a sampled school on the ordered school sampling frame were designated as replacement schools, and always within the same explicit stratum. Since schools were grouped into strata and ordered by size, it was expected that the characteristics of the replacement schools would be similar to those of the originally sampled schools they were intended to replace. This strategy was implemented in Iran, Italy, Lebanon, the Philippines and the Russian Federation.

The Netherlands did not have designated replacement schools as there were not enough schools left after sampling. An alternative procedure was implemented, whereby a list of replacement schools identified by the sampling consultants was provided to the NRCs. These replacement schools were used in their order of appearance on the list, as necessary.

In Armenia and Slovenia, there were no replacement schools, as all eligible schools were in the sample for both populations. In Norway and

Sweden, since all schools were selected for the advanced mathematics sample or for the physics sample, there were no replacement schools available either.

4.3.7 Sampling for the Field Test

Prior to the TIMSS Advanced 2008 data collection, an extensive field test was conducted during March and April of 2007 in 8 of the 10 participating countries. The goal of this field test was to check all instruments—particularly the achievement tests—and operational procedures under conditions similar to those of the data collection.

The goal was to select approximately 25 schools for the field test, which would yield 600 tested students in advanced mathematics, and 600 tested students in physics. Appendix B provides details on the sampling carried out for the field test in each participating country.

4.4 Sampling Precision and Sample Sizes

TIMSS Advanced 2008 set high standards for sampling precision to guarantee that the survey estimates would be accurate, thereby making comparisons between and within countries meaningful. The goal was to achieve a 95 percent confidence interval for the estimate of a national student-level mean to be within 10 percent of its standard deviation. Because the TIMSS Advanced achievement scales have a standard deviation of 100 points, this would translate into standard errors of approximately 5 points.

With this in mind, and taking into account the clustered nature of the samples and the added uncertainty stemming from the imputation used in scaling the achievement data (see Chapter 8), the minimum sample sizes required were set at 2,000 tested students for advanced mathematics and 2,000 for physics, selected from a minimum of 120 schools. These minima were fixed after looking at the sample sizes and precision achieved with the TIMSS Advanced 1995 results. As these were minima, most countries increased their sample sizes to account for non-response. For the Russian Federation, the sample size was increased further because of the additional clustering effect due to sampling regions before sampling schools. The selected and achieved national school sample sizes are presented Appendix B.

4.5 Sampling Implementation

Sound and rigorous sampling of schools and students was a key quality component of TIMSS Advanced 2008. The TIMSS Advanced sampling consultants selected the school samples for all countries but one[2] and trained NRCs in selecting probability samples of classes and students using IEA's within-school sampling software (IEA, 2007) provided by the IEA DPC. As an essential part of their sampling activities, NRCs were responsible for providing detailed documentation describing their national sampling procedures: target populations, school sampling frames, school sample selection if conducted by the NRC and within-school sampling procedures. The documentation submitted by each TIMSS Advanced participant was reviewed by the sampling consultants, who then provided additional information, including coverage and exclusion levels, stratification variables, sampling methods, participation rates, and preliminary variance estimates. The TIMSS & PIRLS International Study Center and the TIMSS Advanced 2008 Sampling Referee, Dr. Keith Rust of Westat, Inc., used this information to evaluate the quality of the samples. All participating countries produced acceptable implementations of the TIMSS Advanced 2008 sample design.

4.5.1 Population Coverage and Exclusions

All participating countries were able to provide full coverage of their defined target populations of advanced mathematics students and

2 Italy selected its own school samples. The procedures used and the samples drawn were verified and approved by the sampling consultants.

physics students. However, countries were allowed specific types of exclusions of schools and students that would have been either too difficult or too costly to assess. For example, very small or remote schools were sometimes excluded. Within some selected schools, students with special needs or students not fluent in the language of the test were sometimes excluded. Exhibit 4.4 summarizes population coverage and exclusions for the TIMSS Advanced 2008 advanced mathematics and physics populations. For every participant, the overall percentage of excluded students (combining school-level and within-sample exclusions) was less than 5 percent. Some TIMSS Advanced 2008 participants had no within-school exclusions. Details on national exclusion categories are presented in Appendix B.

