National Assessment of Student Achievement, 2017

Technical Report

(National Assessment of Student Achievement in Mathematics, Nepali and Science for Grade 8)

Education Review Office, 2018

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Report prepared by

Dr Lekha Nath Poudel

with contributions from

Dr Binod Luitel, Dr Prem Phyak, Shyam Prasad Acharya,
Devi Ram Acharya and Lav Dev Bhatta

Government of Nepal

Ministry of Education, Science and Technology

Education Review Office

Sanothimi, Bhaktapur

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Report Prepared by

Dr Lekha Nath Poudel with contributions from Dr Binod Luitel, Dr Prem Phyak, Shyam Prasad Acharya, Devi Ram Acharya and Lav Dev Bhatta

Data analysed by

Shyam Prasad Acharya, Devi Ram Acharya and Lav Dev Bhatta and Ram Chandra Dhakal

Language Edited by

Dr Binod Luitel and Dr Prem Phyak

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Contact:

Education Review Office

Sanothimi, Bhaktapur, Nepal

Phone: +977-1-6639556, 6639557; Fax: +977-1-6639556

Email : eronasa@gmail.com

Website : www.ero.gov.np

Printed at:

Routa Printing Support

Anamnagar, Kathmandu

Phone : +977-1-4247456

Email : Routaps@gmail.com

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This technical report of NASA 2017 conducted by ERO for Grade 8 in Mathematics, Nepali and Science has been prepared to describe and communicate the theory, methods and process used in designing, developing and conducting the assessment. It presents the details of technical aspects including designing, development and administration of assessment; data preparation and parameters estimation; equating and analysing; and reporting of assessment results. A separate public report of NASA 2017 has been prepared on the results and findings which will provide useful information on the achievement of students for Grade 8 in Mathematics, Nepali and Science in Nepal with a number of variables including province, gender, home language, ethnicity, socioeconomic status, school types, leisure time and activities in the leisure time at school, attitude towards teacher and school, school bullying, availability of textbooks, and activities at home.

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Dr Lekha Nath Poudel
Joint Secretary
Education Review Office

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Acronyms

1PM	:	One Parametric logistic Model
CDC	:	Curriculum Development Centre
CR	:	Constructed Response
CRT	:	Criteria Referenced Test
CT	:	Confidence Interval
CTT	:	Classical Test Theory
DEO	:	District Education Office
DOE	:	Department of Education
EMIS	:	Education Management Information System
ERO	:	Education Review Office
ICC	:	Item Characteristic Curve
ID	:	Identification
IEA	:	International Association for the Evaluation of Educational Achievement
IRT	:	Item Response Theory
MC	:	Multiple Choice
MLE	:	Maximum Likelihood
MOS	:	Measure of Size
NASA	:	National Assessment of Student Achievement
NRT	:	Norm Referenced Test
OECD	:	Organisation of for Economic Cooperation and Development
OMR	:	Optical Mark Recognition
PCAP	:	Pan-Canadian Assessment Program
PCM	:	Partial Credit Model
PISA	:	Programme for International Student Assessment
PPS	:	Probability Proportionate to Size
PRC	:	Printing Ready Copy
PV	:	Plausible Value
RWGT	:	Replicable Weight
SE	:	Standard Error
SPSS	:	Statistical Package for Social Science
SR	:	Selected Response
SRS	:	Simple Random Sampling
SSDP	:	School Sector Development Programme
TIMSS	:	Trends in Mathematics and Science Study
VDC	:	Village Development Committee
WLE	:	Weighted Likelihood Estimation

CHAPTER 1

National Assessment of Student Achievement: An Introduction

1.1 Introduction

National Assessment of Student Achievement (NASA) is conducted to identify the existing status of students' learning achievement in different subjects throughout the country. The goal of NASA is not to compare the students' results at individual level. Rather, it aims to provide the Ministry of Education and other concerned stakeholders with insights for understanding the current status of the students' achievement, and to suggest policy recommendations for improving the students' overall learning achievement. Administered among the representative sample of students, national assessments are designed to assess students' achievement across content and cognitive domains in each subject.

This report provides technical details of NASA, 2017 and describes the overall technical aspects of NASA 2017 cycle from assessment design to report preparation. It includes the process, methods and tools adopted in developing assessment framework for NASA 2017, test design, development of items and questionnaires, piloting and selection of test items, preparation of test and questionnaire booklets, administration of tests and questionnaires, scoring and data entry, item parameters estimation and equating, data analysis, and report preparation.

