

trends in student achievement in countries around the world, while keeping to a minimum the burden on schools, teachers, and students. Both programs employ rigorous school and classroom sampling techniques so that achievement in the student population as a whole can be

assessments, TIMSS and PIRLS want to avoid assessing very young students. Thus, TIMSS and PIRLS recommend assessing the next higher grade (i.e.,

h grade for PIRLS or fourth grade TIMSS and ninth grade for eighth grade TIMSS) if, for fourth grade students, the average age at the time of testing would be less than 9.5 years and, for eighth grade students, less than 13.5 years.

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

F (IM,): All students enrolled in the grade that represents four years of schooling counting from the first year of ISCED Level 1, providing the mean age at the time of testing is at least 9.5 years.

E (IM,): All students enrolled in the grade that represents eight years of schooling counting from the first year of ISCED Level 1, providing the mean age at the time of testing is at least 13.5 years.

All students enrolled in the target grade, regardless of their age, belong to the international target population and should be eligible to participate in TIMSS and PIRLS. Because students are sampled in two stages, first by randomly selecting a school and then randomly selecting a class from within the school, it is necessary to identify all schools in which eligible students are enrolled. Essentially, eligible schools for TIMSS or PIRLS are those that have any students enrolled in the target grade, regardless of type of school. All schools of all educational sub-systems that have students learning full-time in the target grade are part of the international target population, including schools that are not under the authority of the national Ministry of Education.

National Target Populations

For most countries, the target grade for PIRLS or TIMSS is the fourth and/

National Coverage and Exclusions

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

Even countries with complete population coverage find it necessary to

other qualified staff members, to have intellectual disabilities or who have been tested as such. This includes students who are emotionally or mentally unable to follow even the general instructions of the test.

maintain sample size in the face of non-response, it does not compensate for non-response bias.

For each country, the school sample for the field test for TIMSS and PIRLS is drawn at the same time and from the same population of schools as the full sample. The field test sample size requirement is 200 students per field test achievement booklet. The total field test sample size is a function of the number of achievement booklets being field tested. Typically, PIRLS has four field test booklets and so requires a field test sample of 800 students, whereas TIMSS with six booklets requires a sample of 1200 students at each grade.

PARTICIPATION RATES

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

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

OR

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

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

Developing and Implementing the National Sampling Plan

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

as the first stage and classes within schools as the second stage) and must be approved by Statistics Canada. (For more information about the TIMSS & PIRLS international sample design, [see Appendix A](#).)

Stratification

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

In TIMSS and PIRLS, stratification is used to:

- ◆ Improve the efficiency of the sample design, thereby making survey estimates more reliable;
- ◆ Apply different sample designs, such as disproportionate sample

view a summary of the stratification variables used by countries in TIMSS & PIRLS in 2011, [https://nces.ed.gov/ipeds/data/timss_pirls/2011/](#)

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

To document the stratification variables used in their sampling plans, each NRC completes Sampling Form 3, which lists the variables to be used for explicit and implicit stratification, and the number of levels of each stratification variable. (To see a sample of the Sampling Form 3, see [https://nces.ed.gov/ipeds/data/timss_pirls/2011/](#))

originally sampled school has two pre-assigned replacement schools, usually the school immediately preceding the originally sampled school on the school sampling frame and the one immediately following it. Replacement schools always belong to the same explicit stratum as the original, but although they may come from different implicit strata if the school they are replacing is either the first or last school of an implicit stratum.

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

within schools is described in more detail in “Survey Operations and Quality Assurance.”

Sampling Weights

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

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

School Weighting Component

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

$$BW = \frac{M}{n}$$

where n

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

If a sampled school does not participate in TIMSS or PIRLS and neither does either of its two designated replacement schools, it is necessary to adjust the basic school weight to compensate for the reduction in sample size. The school-level nonparticipation adjustment is calculated separately for each explicit stratum, as follows:

$$A = \frac{n_1 + n_2 + n_3}{n_1 + n_2}$$

where n

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

The basic class-within-school weight for a sampled class is the inverse of

$$FW_{cl}^i \quad A_{cl} \quad BW_{cl}^i$$

where α equals 1 when there was no student subsampling (intact classes) and 2 when a sample of students was drawn from the students in the class.

Overall Student Sampling Weight

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

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

All student data reported in the TIMSS or PIRLS international reports are weighted by the overall student sampling weight, known as TOTWGT in the TIMSS and PIRLS international databases.

Participation Rates

a “participating school” if at least one of its sampled classes has a student participation rate of at least 50 percent. The two unweighted school participation rates are calculated as follows:

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

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

$$R_{unw}^s = \frac{\sum_i c_i^*}{\sum_i c_i}$$

$$R_{unw}^r = \frac{\sum_i c_i^*}{\sum_i c_i}$$

UNWEIGHTED CLASS PARTICIPATION RATE

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

$$R_{unw}^{cl} = \frac{\sum_i c_i^*}{\sum_i c_i}$$

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

UNWEIGHTED STUDENT PARTICIPATION RATES

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

$$R_{unw} = \frac{\sum_i n_i^*}{\sum_i n_i + \sum_i n_i}$$

OVERALL UNWEIGHTED PARTICIPATION RATES

The overall unweighted participation rate is the product of the unweighted school, class, and student participation rates. Because TIMSS and PIRLS compute two versions of the unweighted school participation rate, one based on original

Participation Rates

were used. Note that the basic school weight appears in the numerator, whereas the final school weight appears in the denominator.

WEIGHTED CLASS PARTICIPATION RATES

The weighted class participation rate is computed as follows:

where both the numerator and denominator were summations over all responding students from classes with at least 50 percent of their students participating in the study, and the appropriate student-level sampling weights were used. In this formula, the basic

only and the other including replacement as well as originally sampled schools, there also are two overall weighted participation rates:

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

$R_{wtd}^{ov r}$