Exhibit 4.4 Coverage and Exclusions of TIMSS Advanced 2008 Populations

Advanced Mathematics

Country	Coverage	School-level Exclusions	Within-sample Exclusions	Overall Exclusions
Armenia	100%	0.0%	0.0%	0.0%
Iran, Islamic Rep. of	100%	0.0%	0.0%	0.0%
Italy	100%	0.0%	0.5%	0.5%
Lebanon	100%	1.3%	0.0%	1.3%
Netherlands	100%	2.5%	0.0%	2.5%
Norway	100%	0.9%	0.1%	1.0%
Philippines	100%	0.0%	0.0%	0.0%
Russian Federation	100%	0.0%	0.0%	0.0%
Slovenia	100%	0.0%	1.3%	1.3%
Sweden	100%	1.5%	0.2%	1.7%

Physics

Country	Coverage	School-level Exclusions	Within-sample Exclusions	Overall Exclusions
Armenia	100%	0.0%	0.0%	0.0%
Iran, Islamic Rep. of	100%	0.0%	0.0%	0.0%
Italy	100%	0.0%	0.9%	0.9%
Lebanon	100%	1.3%	0.0%	1.3%
Netherlands	100%	2.5%	0.2%	2.7%
Norway	100%	0.4%	0.0%	0.5%
Russian Federation	100%	0.0%	0.0%	0.0%
Slovenia	100%	0.0%	0.5%	0.5%
Sweden	100%	2.1%	0.1%	2.3%

4.5.2 Population and Sample Sizes

The minimum school sample size required to meet the TIMSS Advanced sampling standards was 120 schools for each study population. All but three countries complied with this rule. In Armenia, the number of schools with eligible advanced mathematics and physics students was 38 and all of them were selected. Italy was given permission to select 100 schools for advanced mathematics and 112 for physics. In Slovenia, there were only 87 schools with advanced mathematics students, of which 66 also had physics students; all 87 schools were sampled. Most countries sampled one or two classes per sampled school. Details on the national samples of schools and classes are provided in Appendix B.

Exhibit 4.5 displays the number of eligible schools and students in each country's target populations, based on the sampling frame used to select the TIMSS Advanced 2008 school samples and after removing any excluded schools. This exhibit also includes the number of sampled schools and students that participated in the assessments and provides an estimate of the student population size based on the student samples. The estimate of the student population size (the sixth column of Exhibit 4.5) was derived using sampling weights, while the population of students (the third column) was taken from the national sampling frames. The estimated populations should be fairly close to the student populations taken from the sampling frames. Differences are attributable to within-sample exclusions and to changes in populations from the time the sampling frames were created to the time the TIMSS Advanced 2008 assessments were conducted. The observed differences are largest for Iran and Italy. In Iran, many sampled schools were closed, which explains the lower estimated population from the sample. In Italy, many sampled schools were found to be ineligible as they did not have any eligible students. Also, many sampled schools had fewer eligible students than expected in both populations, especially so in physics.

Exhibit 4.5 TIMSS Advanced 2008 Population and Sample Sizes

Advanced Mathematics

Country	Population		Sample			Average Age at Time of Testing
	Schools	Students	Schools	Students	Estimated Population	
Armenia	38	2,755	38	858	2,684	17.7
Iran, Islamic Rep. of	3,187	123,802	119	2,425	111,298	18.1
Italy	1,318	149,558	91	2,143	119,162	19.0
Lebanon	345	5,037	212	1,615	4,702	17.9
Netherlands	493	6,906	112	1,537	7,091	18.0
Norway	253	7,424	107	1,932	6,668	18.8
Philippines	165	15,105	118	4,091	14,007	16.4
Russian Federation	1,031	29,285	143	3,185	29,672	17.0
Slovenia	87	9,945	79	2,156	8,836	18.8
Sweden	328	11,934	116	2,303	16,116	18.8

Physics

Country	Population		Sample			Average Age at Time of Testing
	Schools	Students	Schools	Students	Estimated Population	
Armenia	38	2,755	38	894	2,684	17.7
Iran, Islamic Rep. of	3,187	123,802	119	2,434	111,908	18.0
Italy	642	31,163	91	1,861	23,176	18.9
Lebanon	345	5,037	210	1,600	4,724	17.9
Netherlands	493	6,906	116	1,511	6,889	18.1
Norway	236	4,404	101	1,642	4,181	18.8
Russian Federation	1,875	54,782	149	3,166	52,934	17.1
Slovenia	66	1,752	54	1,120	1,635	18.7
Sweden	317	10,134	121	2,291	13,873	18.8

4.6 Calculating Sampling Weights

The estimation method used to produce estimates of totals from TIMSS Advanced 2008 data was a simple weighted sum of all responding students for any variable of interest. Estimates of percentages or means were taken as ratios of these estimated totals. The national sample designs implemented in TIMSS Advanced generally involved varying selection probabilities for schools, classes, and students that required specific sampling weights for each participating class, which were assigned to each individual student. The sampling weights were computed separately for each TIMSS Advanced population and within each explicit stratum.