This chapter provides a general overview of the NASA 2017 for Grade 8 in Mathematics, Nepali and Science. More specifically, it includes the context of NASA, a brief introduction to NASA 2017, use of item response theory and outline of the report.

1.2 Context

The Government of Nepal established Education Review Office (ERO) in 2010 as an agency for carrying out research on assessment and other educational issues to support the government in its efforts to reform school level education. Before the establishment

of ERO, some assessment studies were carried out at national level by external agencies. These assessments (conducted between 1995 and 2010) were based on the Classical Test Theory (CTT). ERO has been conducting National Assessment of Student Achievement (NASA) in various Grades and subjects of school education since 2011 (see ERO, 2013; 2015; 2015a; 2016). It has already carried out two rounds of NASA for the students of Grades 3, 5 and 8.

ERO has used the Item Response Theory (IRT), instead of CTT, in selecting test items and analyzing the assessment results. This theory is helpful to compare different versions of tests by calibrating the items and comparing between the results of assessment in different years. However, the use of norm-referenced test (NRT) and the analysis of results without defining the proficiency level have some limitations to make assessment results fully comparable across the years. In order to develop criterion-referenced test (CRT) for this assessment, ERO has defined criteria and standards to be achieved by the students of Grade 8 and specified the proficiency levels of the students in each of the assessed subjects.

As recommended in School Sector Development Plan (SSDP) prepared by the government of Nepal, ERO has conducted NASA for Grade 8 in 2017 and has a plan to conduct NASA for Grade 5 and Grade 10 in 2018 and 2019, respectively. ERO has used and will be using the Item Response Theory (IRT) for these assessments to compare test results across the years, test versions as well as similar types of international assessments. The major departure from the previous assessments, conducted by ERO, to this assessment of Grade 8 is the use of criteria and standards-referenced assessment, instead of norm-referenced assessment. Similarly, this assessment has used a scale score instead of percentage in reporting the students' proficiency towards making the results comparable and explaining the students' latent traits with the help of the score in relation to the characteristics of items. In addition, the assessment framework (Pant, Singh and Poudel, 2016a) has been developed as the guiding document of the entire assessment process, to make the national assessment more valid and reliable. The use of sampling weights to estimate the generalizability of test scores to the entire population has been another step followed in this assessment.

For the first time, ERO is publishing two reports — technical and public. The technical

report includes the details of the process and activities in design and administration of the test, and analysis of the assessment results. On the other hand, the public report generally includes the assessment results without adding the details of technical aspects of the assessment. The two versions of reports have been prepared to make NASA results accessible to all educational stakeholders including policy makers, general public, programme developers, implementers and educational researchers. The agencies and individuals that may not be interested in technical details (but are rather interested in the synopsis of the major results only) can study the public report, while researchers and the agencies that are interested in technical details could consider reading the technical report.

1.3 National Assessment of Student Achievement

Since 2011, ERO has been conducting NASA to study and report on student achievement in various grades within a certain time interval. It has already completed two rounds of NASA for the students of Grades 3, 5 and 8. Now, ERO has been administered NASA for Grade 8 students to assess their achievements in Mathematics, Nepali (reading and writing) and Science subjects, and has planned to conduct NASA in Grade 5 and 10 in 2018 and 2019 respectively. As in the previous NASA studies, NASA 2017 is also a sample-based assessment, but the sample weights have been used for reporting the results by estimating the achievement of the entire student population of the grade.

NASA studies are "designed to describe the achievement of students in a curriculum area aggregated to provide an estimate of the achievement level in education system as a whole at a particular age or grade level" (Greaney & Kellaghan, 2007, p. 7). More specifically, such assessments have been conducted to audit the effectiveness of the entire national education system and provide information to the policy makers regarding the existing status of the educational attainment. Furthermore, such assessments aim to inform the policy-making process towards improving the quality of and equity in education.

Looking at the overall purpose of national assessments, the following were the objectives of NASA 2017:

a. To point out the current achievement level of Grade 8 students in Mathematics, Nepali and Science;

b. To determine the variations in student achievement by gender, province, school types, ethnicity, home language, socio-economic status and so on;

c. To explore factors that influence student achievement;

d. To generate baseline data for the future for comparing and monitoring the progress of students towards student achievement in assessed subjects;

e. To develop the capacity of education system in conducting national assessments; and

f. To provide recommendations for policy making towards improving quality of and equity in school education.

