



Sampling Manual for National Education Assessment 2021



Bhutan Council for School Examinations and Assessment
Royal Government of Bhutan



Bhutan Council for School Examinations and Assessment

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1. Introduction

The NEA sampling manual is a document that outlines the key elements that need to be taken into account while drawing sample size for every NEA cycle. Apart from defining the terms like sampling, desired and defined population, exclusion, sampling frame, sample design, stratification, etc., the manual also spells out the systemic sampling process for developing a scientifically appropriate sample size. This will ensure the level of precision and accuracy in each NEA cycle.

2. Sampling

Sampling is the process of selecting a small group from a larger defined target group called the targeted or desired population such that the information gathered from the small group will allow judgments to be made about the larger group. The purpose of sampling is to determine a target population's characteristics by directly observing only a small group or sample of the target population.

A sample drawn through the use of scientific sampling methods, helps to guarantee appropriate levels of statistical precision and validity in the interpretation of assessment results.

Sampling is mostly preferred over census owing to the merits such as reduction in cost, reduction in training and labour, speeding of data collection and analysis, increasing resourcing for field supervision. It also enhances the effectiveness of monitoring leading to more precise results and enables the calculation of the magnitude of errors.

3. Sampling plan

A sampling plan provides an outline based on which sampling unit, sample size and sampling procedures are decided. The following are some of the essential components that must be considered for the development of NEA sampling plan.

- Definition of the student population to be surveyed
- Development of a list of schools (sampling frame) in which eligible students are enrolled
- Selection of the sample schools from the list
- Development of a list of eligible students within each sampled school
- Selection of the sample students from within each sampled school
- Documentation of the sampling process and the calculation of indicators of the effectiveness of the sampling and survey operations

4. Population

The definition of the population should provide clear guidance on the elements that are to be included or excluded in the study. For the conduct of NEA, it is important to have a precise description of the population of elements (persons, organisations, objects, etc.) which forms the focus of the study.

The population for NEA covers all students enrolled at grades III, VI and IX across the schools in the country. Therefore, schools are the Primary Sampling Units (PSUs) for selecting the students for NEA.

4.1 Desired population

The desired population for this assessment includes all grades III, VI and IX students enrolled in the schools during the NEA cycle (2021, 2024, 2027, etc.). Students from both public and private schools are considered as the desired population. However, some schools and students would be excluded due to some reasons as stated in section 4.2. Thus, the defined (actual) population of schools and the students considered for the assessment would be a little lower than the targeted or desired population. Educational Management Information System (EMIS) from the Ministry of Education will be the primary data source for arriving at the desired population for NEA.

4.2 Exclusions

Exclusions take place either at the school level (exclusion of entire schools) or within-school level (exclusion of individual students). Exclusion at the school level is due to a small number of students, inaccessibility and a different curriculum from mainstream education.

Exclusion within-school level is due to the severity of functional and intellectual disabilities as stated below:

- Intellectually disabled students are those who have a mental or emotional disability and who, in the professional opinion of respective teachers, are cognitively delayed such that they cannot be validly assessed in the NEA testing setting. This category includes students who are emotionally or mentally unable to follow even the general instructions of the test after providing accommodations and adaptations.
- Functionally disabled students are those who are permanently physically disabled in such a way that they cannot be validly assessed in the NEA testing setting. However, functionally disabled students who could provide responses after providing accommodations and adaptations should be included in the testing.
- Students under individualised educational plans (IEPs) who receives instruction solely designed for special needs are excluded from the test.
- Schools whose Measure of Size (MOS) is less than eight will be excluded due to logistic reasons.
- However, students cannot be excluded solely because of their poor academic performance or normal disciplinary problems. The exclusion rate is kept to a minimum so that national samples accurately represent the national target population and minimise the sampling bias.

The following are the three standards used for the exclusion in NEA sampling.

Standard 1

- The overall number of excluded students must not account for more than 5% of the NEA desired population in the country. The overall number includes both school-level and within-school exclusions.

Standard 2

- School-level exclusions due to inaccessibility and other reasons should not be more than 0.5 % of the NEA desired population.
- School-level exclusions due to SEN schools should not be more than 2% of the NEA desired population.

Standard 3

- Within-school exclusions (Student-Level Exclusions) should not be more than 2.5% of NEA desired population.

4.3 Defined population

The difference between the desired and defined population is natural due to some constraints associated with the desired population to participate in the assessment process. Some of the major causes for the variation in the defined population from the desired population are due to the following reasons:

- intellectually and functionally disabled students in the target grade;
- less MOS in target grades; and
- inaccessibility to the school due to remote geographical location.