The overall sampling weights assigned to individual students comprise a series of multiplicative components. A basic overall weight was derived from the inverse of the probability of selecting a student from the population. This basic overall weight was adjusted by multiplicative factors that account for non-responding schools, classes, and students. For some countries, additional adjustments were required to account for additional sampling steps.

Sampling weights were calculated according to a three-step procedure involving selection probabilities for schools, classes, and students. The first step consisted of calculating a school weight, which also incorporated weighting factors from any additional front-end sampling stages, such as regions in the Russian Federation. A school-level participation adjustment also was computed to compensate for any sampled schools that did not participate and were not replaced.

In a second step, a class weight was calculated, reflecting the probability of the selected class(es) being sampled among all the eligible classes in a school. This class weight was calculated independently within each participating school. A class-level participation adjustment was computed to compensate for sampled classes that did not participate, or if the participation rate among students in a class fell below 50 percent. The class participation adjustment was computed at the explicit stratum level, rather than at the school level, to reduce the potential for response bias.

The third and final step consisted of calculating a student weight, which was computed according to the particular sample design implemented in each participating country. In countries where separate school samples were selected for each population, intact classes were sampled and all students were selected with certainty. Thus, the student weight was set to 1. In countries where a single school sample was selected for both populations, and both advanced mathematics booklets and physics booklets were distributed in the sampled classes, students within the sampled classes were randomly selected for one population or the other. Thus, the student weight was calculated within each class to reflect the probability of a student being selected for a specific population. A student participation adjustment then was made to compensate for sampled students who did not take part in the assessments. This adjustment was calculated separately for each sampled class.

The basic overall sampling weight assigned to each student was the product of the three basic weights—the school weight, the class weight, and the student weight. The final overall sampling weight was the product of the basic overall sampling weight and the three participation adjustments.

4.6.1 The School Weight

In general, the school weight represents the inverse of the probability of a school being sampled at the first stage. In the national sample designs for Iran, Italy, and the Russian Federation, the school selection probabilities were proportional to school size, generally defined as the number of students in the target population. Thus, the basic school weight (with the subscript *sc*) for the i^{th} sampled school of population g (where g takes the value M for advanced mathematics and P for physics) was defined as:

$$BW_{sc}^{g,i} = \frac{MOS}{n \cdot mos_i}$$

Where n was the number of sampled schools in population g, mos_i was the measure of size for the i^{th} school, and

$$MOS = \sum_{i=1}^{N} mos_i$$

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

In order to avoid school weights being less than 1, the size of large schools (schools of size greater than the sampling interval given by MOS/n), was set as the sampling interval. As a result, these large schools were sampled with a probability of 1.

In a similar way, the measure of size for small schools was set to a constant to prevent large variance fluctuations that typically arise from the large school weights that could occur otherwise. As a result, these small schools were sampled with equal probability.

In Armenia, Lebanon, the Netherlands, Norway, the Philippines, Slovenia, and Sweden, equal probability sampling of schools, rather than PPS, was carried out, meaning that every school had the same measure of size ($mos_i = 1$). Thus the school weight for the i^{th} sampled school in population g in these countries was calculated as:

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

Special Weight Factor for Italy

As was mentioned earlier, special weight factors or adjustments were calculated to account for additional sampling steps introduced during school sampling and arising from special adaptations to national sample designs in some countries.

In Italy, while all schools sampled from the stratum of schools with both the advanced mathematics program and the advanced mathematics and physics program were assigned to the physics population, approximately half of them were randomly sub-sampled for the advanced mathematics population. Thus, an additional weight factor for the sub-sampled schools in advanced mathematics was computed as the inverse of the probability of a school sampled from this stratum being selected for advanced mathematics, and the original school weight was multiplied by this additional weight factor.