Although NASA 2017 is a curriculum-based assessment, curricular competencies have been redefined and made more specific in the assessment framework. In addition, the assessment criteria have been further defined, based on the curricular competencies mentioned in the national curriculum framework; and each criterion are elaborated in six standards— from 'pre-basic' to 'advanced' (see Pant, Singh & Poudel, 2016a). For NASA 2017, test items have been developed and selected considering these six standards in each criterion to make the assessment representative of various levels of standard (proficiencies).

As the purpose of this assessment is to provide feedback to the entire education system for improving the quality of and equity in school education, this assessment does not report individual students' performance, nor does it compare the proficiency of an individual school against others. Similarly, students' individual scores are not made public in any form of identification. It provides the national and provincial results as well as differences in achievement scores due to the various influencing factors such as socioeconomic status, home language, gender, ethnicity, and home and school related factors.

1.4 Use of Item Response Theory

NASA 2017 has used IRT modelling to select items for the test and to generate data from the test. The scores generated through the IRT modelling are not the raw scores of the students; rather, they represent each student's ability in relation to a particular item and its characteristics. Chalmers (2012) states that IRT modelling provides "a general framework for specifying the functional relationship between a respondent's underlying latent trait level (commonly known as 'ability' in educational testing…) and an item level stimulus."

Using this probabilistic model, NASA 2017 has estimated each student's trait level from their responses to individual items in relation to the characteristics of the test items.

One major feature of IRT modelling is that it has sample-independent item characteristics, and it gives test-independent scores of each student (latent trait). Besides, there are two other assumptions of IRT. First, the test items collectively measure a unique underlying latent trait for each student; and that (only one) latent trait influences the item responses (known as unidimensionality). Second, if the assumption of unidimensionality is ensured, the response of a student to one item will be independent of his or her response to another item – which is called local independence (Le, 2013).

With this understanding about IRT, ERO has used the IRT modelling for item selection, item calibration and equating and estimating students' ability (latent traits-theta value). The equating was done by using some linking items and their parameters between different item booklets, and comparing the test results of different years as well as with other similar assessments. In addition, NASA 2017 used Conquest software for IRT modelling. Along with Conquest, Excel and SPSS (SPSS 23) were also simultaneously used for data analysis and results preparation.

1.5 Structure of Technical Report

The technical report provides a portrayal of National Assessment of Student Achievement (NASA) 2017 conducted at Grade 8 in three subjects: Mathematics, Nepali and Science. This technical report is presented in 12 chapters. Chapter 1 introduces national assessment in general and NASA 2017 conducted by ERO for Grade 8 students of the schools in Nepal in particular. It also introduces and justifies the assessment theories and models, including the Item Response Theory (IRT), as used in this assessment.

Chapter 2 of this report presents the details about the sampling done for this assessment. It identifies sampling frame, and defines population for assessment together with the desired population, exclusions and defined population. This chapter also defines strata for the sampling and describes the sampling process and methods for selecting schools (clusters) and students within the school. Finally, it specifies the number of sampled schools and students in each stratum (province) in each subject.

Chapter 3 describes test design and development of assessment, and assessment methods, process and tools used. It summaries assessment framework, classifies cognitive domain, and describes the activities and processes used for item development, piloting, item analysis and items selection, item booklet preparation, marking scheme preparation, OMR sheet design and item register preparation. Chapter 4 presents the framework for preparing students' background questionnaire, teachers' questionnaire and head teachers' questionnaire. Similarly, this chapter includes a framework for preparing attitude survey questionnaire for students towards the subject and teacher.

Chapter 5 elaborates in detail the test administration process at schools. It describes the process and activities carried out in different stages of test administration such as printing, packing and delivery of tools, orientation about the test administration process to district focal persons and head teachers and teachers responsible for administrating the test, process of administering the tests and questionnaires, collection of the responses from students in the tests and questionnaires, and the monitoring test administration. Chapter 6 presents the selection and orientation of scorers, process of marking, writing responses and marks in OMR sheet, scanning of OMR sheets, and preparing data files.

Chapter 7 describes how the data were prepared for analysis. It explains the data cleaning and code book preparation process. Chapter 8 describes the method and process of calculating sample weights of school and students, and then it presents some examples of calculated weights.