The defined target population provides an operational definition that will guide the construction of a list of population elements, or sampling frame, from which the actual sample are drawn. The elements excluded from the desired target population to form the defined target population are referred to as the excluded population.

5. Sampling Frame

A sampling frame is a list of all members of the defined target population. Ideally, a complete list of schools in the population with enrolment data for each school and other variables is taken into consideration. The selection of the actual sample from a defined target population requires the construction of well-defined sampling frames. A well-constructed sampling frame allows the researcher to 'take hold' of the defined target or desired population.

Generally, the sampling frame is more structured than what is usually expected to be a simple list of elements. It includes listed schools according to a number of stratification variables: size (number of students), region (Dzongkhag or Thromde), location (urban or rural), type (public or private) and gender composition (male or female). The NEA shall use a single data source across all the sampling units when constructing the sampling frame for consistency.

The following components should be considered while developing a sampling frame:

- Should be as up-to-date as possible as out-of-date information risks under-coverage of the target population and reduces survey estimates' precision.
- Should not have duplicate entries or entries of elements that are outside the target population.
- Should be developed with reference to the complete sampling plan.
- Should be constructed with care as it directly affects the survey results.
- Should contain all elements in the defined target or desired population.

- Should include stratification variables, replacement schools and non-response adjustments at school and students' levels.
- Should have all stratification variables for each element.
- Should have its elements belonging to only one category in each stratification variable.
- Should include MOS variable, if Probability Proportional to Size (PPS) selection method is used in the first stage of sampling.
- Should have its preferred school MOS as the number of students currently enrolled in the target class.
- Should require a measure of size, although not essential in the frame if an equal probability selection method is used in the first stage of sampling.

6. Sample Size

The sample size for a survey is determined based on the cost and the logistics of data collection, the need to have a sufficient level of precision and confidence level, and the analytical goals of the survey. As a rule of thumb, a precision level of $\pm 5\%$ around any statistic is a suitable one and to achieve this, Simple Random Sampling (SRS) of 400 elements is sufficient.

However, in educational assessments such as NEA, SRS is impractical. Therefore, a clustered sample is usually used. Conversely, the use of clustering decreases the efficiency of the sample. To achieve the same precision level as that of the SRS, the sample size must be increased by the value of the clustering effect known as Design Effect (**deff**).

The effective sample size for a given two-stage cluster sample is equal to the size of the simple random sample, which has a level of sampling accuracy, as measured by the variance of the sample mean, which is equal to the sampling accuracy of the given two-stage cluster sample.

For a two-stage cluster sample, the following two equations relates the actual sample size (n_c), the effective sample size (n^*), and the **deff**.

$$n_c = n^* \times \text{deff}$$

$$n_c = n^* \times (1 + (b - 1) \text{Rho})$$

Thus, the sample size for the clustered design is calculated by using the following equation.

$$n_c = n^* \times (1 + (b - 1) \text{Rho})$$

$$n_c = 400 \times (1 + (b - 1) \text{Rho})$$

Where n^* is an effective sample size which is more than or equal to 400 in order to achieve 95% confidence limits of $\pm 5\%$. Similarly, **b** is the size of the clusters (the number of students in the school), and **Roh** is the coefficient of intra-class correlation. It provides a measure of homogeneity within clusters. It is taken from the previous study undertaken.

Since **Roh** value in grade III for Bhutan is not available, the sample size for NEA in the first cycle is PISA minimum sample size of 4500 and a minimum sample of 150

schools. The target cluster size selected per school is 30 students to ensure adequate accuracy in estimating variance components within and between schools. In case the PSU has less than 30 students, all the students will be sampled.

However, in the actual sample size, the sample size and the number of schools will increase due to the inclusion of schools from the explicit stratum.

7. Sample Design

A systematic two-stage cluster sample design will be used in the NEA to determine the sample size. This design is generally employed by selecting schools at the first stage of sampling using the PPS method, followed by selecting either cluster of students within schools or clusters of students within classes at the second stage using SRS method.

The PSU schools (clusters) is selected within the Dzongkhag/Thromde (region) using the PPS method, and the students from each sampled schools is chosen using the SRS method.

8. Stratification

Stratification consists of classifying schools into similar groups according to selected variables referred to as stratification variables. Two types of stratifications are used in the NEA sampling design, explicit and implicit stratification. Explicit stratification consists of grouping schools into strata that will be treated independently from one another, as if they are separate school sampling frames, while implicit stratification consists essentially of sorting the schools uniquely within each explicit stratum by a set of designated implicit stratification variables. The decision to include stratification variables must be recorded in the Sampling form 3 Stratification as annexed to this document.