Special Weight Factors for the Russian Federation

The sample design for the Russian Federation included a preliminary sampling stage, in which regions were sampled. Thus, the school weight also incorporated the probability of selection in this preliminary stage. Hence, the school weight for all schools from the Russian Federation was the product of the "region" weight and the school weight described earlier. This region weight was computed in a manner similar to the school weight, with regions having selection probabilities proportional to their size.

An additional weight factor was required for schools sampled from the group of sampled regions and where both populations were found. This extra factor was required as these schools were randomly assigned to only one population prior to school sampling. Within each region, an additional weight factor was computed as the inverse of the probability of a school being assigned to a specific population. The school weight for these schools was multiplied by this weight factor to account for this additional sampling step.

Special Weight Factor for Sweden

In Sweden, in the stratum comprised of schools with students from both the natural science and the technology programs, an additional sampling step was introduced after school sampling. The sampled schools were randomly allocated to one of the programs and only students from the selected program took part in TIMSS Advanced 2008. An additional weight factor was computed for these sampled schools as the inverse of the probability of a school being selected for a specific program. Hence, the school weight for schools assigned to each specific program was multiplied by this additional weight factor to account for this additional sampling step.

4.6.2 School Participation Adjustment

A school-level participation adjustment was required to compensate for schools that were sampled but did not participate, and were not replaced. Sampled schools that were found to be ineligible[3] were removed from the calculation of this adjustment. The school participation adjustment was calculated separately for each explicit stratum and each population g, as follows:

$$A_{sc}^{g} = \begin{cases} \dfrac{n_s + n_{r1} + n_{r2} + n_{nr}}{n_s + n_{r1} + n_{r2}} & \text{for participating schools} \\ 0 & \text{for non-participating schools} \end{cases}$$

where n_s was the number of 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 and were not replaced.

The final school weight assigned to all students in the i^{th} school of population g ($g = M$ or P), corrected for non-participating schools, was:

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

3 A sampled school was ineligible if it was found to contain no eligible students. Such schools usually were in the sampling frame by mistake or were schools that had recently closed.

4.6.3 The Class Weight

The class weight is the inverse of the probability of a class being selected within a sampled school. All countries sampled classes with equal probability. For the i^{th} school sampled in population g, let $C^{g,i}$ be the total number of eligible classes and $c^{g,i}$ the number of sampled classes. The class weight (with the subscript cl) assigned to all sampled classes in the i^{th} school in population g was computed as:

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

For most TIMSS Advanced participants, $c^{g,i}$ took the values 1 or 2. Some TIMSS Advanced participants sampled all eligible classes in a selected school, in which case $c^{g,i}$ was equal to $C^{g,i}$.

4.6.4 Class Participation Adjustment

A class-level participation adjustment was applied to compensate for classes that did not participate, or where the student participation rate was below 50 percent. The class participation adjustment was calculated at the explicit stratum level, rather than by school, to minimize the potential for response bias. The adjustment was calculated as follows:

$$A_{cl}^{g} = \begin{cases} \dfrac{n_s + n_{r1} + n_{r2}}{\sum_{i}^{s+r1+r2} \delta^{g,i} / c^{g,i}} & \text{for participating classes} \\ 0 & \text{for non-participating classes} \end{cases}$$

where the summation was over all sampled and replacement schools, $c^{g,i}$ was the number of sampled classes in the i^{th} school, and $\delta^{g,i}$ was the number of participating classes in the i^{th} school of population g within the explicit stratum.

The final class weight assigned to all students in the sampled classes of the i^{th} school of population g was computed as:

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

4.6.5 The Student Weight

The student weight is the inverse of the probability of a student in a sampled class being selected. By design, all students within selected classes were selected for the TIMSS Advanced 2008 assessments. In most cases, they were all assigned a booklet from one subject—either advanced mathematics or physics. In countries with completely overlapping populations, however, roughly half of the students in a class were assigned a booklet in one subject and the other half in the other subject. The student weight (with the subscript *st*) for the j^{th} class in the i^{th} school of population g was calculated as follows:

$$W_{st}^{g,i,j} = \frac{n^{i,j}}{n^{g,i,j}}$$

where the $n^{i,j}$ was the total number of students in the j^{th} class of the i^{th} school and $n^{g,i,j}$ was the number of students in that class selected for population g ($g = M$ or P).