Chapter 9 explains the method and process of estimating item parameters, item review with test-by-test analysis and calibration and equating of items in different versions of test with the lists of estimated parameters, selected and discarded items with their characteristics. It also describes the process of estimating cases – students' ability in each subject, presenting example of case estimation output using WLE method. Chapter 10 describes the method and process of replicating the sample weights for the estimation of population by calculating Plausible values (PVs) and using regression model. It also describes how standard errors were estimated while estimating results for the population.

Chapter 11 describes the method and process of estimating students' abilities in a scale score by transforming logit values to a scale score of students' ability. It also elaborates how the logit values are transformed to a scale score and how various proficiency bands

have been defined and how students are categorized into those levels of proficiency in this assessment.

Chapter 12, the final chapter of this technical report, briefly presents the categories in which the students' results have been prepared for reporting. First, the overall basic results of different provinces will be reported. Then the results based on several influential factors from the background information questionnaire of students will be presented. Finally, it describes how provincial results in different categories will be prepared. Tables of some of the results are included in the annex of this report, while the presentation and discussion of results will be presented separately in a public report of NASA 2017.

CHAPTER 2

Sampling

2.1 Introduction

This chapter includes the sampling procedure adopted for NASA 2017 study. It provides information regarding the desired population, sampling frame, sample size, and sample design. The chapter also discusses the process of selecting schools and students for NASA 2017. It also describes the process of calculating the sampling weights of schools and students.

2.2 Population

The population for this assessment covers all students enrolled at Grade eight in the schools of Nepal. Therefore, schools are the primary sampling units (PSUs) for selecting the students for this assessment.

Desired population

The desired population for this assessment includes all Grade 8 students enrolled in the schools of Nepal for the academic session 2016/17. All the students from both public and private schools are considered as desired population. The total desired population for this assessment was about 582,637 Grade 8 students from 14,635 schools of Nepal. However, some schools and students were excluded due to some reasons and thus the defined (actual) population of schools and the students considered for the assessment are a little lower than the targeted or desired population. The school names and number of student from each school were received from the Department of Education (DOE). Based on the data from the DOE, Education Review Office (ERO) has defined the population by specifying the exclusions of some participants from the whole population.

Exclusions and 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 as follows:

- Some Grade 8 students who were unable to respond to test items and survey questionnaire because of their physical and intellectual disability have not been included;
- Some students from very isolated and remote settlements were not included in the assessment, as the cost required for assessment was very high;
- Some schools do not run Grade 8 and/or have less than five students in Grade eight. Such schools were not included in the assessment.

The following table (Table 2.1) shows the school level (very small schools; or schools with no student; or schools of remote areas) and student level exclusions due to various reasons. The table also shows the difference between the desired (targeted/total) population and defined population for the assessment in seven provinces.

Table 2.1: Estimation of schools' and students' exclusions; and the desired and defined population

Province	Total (desired) schools	School Level Exclusions	Defined School	Total (Desired) students	Student level exclusions	Defined Student population	Percentage
1	2754	81	2673	101598	89	101509	17.44%
2	1021	14	1007	74779	76	74703	12.83%
3	3800	126	3674	125811	110	125701	21.59%
4	1799	60	1739	61350	40	61310	10.53%
5	2308	76	2232	107937	89	107848	18.52%
6	1283	208	1075	46021	24	45997	7.90%
7	1670	62	1608	65177	67	65110	11.18%
Total	14635	627	14008	582673	495	582178	100%

The population not included in the assessment is estimated, and attempt has been made to ensure the exclusion of students as minimum as possible to make the defined population as close as the desired population. Table 2.2 presents the defined population (schools and students) and population distribution in public and private schools.

Table 2.2: Defined population for NASA 2017

Province	Number of Schools			Number of Students		
	Public	Private	Total	Public	Private	Total
1	2098	575	2673	83244	18265	101509
2	957	50	1007	72660	2043	74703
3	2284	1390	3674	80163	45538	125701
4	1317	422	1739	47549	13761	61310
5	1675	557	2232	85929	21919	107848
6	1048	27	1075	45206	791	45997
7	1505	103	1608	62054	3056	65110
Total	10884	3124	14008	476805	105373	582178

2.3 Sampling Frame

The list of all schools to be included in the assessment, with their unique ID (school EMIS code) provided by DOE, is considered as the sampling frame. In addition to the name, location (provincial, district, geography and municipality/VDC) and ID (code) of each school, public and private categories, the total number of students, with gender categories, in each school are taken as the sampling frame. These data are available from the flash report of DOE, which are collected through the national census study of schools every year. The sampling frame for this assessment prepared on the basis of the school data of 2017. However, there can be some changes in the school data each year.