Stratification in NEA is used to:

- improve the efficiency of the sample design, thereby making the survey estimates more reliable;
- apply different sample designs, such as disproportionate sample allocations, to specific groups of schools, such as those in Dzongkhag/Thromde (region);
- ensure all parts of a population are included in the sample; and
- ensure adequate representation of specific groups of the target population in the sample.

Table 1 and 2 illustrates the stratification variables used in NEA at grade III.

Table 1: Explicit variables used in NEA at grade III

Explicit stratification variables	Levels of each implicit variable and its number
School management (public and private) students from 19 private schools	1
Special Institution (Special and Non-Special) students from 2 special institutions	1

Explicit stratification variables	Levels of each implicit variable and its number
Size of region (Small and Regular) students from small regions 13 schools	1
students selected from 150 sample schools from the regular regions	1
Total number of strata	4

Table 2: Implicit stratification variables used in NEA at grade III

Implicit stratification variables	Levels of each implicit variable and its number
Regular Regions: Bumthang, Chukha, Dagana, Lhuentse, Mongar, Paro, Pemagatshel, Phuentsholing Thromde, Punakha, Samdrup Jongkhar Dzongkhag, Samtse, Sarpang, Thimphu Thromde, Trashigang, Trashiyangtse, Trongsa, Tsirang, Wangduephodrang and Zhemgang (except Haa, Gasa, Gelephu Thromde and Samdrup Jongkhar Thromde which are included in the explicit stratification under Size of Region as the smaller region having few schools)	20
Location (Rural and Urban)	2
Total number of strata	20*2 = 40

9. Selection of Schools

The selection of desired number of schools from the defined population is carried out using the PPS method. PPS sampling is a method of sampling in which MOS is available for each population unit before sampling, where the probability of selecting a unit is proportional to its size and an equal number of elements is sampled within each unit. Here population unit is referred to as PSU. If one PSU has twice as large a population as another, it is given twice the chance of being selected.

Before the selection of schools, some schools will be excluded due to less MOS (MOS < 8 , for the NEA), then the remaining schools will be ordered in the sampling frame using explicit strata followed by implicit strata variable.

For example, in the case of the Grade III NEA, the sampling has been sorted by the region and then by location in ascending order. Selection of the schools is then carried out at the first phase by certainty. The process entails the selection of schools when the MOS of the particular school divided by sampling interval (SI) generates a value more than or equal to 1. In other words, all the PSUs that have MOS more than or equal to 1 is guaranteed to be in the sample and are called certainty schools. The selection of the certainty schools using the above process takes two-three rounds of iterations.

The remaining PSUs are selected by random number generation, which is used as a selection number. Before the selection of PSUs by a random number, the schools are sorted by MOS alternatively from low to high and then from high to low through all implicit strata within an explicit stratum. An example of the sort order for a 2 × 2 cross-classification structure is shown in Table 3.

Table 3: Sorting order of stratum

Management Type	Region	Location	School Name	School Level	MOS	
Public Schools	Bumthang	Rural	Khangrab	PS	10	Ascending →
Public Schools	Bumthang	Rural	Tang CS	MSS	11	
Public Schools	Bumthang	Rural	Tangsibi	PS	11	
Public Schools	Bumthang	Rural	Kharsat	PS	12	
Public Schools	Bumthang	Rural	Chhoekhor Toe	PS	12	
Public Schools	Bumthang	Rural	Gytesa	PS	17	
Public Schools	Bumthang	Rural	Dur	PS	20	
Public Schools	Bumthang	Rural	Ura CS	MSS	25	
Public Schools	Bumthang	Rural	Zangtherpo	PS	25	
Public Schools	Bumthang	Urban	Gangrithang	PS	54	Descending →
Public Schools	Bumthang	Urban	Chhumeey CS	MSS	14	
Public Schools	Chhukha	Rural	Meretsemo	PS	8	Ascending →
Public Schools	Chhukha	Rural	Pakchina	ECR	9	

The process of selecting the PSUs by random number method with selection number is described in section 9.2.

9.1 School sample allocation over explicit strata

The total number of schools to be sampled across the country is allocated among the explicit strata so that the expected proportion of students in the sample from each explicit stratum is approximately equal to the population proportions of NEA-eligible students in each corresponding explicit stratum.

However, this could lead to under-sampling or oversampling of the population from a particular strata depending on their MOS. This can be addressed by applying appropriate weight to different strata during the time of national reporting.