When classes were sampled for only one population, then $n^{g,i,j}$ was equal to $n^{i,j}$ and the probability of a student in a selected class being sampled for that population was equal to 1. When booklets from both populations were distributed among students from a selected class, this probability was approximately one half. In both cases, the student weight was calculated separately for each selected class and for each population.

4.6.6 Student Participation Adjustment

A student-level participation adjustment was calculated at the class level and it was calculated in the same manner, regardless whether a class was selected for a single population or for both populations. The student participation adjustment for the j^{th} class in the i^{th} school of population g was computed as:

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

where $s_{rs}^{g,i,j}$ was the number of students that responded to their assigned population g booklet in the j^{th} class of the i^{th} school, and $s_{nr}^{g,i,j}$ was the number of students that did not respond to their assigned population g booklet in the j^{th} class of the i^{th} school.

The final student weight for students selected for population g in the j^{th} class of the i^{th} school was defined as:

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

4.6.7 Overall Sampling Weights

The basic overall sampling weight was the product of the school weight, the class weight, and the student weight. Thus, for each study population g, this product was computed as:

$$BW^{g,i,j} = BW_{sc}^{g,i} \cdot BW_{cl}^{g,i,j} \cdot BW_{st}^{g,i,j}.$$

The final overall sampling weight was the product of the final school, class, and student weights, and was computed as:

$$FW^{g,i,j} = FW_{sc}^{g,i} \cdot FW_{cl}^{g,i,j} \cdot FW_{st}^{g,i,j}.$$

4.7 Calculating Participation Rates

Since non-participating schools, classes, and students can lead to bias in the study results, participation rates were needed to show the degree of success each TIMSS Advanced participant achieved in securing participation from their sampled schools, classes, and students. To monitor school participation, two school participation rates were computed for each population: one based on sampled schools only and one based on sampled and replacement schools. Class and student participation rates were also computed, based on sampled and replacement schools, as were overall participation rates. Both unweighted and weighted participation rates were computed.

4.7.1 Unweighted School Participation Rates

For each population, two unweighted school participation rates were computed, as follows:

$R_{unw}^{g,sc-s}$ = unweighted school participation rate from sampled schools only

$R_{unw}^{g,sc-r}$ = unweighted school participation rate from sampled and replacement schools.

For each population, the rates were defined as the ratio of the number of participating schools to the number of sampled schools, excluding any ineligible schools. A school was labeled a participating school if at least one of its sampled classes had a student participation rate of at least 50 percent. The unweighted school participation rates were calculated as follows:

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

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

4.7.2 Unweighted Class Participation Rates

The unweighted class participation rates were computed as follows:

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

where the summations were over all participating sampled and replacement schools, $c^{g,i}$ was the number of sampled classes, and $c_{*}^{g,i}$ the number of participating classes in the i^{th} school of population g.

4.7.3 Unweighted Student Participation Rates

The unweighted student participation rates were computed as follows:

$$R_{unw}^{g,st} = \frac{\sum_{i,j}^{s+r1+r2} s_{rs}^{g,i,j}}{\sum_{i,j}^{s+r1+r2} \left(s_{rs}^{g,i,j} + s_{nr}^{g,i,j} \right)}$$

where the summations were over all participating schools and classes for population g.

4.7.4 Unweighted Overall Participation Rates

Two unweighted overall participation rates were computed for each TIMSS Advanced population, as follows:

$R_{unw}^{g,ov-s}$ = unweighted overall participation rate from sampled schools only

$R_{unw}^{g,ov-r}$ = unweighted overall participation rate from sampled and replacement schools.

The overall unweighted participation rates were defined as the product of their respective unweighted school participation rates, the unweighted class participation rate, and the unweighted student participation rate. They were calculated as follows:

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

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

4.7.5 Weighted School Participation Rates

Two weighted school participation rates were computed for each population, as follows:

$R_{wtd}^{g,sc-s}$ = weighted school participation rate from sampled schools only

$R_{wtd}^{g,sc-r}$ = weighted school participation rate from sampled and replacement schools.

The weighted school participation rates were calculated as follows:

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

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

where the summation in the first numerator was over all responding students in sampled schools and all other summations were over all responding students in all participating schools. What distinguished the numerators from the denominators was the use of the basic school weight rather than the final, or adjusted, school weight in the denominators.