2.4 Sample Size

Educational survey research studies suggest that the sampling precision requirements should be such that they would be satisfied by a simple random sample (SRS) of 400 students for the main criterion variable. This size of simple random sample of student yields 95% of confidence interval for the student-level estimate with 3% of confidence interval (Margin error). However, a perfect random sampling is not an easy task in a large-scale national assessment. The sampling design includes the combination of different sampling techniques in different stages, including stratification, clustering and random selection of students. For this, the design effect due to the multi-stage sampling has to be

calculated and adjusted while selecting the sample size.

The following mathematical equations have been used to estimate the sample size of students using a multi-stage sampling, considering the relationships between simple random sample and multi-stage sampling methods.

$n_c = n^* \times deff$, where n_c is the required sample size, n* is the effective sample size for simple random sampling (srs), and Deff is the design effect.

$Diff = 1 + (C - 1)\rho\rho$, where C is the population size, $\rho\rho$ (Rho) = Intraclass correlation.

Putting the value of design effect, Deff = 10, as a multi-stage cluster sampling at the national level might have a design effect of 10 or higher (Murphy & Schulz, 2006), the minimum sample size of students is estimated as:

$n_c = 400 \times 10 = 4000$

For reporting the assessment at national level, the sample size above 4000 students will be sufficient. However, this study has included the bigger size of sample as reporting and comparison between the test results of seven strata (province) has been planned and carried out. Calculation of the samples of each province has given the national targeted sample size of 16000 students and 650 schools for each subject.

However, the design effect within the province was not as high as the national sample – as the population within the province is relatively more homogeneous than the national population. In this case, while drawing the sample from each province a minimum of 180 schools (60 schools per subject) and 4500 students (1500 students per subject) were selected from each province. Similarly, the samples from the provinces were selected in such a way that the province with relatively higher population will have bigger sample size.

2.5 Sample Design

The sample design for NASA 2017 in Grade 8 was a multi-stage sampling which included the selection of schools from each explicit stratum (province). The sampling design was developed by considering the group of districts having the similar ecological/ geographical locations within each stratum (province). The geographical locations were

identified by considering district as a unit in the province. The selection of districts from each geographical location is done randomly within the similar geographical categories. The Primary Sampling Unit (PSU), schools (clusters), were selected within the district by using random sampling method; and the students from each of the sampled schools were selected randomly.

Stratification

Stratification is a process of classifying schools into similar groups, according to some defined characteristics or selected variables. The selected variables for stratification are known as stratification variables. As in PISA 2015, this assessment has used stratification process with the following objectives (see, OECD, 2016):

- To make the survey estimates more reliable by improving the efficiency of the sample design;
- To represent specific locations, groups in the sample; and
- To include all parts of a population in the sample.

All schools were divided into seven provinces to make strata explicit. Within the province, districts were classified under various geographical locations/regions, if applicable; and districts from each geographical stratum were selected for NASA 2017. As the implicit stratification, public and private schools were grouped separately in each district to ensure adequate samples from both private and public schools.

Table 2.3: Provincial and geographical distribution of districts in Nepal

Province	Mountain District	Hill District	Tarai District	Kathmandu Valley District	Total number of district
1	Sankhuwasabha, Solukhumbu, Taplejung,	Bhojpur, Dhankuta, Ilam, Khotang, Okhaldhunga, Panchthar, Terhathum, Udayapur	Jhapa, Morang, Sunsari		14

Province	Mountain District	Hill District	Tarai District	Kathmandu Valley District	Total number of district
2			Bara, Dhanusa, Mahottari, Parsa, Rautahat, Saptari, Sarlahi, Sirha,		8
3	Dolaka, Rasuwa, Sindhupalchok	Dhading, Kavrepalanchok, Nuwakot, Ramechhap, Sindhuli,	Chitwan, Makawanpur	Bhaktapur, Kathmandu, Lalitpur	13
4	Manang, Mustang	Bablung, Gorkha, Kaski, Lamjung, Myagdi, Parbat, Syanja, Tanahu	Nawalparasi (east)		11
5		Arghakhanchi, Gulmi, Palpa, Pyuthan, Rolpa, Rukum (east)	Banke, Bardiya, Dang, Kapilbastu, Nawalparasi (west), Rupandehi		12
6	Dolpa, Jumla, Humla, Kalikot, Mugu	Dailekh, Jajarkot, Rukum (west), Salyan,	Surkhet		10
7	Bhajhang, Bajura	Achham, Baitadi, Dadeldhura, Darchula, Doti	Kanchanapur, Kailali		9
	15	36	23	3	77