9.2 Determining the sample schools

The PPS-systematic sampling method used in NEA requires the computation of total MOS (S), total sample (D), sampling interval (I), random number, random start and probability of schools getting selected.

To determine the sample schools, the following steps are critical for calculation:

- recording the total S for all schools in the sampling frame for each specified explicit stratum;
- recording the number of schools (Total sample = D) to be sampled from the specified explicit stratum, which is the number allocated to the explicit stratum;

- calculating the sampling interval, I , as follows: $I = S / D$;
- including all the schools for which the school's size measure exceed I (known as certainty schools) in the sample;
- removing certainty schools from the frame, recalculating S , D , and I ; and
- re-recording the sampling interval, I , to four decimal places.

A random number must be generated for each explicit stratum. The generated random number (RN) must be between zero and one and should be recorded to 4 decimal places.

The next step in the PPS selection method in each explicit stratum is to calculate selection numbers - one for each of the D schools to be selected in the explicit stratum. Selection numbers are obtained using the following methods.

- Obtaining the first selection number by multiplying the sampling interval, I , by the random number, RN. This RN number is a random number between zero and one. This first selection number is used to identify the first sampled school in the specified explicit stratum.
- Obtaining the second selection number by adding the sampling interval, I , to the first selection number. The second selection number is used to identify the second sampled school.
- Continuing to add the sampling interval, I , to the previous selection number to obtain the next selection number. This is done until all specified line numbers (1 through D) have been assigned a selection number. Thus, the first selection number in an explicit stratum is $(RN \times I) + 1$, and the next selection number is $\text{First Selection Number} + I \times (\text{Schools to be sampled} - 1)$. Selection numbers are generated independently for each explicit stratum, with a new random number generated for each explicit stratum.

9.3 Identifying the sampled schools

The next task is to compile a cumulative MOS in each explicit stratum of the school sampling frame that assisted in determining which schools were to be sampled. Sampled schools are identified as follows:

Let Z denote the first selection number for a particular explicit stratum. It is necessary to find the first school in the sampling frame where the cumulative MOS equalled or exceeded Z . This is the first sampled school.

Box 1 shows the illustration of PPS sampling:

Box 1 Illustration of probability proportional to size (PPS) sampling

To illustrate these steps, suppose if there are 13049 students enrolled in grade III in 516 schools in the 2021 then,

- the total population, 13049;
- exclusions due to certain reasons, 564 (school level) + 28 (within school) = 592;
- defined target population, 12457;
- explicit sample population, 1126;

- actual population that under goes PPS, 11331 (12457 - 1126 = 11331)
- the number of schools, D, to be sampled is 150;
- after removing 42 certainty schools with 4187 students;
- total MoS, 7144;
- number of sample school, $150 - 42 = 108$;
- the sampling interval, I, $7144/108 = 66.1481481$;
- generate a random number, RN, 0.48950904;
- the first selection number, $[0.48950904 \text{ (RN)} \times 66.1481481 \text{ (I)}] + 1 = 33.3801163444154$ (random start). This first selection number is used to identify the first sampled school in the specified explicit stratum; and
- the second selection number is $[33.3801163444154 + 66.1481481 \times (\text{school to be sampled} - 1)]$. The second selection number was used to identify the second sampled school.

Similarly, third selection number can be generated repeating the above steps. The third selection number was used to identify the third sampled school, and so on until the end of the school list is reached. This will result in a school sample size of 108 schools.

The tables below also provide these example data. The school that contains the generated selection number within its cumulative enrolment is selected for participation.

Sampling data	Values	Schools to be sampled	Selection number	Selection number integer
Total MOS	7144	1	33.38011634	33
Number of sample (NS)	108	2	99.52826449	99
Sampling interval (SI)	66.1481481	3	165.6764126	165
Certainties Schools	42	4	231.8245608	231
Total Sample	150	5	297.9727089	297
Random number	0.48950904	6	364.1208571	364
Random start	33.3801163	7	430.2690052	430

School Name	School Level	MOS	Cum MOS	ProbSch = (MOS of the sch) / SI	Sel. #	Replacement Schools
Khangrab	PS	10	10	0.151175812		
Tang CS	MSS	11	21	0.166293393		
Tangsibi	PS	11	32	0.166293393		R2
Kharsat	PS	12	44	0.181410974	33	
Chhoekhor Toe	PS	12	56	0.181410974		R1
Gytesa	PS	17	73	0.25699888		
Dur	PS	20	93	0.302351624		R2