The denominator was the same in both equations and was the weighted estimate of the total enrollment in the target population. The numerators, however, were different. Only students from participating classes and participating sampled schools were included in the first equation. Students from the replacement schools were added in the second equation.

4.7.6 Weighted Class Participation Rates

The weighted class participation rates for both populations were computed as follows:

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

where the summations in both the numerator and denominator were over all responding students from participating classes and schools. The basic class weight appears in the numerator, whereas the final class weight appears in the denominator. Furthermore, the denominator in this formula is the same quantity that appears in the numerator of the weighted school participation rate for all participating schools, including sampled and replacement schools.

4.7.7 Weighted Student Participation Rates

The weighted student participation rates for each population were computed as follows:

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

where the summations in both the numerator and denominator were over all responding students from participating classes and schools. The basic student weight appears in the numerator, whereas the final student weight appears in the denominator. The denominator in this formula is the same quantity that appears in the numerator of the weighted class participation rates.

4.7.8 Weighted Overall Participation Rates

Two weighted overall participation rates were computed for each population, as follows:

$R_{wtd}^{g,ov-s}$ = weighted overall participation rate from sampled schools only

$R_{wtd}^{g,ov-r}$ = weighted overall participation rate from sampled and replacement schools.

The weighted overall participation rates were defined as the product of their respective weighted school participation rates, the weighted class participation rate, and the weighted student participation rate. They were computed as follows:

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

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

4.7.9 Meeting the TIMSS Advanced 2008 Sampling Participation Standards

All TIMSS Advanced 2008 participants understood that the goals for sampling participation were 100 percent for all sampled schools, classes, and students. Guidelines for reporting achievement data for TIMSS Advanced participants securing less than full participation were modeled after IEA's TIMSS and PIRLS studies. As summarized in Exhibit 4.6, 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 the TIMSS Advanced 2008 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. An important goal for quality data in TIMSS Advanced 2008 was to have as many countries as possible achieve Category 1 status.

EXHIBIT 4.6 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 will 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 will 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 will 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 provided documentation to show that they complied with TIMSS sampling procedures and requirements but did not meet the requirements for Category 1 or Category 2 will be placed in Category 3. Countries in this category will appear in a separate section of the achievement tables, below the other countries, in international reports. These countries will be presented in alphabetical order.

Exhibits 4.7 through 4.10 present the school, class, student, and overall participation rates and achieved sample sizes for all TIMSS Advanced 2008 participants and for both populations.

For advanced mathematics, all participants but one met the TIMSS Advanced sampling requirements and belonged in Category 1. The Netherlands met the requirements only after including replacement schools (Category 2); and, as a consequence, their results were annotated with an asterisk in the advanced mathematics achievement exhibits of the international report. For physics, all countries but two had acceptable participation rates and belonged in Category 1. The Netherlands met the requirements only after including replacement schools (Category 2), and their results were annotated with an asterisk in the physics achievement exhibits in the international report. Slovenia with an overall participation rate of 65 percent belonged in Category 3.

Exhibit 4.7 School Participation Rates and Sample Sizes

Advanced Mathematics

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	100%	100%	38	38	38	0	38
Iran, Islamic Rep. of	99%	99%	120	120	119	0	119
Italy	97%	99%	100	92	88	3	91
Lebanon	86%	89%	240	240	203	9	212
Netherlands	77%	84%	135	133	102	10	112
Norway	94%	94%	120	120	107	0	107
Philippines	98%	98%	121	120	118	0	118
Russian Federation	100%	100%	143	143	143	0	143
Slovenia	96%	96%	87	82	79	0	79
Sweden	90%	94%	127	126	111	5	116

Physics

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	100%	100%	38	38	38	0	38
Iran, Islamic Rep. of	99%	99%	120	120	119	0	119
Italy	100%	100%	112	91	91	0	91
Lebanon	85%	88%	240	240	201	9	210
Netherlands	73%	87%	135	133	98	18	116
Norway	85%	85%	120	120	101	0	101
Russian Federation	100%	100%	149	149	149	0	149
Slovenia	83%	83%	66	64	54	0	54
Sweden	97%	97%	127	125	119	2	121