After dividing the whole population into seven strata-provinces and the districts of

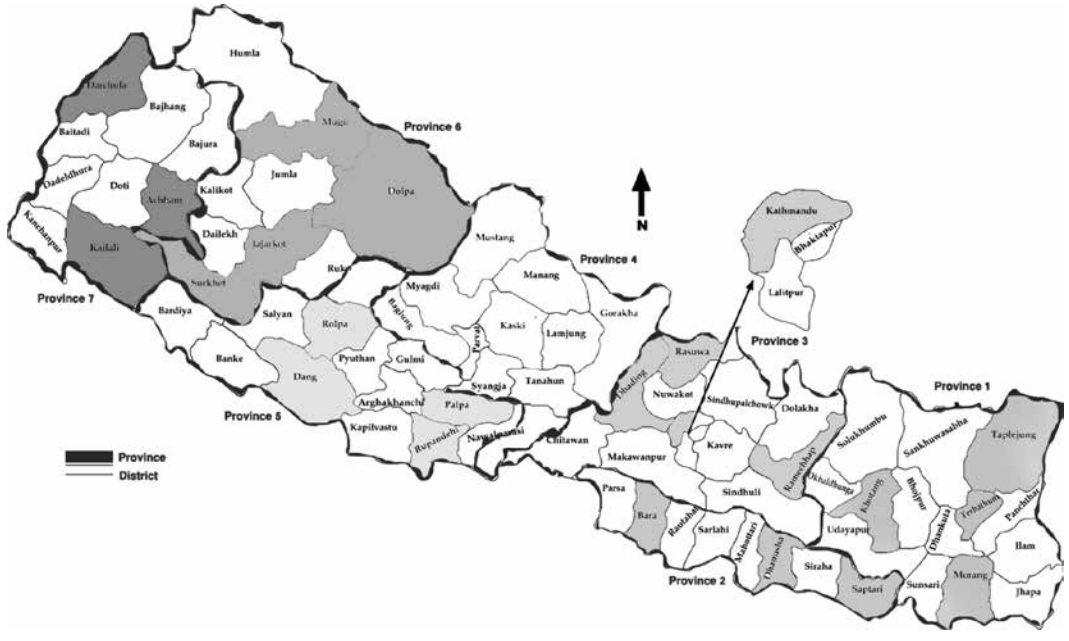
similar geography (Mountain, Hill, Tarai and Kathmandu Valley) within the province, the districts from each stratum were selected randomly. For the selection of the district, the total number of districts (Note that 75 were considered initially when sample was designed, but latter when 77 districts were formed we have adjusted accordingly.) was divided into three groups, having almost the same number of districts in each group. With this, 26 districts were selected for NASA 2017. The grouping of districts into 3 groups of similar categories helped to reduce the administrative burden and the cost, compared to selecting the sample schools from each district. There were two purposes of selecting the districts from each province before selecting the sample schools. First, it helped to select schools from every geographical region of the province. Second, it facilitated the test administration process. When sample was designed for this study in 2016, there were 75 districts in Nepal, so 26 districts were selected among 75 districts. Latter, in 2017 government decided to form 77 districts by splitting each of Nawalparasi and Rukum districts into two districts, and then the sample districts were adjusted accordingly. After this adjustment, 77 districts were counted and included in this report. The data collected from the sample schools and students were reported at the national and province levels.

Table 2.4: Name of the districts selected for NASA 2017 in each province

Province	Number of district	Name of the districts	Number of schools sampled	No. of schools per subject	Number of students sampled	No. of students sampled per subject
1	4	Taplejung, Khotang, Terhathum, Morang	296	Math 100 Nepali 98 Science 98	6914	Math 2329 Nepali 2305 Science 2280
2	3	Bara, Dhanusa, Saptari	223	Math 74 Nepali 73 Science 76	6244	Math 2048 Nepali 2107 Science 2089
3	4	Rasuwa, Dhading, Ramechhap, Kathmandu	373	Math 124 Nepali 124 Science 125	8958	Math 2966 Nepali 3009 Science 2983