School Name	School Level	MOS	Cum MOS	ProbSch = (MOS of the sch) / SI	Sel. #	Replacement Schools
Ura CS	MSS	25	118	0.37793953	99	
Zangtherpo	PS	25	143	0.37793953		R1, R2
Gangrithang	PS	54	197	0.816349384	165	

9.4 Identifying replacement schools

Each sampled school is assigned two replacement schools from the school sampling frame. The schools immediately preceding and following it in the explicit stratum, which is ordered within by the implicit stratification, are designated as their replacement schools. The school immediately following the sampled school is designated as the first replacement and labelled R1, while the school immediately preceding the sampled school is designated as the second replacement and labelled R2. Exceptions are allowed if a sampled school happens to be the last school listed in an explicit stratum. In this case, the two schools immediately preceding it are designated as replacement schools. However, replacement of schools from other explicit (Dzongkhag/Thromde) stratum should be avoided.

Similarly, the two schools immediately following it are designated as replacement schools for the first school listed in an explicit stratum. In certain situations, there could potentially be problems when trying to identify two replacement schools for each sampled school. This could happen when some very large sampled schools appear close to each other in the sampling frame, or when it is possible to assign only one replacement school, or none, because two consecutive schools in the sampling frame are sampled. In such cases, sample schools are alerted and are asked to confirm their participation in the assessment without replacement.

9.5 Tracking sampled schools

Once schools have been sampled, a sampled schools list should be created. This list will be used to track the schools' participation status. A brief list outlining the key variables should also accompany the sample schools list.

Efforts should be made to confirm the participation of as many sampled schools as possible to minimise the potential for non-response biases. Each sampled school that does not participate should be replaced if possible.

9.6 Treatment of small schools while sampling

Small schools are those schools with very few students enrolled compared to a typical classroom of the target grade. It can cause difficulties in PPS sampling because students sampled from them tend to increase sampling variance apart from causing administrative issues with many testing sessions with few students. Schools with MOS less than one-quarter of the minimum cluster size (30 students) are excluded in NEA sampling.

10. Selection of students

The selection of students from the sample schools are done by using SRS method. It is a probability sampling procedure that gives every element in the target population

an equal chance of being selected.

Before selecting students, a new sampling frame must be created that combines the selected schools' list as mentioned in section 9 (selection of schools) with the schools (all private schools, special institutes and all schools from small region) selected by default from the explicit strata.

The process entails direct selection of all the students from the PSUs if their MOS is less than or equal to a cluster size of 30 for target grade III across the country in 2021. If the MOS is greater than cluster size (30 students), only that cluster size sample gets selected from that school, and the rest will be dropped from the sample. Further, the required number of male and female students from the selected schools need to be proportionately chosen by considering the MOS of that school using the SRS method. It entails custom sorting out the school, gender and random number in the new sampling frame and then selection of equal proportion of male and female students.

11. Definition of Teacher

A teacher is defined as “one whose primary or major activity in the school is student instruction, involving the delivery of lessons to students. Teachers could work with students as a whole class in a classroom, in small groups in a resource room or one-to-one inside or outside regular classrooms.”

To cover a wider variety of perspectives and guarantee samples that are large enough, all teachers who CAN or WILL be teaching the modal grade (III, VI and IX) in respective domains in a later year are also considered to belong to the teacher target population. This also applies for teachers who have been teaching the modal grade in the past who were still in the school. Thus, sampling for teachers includes ALL teachers who are eligible for teaching the modal grade - whether they are doing so currently, had taught before, or will/could do so in the future. At least three teachers from each sample school will participate in the teachers' questionnaires survey during the assessment.

12. Definition of School

Although to define a “school” is difficult, NEA generally aims to sample whole schools as the first stage units of selection, rather than programmes or tracks or shifts within schools. The head of the sampled schools (Principals) will participate in the principal's questionnaire survey during the assessment. If the head is not available during the survey, the designated head will participate in the survey.

13. Definition of Dzongkhag / Thromde

Dzongkhag / Thromde is the district administrative region. The Chief Dzongkhag / Thromde Education Officers (CDEO / CTEO) will participate in the Dzongkhag questionnaire survey during the assessment.