Exhibit 4.8 Student Participation Rates and Sample Sizes

Advanced Mathematics

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	95%	899	0	0	899	41	858
Iran, Islamic Rep. of	97%	2,556	55	0	2,501	76	2,425
Italy	96%	2,269	15	8	2,246	103	2,143
Lebanon	95%	1,767	36	0	1,731	116	1,615
Netherlands	92%	1,876	200	0	1,676	139	1,537
Norway	89%	2,206	17	2	2,187	255	1,932
Philippines	96%	4,253	3	0	4,250	159	4,091
Russian Federation	98%	3,269	11	0	3,258	73	3,185
Slovenia	85%	2,577	3	22	2,552	396	2,156
Sweden	89%	2,645	26	1	2,618	315	2,303

Physics

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	97%	926	0	0	926	32	894
Iran, Islamic Rep. of	97%	2,556	43	0	2,513	79	2,434
Italy	97%	1,968	18	15	1,935	74	1,861
Lebanon	94%	1,755	35	0	1,720	120	1,600
Netherlands	90%	1,911	203	3	1,705	194	1,511
Norway	86%	1,935	17	1	1,917	275	1,642
Russian Federation	97%	3,269	9	0	3,260	94	3,166
Slovenia	82%	1,404	0	6	1,398	278	1,120
Sweden	92%	2,537	29	4	2,504	213	2,291

Exhibit 4.9 Unweighted School, Class, and Student Participation Rates

Advanced Mathematics

Country	School Participation Before Replacement	School Participation After Replacement	Class Participation	Student Participation	Overall Participation Before Replacement	Overall Participation After Replacement
Armenia	100%	100%	100%	95%	95%	95%
Iran, Islamic Rep. of	99%	99%	100%	97%	96%	96%
Italy	96%	99%	100%	95%	91%	94%
Lebanon	85%	88%	99%	94%	79%	83%
Netherlands	77%	84%	100%	92%	70%	77%
Norway	89%	89%	100%	88%	79%	79%
Philippines	98%	98%	100%	96%	95%	95%
Russian Federation	100%	100%	100%	98%	98%	98%
Slovenia	95%	95%	100%	84%	80%	80%
Sweden	87%	91%	100%	88%	77%	80%

Physics

Country	School Participation Before Replacement	School Participation After Replacement	Class Participation	Student Participation	Overall Participation Before Replacement	Overall Participation After Replacement
Armenia	100%	100%	100%	97%	97%	97%
Iran, Islamic Rep. of	99%	99%	100%	97%	96%	96%
Italy	100%	100%	100%	96%	96%	96%
Lebanon	84%	88%	99%	94%	78%	82%
Netherlands	74%	87%	99%	90%	66%	78%
Norway	84%	84%	99%	86%	72%	72%
Russian Federation	100%	100%	100%	97%	97%	97%
Slovenia	83%	83%	96%	82%	65%	65%
Sweden	95%	97%	100%	91%	87%	89%

Exhibit 4.10 Weighted School, Class, and Student Participation Rates

Advanced Mathematics

Country	School Participation Before Replacement	School Participation After Replacement	Class Participation	Student Participation	Overall Participation Before Replacement	Overall Participation After Replacement
Armenia	100%	100%	100%	95%	95%	95%
Iran, Islamic Rep. of	99%	99%	100%	97%	96%	96%
Italy	97%	99%	100%	96%	93%	95%
Lebanon	86%	89%	99%	95%	81%	83%
Netherlands	77%	84%	100%	92%	71%	77%
Norway	94%	94%	100%	89%	83%	83%
Philippines	98%	98%	100%	96%	95%	95%
Russian Federation	100%	100%	100%	98%	98%	98%
Slovenia	96%	96%	100%	85%	81%	81%
Sweden	90%	94%	100%	89%	80%	84%

Physics

Country	School Participation Before Replacement	School Participation After Replacement	Class Participation	Student Participation	Overall Participation Before Replacement	Overall Participation After Replacement
Armenia	100%	100%	100%	97%	97%	97%
Iran, Islamic Rep. of	99%	99%	100%	97%	96%	96%
Italy	100%	100%	100%	97%	97%	97%
Lebanon	85%	88%	99%	94%	80%	82%
Netherlands	73%	87%	100%	90%	65%	78%
Norway	85%	85%	100%	86%	73%	73%
Russian Federation	100%	100%	100%	97%	97%	97%
Slovenia	83%	83%	98%	82%	67%	67%
Sweden	97%	97%	100%	92%	89%	89%

4.8 Trends in Student Populations

Because one of the major goals of the TIMSS Advanced 2008 assessments was to measure changes in advanced mathematics and physics achievement since 1995 for countries that participated in both assessments, it was important to track any changes in population composition and coverage that might have affected trends in student achievement across the two cycles.

Five of the countries that participated in TIMSS Advanced 2008 also participated in the assessments of advanced mathematics and physics students in their final year of schooling in 1995. The Russian Federation, Slovenia, and Sweden participated in both populations, while Italy participated only in advanced mathematics and Norway participated only in physics. Exhibit 4.11 describes the population definitions used in 1995 for advanced mathematics and physics.

Exhibit 4.11 TIMSS Advanced 1995 Populations

Advanced Mathematics	
Country	**Advanced Mathematics Population**
Italy	Students in their final year in Liceo Scientifico (classical schools) and Instituti Technici (technical schools)
Russian Federation	Students in their final year in general secondary schools who had taken advanced mathematics courses or advanced mathematics & physics courses
Slovenia	All students in their final year in general gymnasia programs
Sweden	Students in their final year in the natural science program and the technology program. It was mandatory for all students from these two programs to take the more advanced Math E course.

Physics	
Country	**Physics Population**
Norway	Students in their final year in the academic program who had taken a three-year physics course
Russian Federation	Students in their final year in general secondary schools who had taken advanced physics courses or advanced mathematics & physics courses
Slovenia	Students in general gymnasia programs who had taken the physics matura exam
Sweden	Students in their final year in the natural science program and the technology program. It was mandatory for all students from these two programs to take the more advanced Physics B course.

Exhibit 4.12 presents five attributes of the national populations sampled in 1995 and 2008: the number of years of formal schooling, the average age at time of testing, the exclusion rates, the TIMSS Advanced coverage indices, and the overall weighted participation rates. More details on the differences between the 1995 and 2008 target population definitions for these countries are provided in the *TIMSS Advanced 2008 International Report* (Martin, Mullis, Robitaille, & Foy, 2009).

Exhibit 4.12 Trends in TIMSS Advanced Student Populations

Advanced Mathematics

Country	Years of Formal Schooling*		Average Age at Time of Testing		Overall Exclusion Rates		Coverage Index (TAMCI)		Overall Participation Rate (After Replacement)	
	2008	1995	2008	1995	2008	1995**	2008	1995	2008	1995
Italy	13	13	19.0	19.1	0.5%	3.8%	19.7%	20.2%***	94.8%	67.5%
Russian Federation	10/11	11	17.0	16.9	0.0%	2.0%	1.4%	2.0%	97.6%	95.9%
Slovenia	12	12	18.8	18.9	1.3%	6.0%	40.5%	75.4%	81.4%	42.4%
Sweden	12	12	18.8	18.9	1.7%	0.2%	12.8%	16.2%	83.7%	88.6%

Physics

Country	Years of Formal Schooling*		Average Age at Time of Testing		Overall Exclusion Rates		Coverage Index (TAPCI)		Overall Participation Rate (After Replacement)	
	2008	1995	2008	1995	2008	1995**	2008	1995	2008	1995
Norway	12	12	18.8	19.0	0.5%	3.8%	6.8%	8.4%	73.0%	83.0%
Russian Federation	10/11	11	17.1	16.9	0.0%	2.0%	2.6%	1.5%	97.3%	95.1%
Slovenia	12	12	18.7	18.8	0.5%	6.0%	7.5%	38.6%	67.1%	43.0%
Sweden	12	12	18.8	18.9	2.3%	0.2%	11.0%	16.3%	89.3%	88.6%

* Represents years of schooling counting from the first year of primary or basic education (first year of ISCED Level 1).

** In 1995 exclusion rates for Advanced Mathematics and Physics were computed based on exclusion rates among all students in the final year of schooling. In the case of the Russian Federation, the figure presented in the 1995 International Report (43.0%) greatly overestimates the level of exclusions in the advanced mathematics and physics populations. The figures presented above (2.0%) include two regions, North Ossetia and Chechen Republic, as well as non-Russian speaking students.

*** The 1995 mathematics coverage index for Italy was recomputed for this report and is different from the figure reported in 1995.

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