14. Accuracy and precision

Accuracy is the degree to which a survey or an estimate based on a survey represents the true value of the attribute that is being measured. A survey is accurate if it is close to the truth with repeated surveys. The estimate from a survey is precise if it obtains similar results with repeated surveys. The goal of the sample is to achieve accurate estimates of the target population performance that are unbiased, with an acceptable level of precision. For NEA in grade III, a minimum of 150 schools will be selected from across the country for the assessment, and within each participating school, a predetermined number of NEA eligible students denoted as target cluster size (usually 30 students), will be randomly selected with equal probability. For those schools with fewer than target cluster size eligible students, all students will be selected. Therefore, a minimum sample size of 4500 (150 × 30) students will sit for paper-based assessment. The target cluster size selected per school is at least 8 students to ensure adequate accuracy in estimating variance components within and between schools.

15. Response rates

Response rates are basic measures used in evaluating the quality of the collected data.

It can be used to gauge the potential for non-response bias. Non-response bias is the error resulting from distinct differences between students who participated in the survey versus those who did not participate. The lower the response rate, the greater the risk of the sample being less representative of the target population. It is calculated by using the following formula:

Response rate = (number of sampled elements that participated in survey ÷ number of elements that were sampled) × 100

Standards for Response rates

Based on the international best practice, the response rate for NEA are:

- School response rate should be above 85% of the sample schools.
- Student response rate should be above 80% of all sampled students across the responding schools.

15.1 School response rates

School response rate of a minimum of 85% is required for initially selected schools. If the initial response rate falls between 65% and 85%, an acceptable response rate will still be reached through the use of replacement of schools.

15.2 Student response rates

An overall response rate of 80% of selected students is required in the participating schools. A student who has participated in the initial or follow-up cognitive sessions is considered a participant. A minimum student response rate of 50% within each school is required for a school to be considered as participating. The overall student response rate is computed using only students from schools with at least a 50%

student response rate. Again, weighted student response rates are used for assessing this standard. Each student is weighted by the reciprocal of his or her sample selection probability.

16. Sampling error

Sampling error occurs whenever data from a subset of a population is used to make inferences about that population. It cannot be eliminated because the population contains some elements that are not in the sampled subset. Sampling error can be measured by adopting probability sampling methodologies when the probability of selection can be calculated.

Sampling error in NEA is controlled by:

- drawing a large enough sample size;
- using stratification;
- establishing a replacement school protocol;
- raising school and student response/participation rates; and
- maintaining a standardised method throughout the data collection stage.

17. Sample Weights

Sample weights are used to reduce biases in the sample caused by some imperfections in sampling, including non-coverage and non-response. Sampling weights correct the imperfections in the sample so that biases and differences between the sample and the population could be minimised. Such imperfections are due to the selection of sample with unequal probabilities, non-coverage of the population, and non-response. The following are the main objectives of calculating and using sample weights:

- to compensate for unequal probabilities of selection;
- to compensate for non-response;
- to adjust the weighted sample distribution for key variables of interest to conform to a known population distribution; and
- unbiased reporting.

Formula used for calculating school, student and final sampling weights are described below:

School-level weights

The school base weight (for PPS samples) is the population size over the number of sampled schools multiplied with the school size:

$$BW_{sc}^i = \frac{N_{pop}}{n_{sc} * N_{mos}^i}$$

The school non-response adjustment is the number of sampled schools over the number of participating schools:

$$Sc_{adj} = \frac{n_{sc}}{n_p}$$

Student-level weights

The Student base weight is the total number of students in a sample school over the number of sampled students:

$$BW_{st}^i = \frac{N_{st}^i}{n_{st}^i}$$

The student-level non-response adjustment is the number of sampled (and eligible) students within a school over the number of participating students:

$$St_{adj} = \frac{n_{st}^i}{n_p^i}$$

Final sampling weight

The final student weight (in simple designs) is equal to multiplying school and student base weights and the non-response adjustments:

$$W_i = BW_{sc}^i * Sc_{adj} * BW_{st}^i * St_{adj}$$

Table 4: Sample weights

REGION	SCHOOL	TOT	EXPLICIT STRATA	Total G3 enr of the school in sample frame (b)	Total G3 enr at the time of testing (c)	Actual no of students in the collected data (d)	SchBaseWgt (e)	SchAdjWgt (f)	StuBaseWgt (g) b/a	StuWgtAdj (h) a/d	FinalWgt (i) e * f * g * h	SumWgt (j) i * d
Bumthang	Gangrithang PS	32	Regular region	54		32	1.398888889	1	1.6875	1	2.360625	75.54
Bumthang	Kharsat PS	12	Regular region	12		12	6.295	1	1	1	6.295	75.54
Bumthang	Ura CS	25	Regular region	25		25	3.0216	1	1	1	3.0216	75.54
Bumthang	Wangdicholing LSS	32	Regular region	99		32	0.763030303	1	3.09375	1	2.360625	75.54
Chhukha	Alaykha PS	9	Regular region	9		9	8.393333333	1	1	1	8.393333333	75.54
Chhukha	Chapcha PS	15	Regular region	15		15	5.036	1	1	1	5.036	75.54
Chhukha	Chumigthang MSS	32	Regular region	74		32	1.020810811	1	2.3125	1	2.360625	75.54
Chhukha	Darla MSS	32	Regular region	68		32	1.110882353	1	2.125	1	2.360625	75.54
Chhukha	Gedu HSS	32	Regular region	36		32	2.098333333	1	1.125	1	2.360625	75.54
Chhukha	Kamji CS	32	Regular region	34		32	2.221764706	1	1.0625	1	2.360625	75.54
Chhukha	Khatoeykha PS	20	Regular region	20		20	3.777	1	1	1	3.777	75.54
Chhukha	Logchina LSS	24	Regular region	24		24	3.1475	1	1	1	3.1475	75.54
Chhukha	Pakshika PS	26	Regular region	26		26	2.905384615	1	1	1	2.905384615	75.54
Chhukha	Tsimalakha MSS	32	Regular region	48		32	1.57375	1	1.5	1	2.360625	75.54
Chhukha	Wangchu MSS	32	Regular region	60		32	1.259	1	1.875	1	2.360625	75.54
Dagana	Balleygang PS	25	Regular region	25		25	3.0216	1	1	1	3.0216	75.54
Dagana	Dagapela MSS	32	Regular region	61		32	1.238360656	1	1.90625	1	2.360625	75.54
Dagana	Gangzor PS	23	Regular region	23		23	3.284347826	1	1	1	3.284347826	75.54
Dagana	Karmaling PS	17	Regular region	17		17	4.443529412	1	1	1	4.443529412	75.54
Dagana	Lhamoyzingkha CS	32	Regular region	42		32	1.798571429	1	1.3125	1	2.360625	75.54

18. Sampling forms

Sample forms are tools used during the planning phase of sample size and sample design and in deriving definitions that are used in the sampling process. Most importantly, it is used for documenting the important decisions made on the sampling process (Refer annexe 1).

The following forms are used in the NEA sampling process:

- Sampling Form 1 - Bhutan Desired Target Population
- Sampling Form 2 - Bhutan Defined Target Population
- Sampling Form 3 - Stratification
- Sampling Form 4 - Sampling Frame Description

19. Timeline for data collection and validation

BCSEA should collect the students', teachers', and principals' data from the EMIS, MoE on the specified months and accordingly carry out a sampling exercise to conduct the sample-based assessment in the table shown below:

Table 5: Timeline for data collection and validation

Sl.#	Activity	Data source	Date	Real survey date
1	Collection of students, teacher, principal data	EMIS, MoE	May - June	November December
2	Data validation	EMIS, MoE	August - September	
3	Final Sampling	BCSEA	September - October	

20. Student attendance sheets

After the sampling process is over the attendance sheet /session attendance must be prepared from the sample school list for the key reason stated below:

- They identify the students in the selected sections and are used to assign student codes
- They indicate which students should be given which test booklet
- They keep a record of the participation status of the student in the sample selection and during the test administration.

There are key variables related to school information such as Dzongkhag name and code, School name and code etc., that must be included in the student attendance sheet.

21. Code and Code Meaning Used in Sampling

21.1 An example of possible school participation codes

Code	Meaning
P	Participant
NP	Non-participant (e.g., a replacement school that was not required; a school refusal)
E1	Ineligible the school was found to contain no eligible students at the relevant class level
E2	Ineligible school closure
E3	Ineligible for other reasons
X1	School Exclusion, other categories of exclusion defined in the target population; other 'non-mainstream school'
O	If not sure how to code, use 'O'

21.2 Participation Codes

Code	Meaning
P	Participant
N1	Refusal
N2	No participation for other reasons
E1	No eligible students
E2	School closure
E3	School ineligible for other reasons (please specify)
EX	School exclusion

21.3 Codes for Special Educational Needs

Description	Code
Functional Disability	1
Cognitive, behavioural, or emotional disability	2
Limited assessment language experience	3
An optional additional category, defined by BCSEA	4

22. Ten key school sampling steps

In summary, there are ten basic steps used to draw a national sample of schools and students, as stated below.

Step 1	Preparing the sampling frame
Step 2	Sorting the sampling frame
Step 3	Identifying and removing certainty schools



Step 4	Calculating the sampling interval
Step 5	Generating a random start
Step 6	Calculating the selection numbers
Step 7	Identifying the sampled schools
Step 8	Assigning identification codes
Step 9	Identifying replacement schools
Step 10	Creating a list to record school participation



Sampling Form 1 Bhutan Desired Target Population

The Kingdom of Bhutan

Person who completed this form: Arjun Kumar Gurung, Project Manager

1. Total enrolment in grade 3 in 516 schools in 2021: [a] 13049

2. Describe the population(s) to be excluded from the desired target population (if applicable).

International students (Non-Bhutanese) as one of the domain is Dzongkha (20)

Severely functional and intellectual disabled students taking adapted curriculum

(IEP = 8) Tendruk CS: 5, Gonpasingma PS: 2, MIK: 1

3. Total enrolment in the desired target population: [c] 13021

box [a] – box [b]

4. Percentage of coverage in the desired target population: [d] 99.785%

box [c] ÷ box [a]

5. Describe your data source:

EMIS 2021, September 2021, MoE

Sampling Form 2 Bhutan Defined Target Population

The Kingdom of Bhutan

Person who completed this form: Arjun Kumar Gurung, Project Manager

1. Total enrolment in the desired target population:

[a] 13021

From box [c] on Sampling Form 1

2. School-level exclusions:

Description of exclusions	# of students
Class size enrolled is less than 8 students in grade III from 114 schools	545
Geographically inaccessible and difficult to reach schools (Laya CS, Lunna PS)	19
TOTAL	[b] 564

Percentage of school-level exclusions:

4.33 %

$\text{box [b]} \div \text{box [a]}$

3. Total enrolment in the defined target population:

[c] 12466

$\text{box [a]} - \text{box [b]}$

4. Within-School exclusions:

Description of exclusions	Expected # of students
International students as one of the domain is Dzongkha	13
Severely functional and intellectual disabled students taking adapted curriculum (IEP)	8
TOTAL	[d] 23

Expected percentage of within-school exclusions:

0.18 %

$\text{box [d]} \div \text{box [c]}$

5. Describe your data source (provide copies of relevant tables):

EMIS data September 2021, MoE

Sampling Form 3 Stratification

The Kingdom of Bhutan

Person who completed this form: Arjun Kumar Gurung, Project Manager

Explicit Stratification

1. List and describe the variables used for explicit stratification.

Explicit stratification variables		# of levels
i	School management (public and private) students from 19 private schools (total 487 students but 377 students selected)	1
ii	Special Institution (Special and Non-Special) students from 2 special institutions (MIK: 3 + WI: 4 = Total: 7) students)	1
iii	Size of region (Small and Regular) students from small regions 13 schools (total 634 students)	1
iv	students selected from 150 sample schools from the regular region	1

2. Total number of explicit $4 \times 1 = 4$ strata

Implicit Stratification

3. List the implicit variables by order of importance and describe their levels.

Implicit stratification variables (List by order of importance)	Levels of each implicit variable (List all levels and by order of importance)	# of levels
i Region	All Dzongkhag and Thromde except Haa, Gasa, Gelephu and S/J Thromde, which are included in the explicit stratification under the size of region and sorted in alphabetical order. Bumthang, Chhukha, Dagana, Lhuentse, Mongar, Paro, Pema Gatshel, Phuntsholing Thromde, Punakha, Samdrup Jongkhar, Samtse, Sarpang, Thimphu, Thimphu Thromde, Trashigang, Trashiyangtse, Trongsa, Tsirang, Wangdue Phodrang and Zhemgang.	
ii Location	Rural and Urban	

4. Total number of implicit $20 \times 2 = 40$ strata

Sampling Form 4 Sampling Frame Description

The Kingdom of Bhutan

Person who completed this form: Arjun Kumar Gurung, Project Manager

1 Specify the type of school sampling frame used.

- Single-level sampling frame
- Double-level sampling frame
- Other (please describe):

Single – level sampling frame as it from single source EMIS

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

- Enrolment in the target class
- Average enrolment per class
- Total school enrolment
- Other (please describe):

3 Specify the school year for which enrolment data will be used for the school MOS.

2021

4 If a double-level sampling frame is to be used, please provide a preliminary description of the information available to construct this frame.

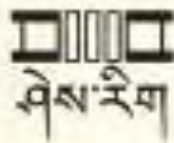
NA





**“An educated and enlightened society
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**“An internationally recognized centre of excellence in
educational assessment that provides quality services to
build the integrity and profile of the education system leading
to an improvement in the quality of learning in Bhutan”**

**Vision - Bhutan Council for School
Examinations and Assessment, Bhutan**