Province	Number of district	Name of the districts	Number of schools sampled	No. of schools per subject	Number of students sampled	No. of students sampled per subject
4	4	Mustang, Gorkha, Kaski, Baglung	262	Math 87 Nepali 87 Science 88	5654	Math 1887 Nepali 1877 Science 1890
5	4	Palpa, Rupandehi, Dang, Rolpa	374	Math 125 Nepali 125 Science 124	9844	Math 3294 Nepali 3298 Science 3252
6	4	Surkhet, Jajarkot, Dolpa, Mugu	187	Math 61 Nepali 63 Science 63	4585	Math 1503 Nepali 1522 Science 1560
7	3	Achham, Darchula, Kailali	235	Math 79 Nepali 79 Science 78	5812	Math 1927 Nepali 1949 Science 1936
Total			1950	Math 649 Nepali 649 Science 652	48011	Math 15954 Nepali 16067 Science 15990

Figure 2.1: Population strata and sample districts



Selection of schools

As the primary sampling unit (PSU), schools in each province were selected from the sample districts. A minimum of 60 schools and 1500 students were selected from each province for each subject with a higher number of sample schools and students from the provinces having high number of students. School selection within a district was done by using a random sampling method, by sorting out the list of schools from the selected districts. The schools were selected by sorting out the list of public and private schools by maintaining the implicit strata by the type of schools (public and private). Using the same process, the schools from all 26 districts were selected. In addition to preparing the list of sample schools, a list of replacement schools was also prepared. During the orientation programme about NASA administration to the district focal persons, the final list of the sample schools was prepared, choosing the schools from the list of replacement schools, if required.

Selection of students

The minimum sample for the province, having the smallest number of student population, was fixed to be 1500 per subject with 60 clusters (sample schools), adjusting some design effect. Viewing the different sizes of schools, the maximum sample size was fixed 28, which is called Measure of Size (MOS).

In the case of a sample school having more than 28 students, the students were selected by using a random sampling method whereas all the students were taken as samples from the schools with 28 or less students in Grade 8. More specifically, the students were sampled in each of the selected schools in two different ways: (i) If the size of the students is less than or equal to the expected sample size (MOS), all the students were sampled. (ii) When the size of the students was greater than the expected size, the required number of the students was selected randomly. This selection process has given different probability of selecting schools, based on the school size; however, the probability of selection of a particular student from schools is always the same.

The number of sample schools and students presented in the tables 2.1 and 2.2 were the total number of schools and students for three subjects: Mathematics, Science and Nepali. The total sample schools and students were distributed almost equally to each subject. At

least 650 schools and 16000 students were included as samples for each subject. However, some small variations were noticed when actual administration of NASA was carried out.

When actual administration of tests was carried out, some deviations were noticed in the participation of schools and students. Table 2.5 presents the targeted sample and achieved sample in each province and sample districts.

Table 2.5: Targeted and achieved sampled schools and students in each stratum

Stratum/ Province	Schools				Students			
	Desired schools	Defined schools	Sample schools	Achieved schools	Desired population (students)	Defined population (Students)	Sample students	Achieved students
1	2754	2673	296	296	101598	101509	6914	6826
2	1021	1007	223	223	74779	74703	6244	5942
3	3800	3674	372	372	125811	125701	8958	8952
4	1799	1739	262	262	61350	61310	5654	5449
5	2308	2232	376	376	107937	107848	9844	9636
6	1283	1075	187	187	46021	45997	4585	4306
7	1670	1608	234	234	65177	65110	5812	5155
Total	14635	14008	1950	1950	582673	582178	48011	46266

The sample population had different characteristics. The following table presents the sample distribution among the various characteristics within the strata.

Table 2.6: Distribution of achieved sample characteristics by strata (Province)

Categories	Characteristics	Prov 1	Prov 2	Prov 3	Prov 4	Prov 5	Prov 6	Prov 7	Total
Community	Brahmin/ Chhetri	2178	663	3539	1989	3273	2187	2488	16317
	Janajati	3038	1769	4131	2112	4221	947	1520	17738
	Dalit	779	769	602	997	1150	796	749	5842
	Other	681	2557	569	294	872	285	313	5571
	Missing	150	184	111	57	120	91	85	798
	Total	6826	5942	8952	5449	9636	4306	5155	46266
Language background	Nepali speaking	4600	1095	7181	4717	6495	3820	2503	30411
	Non-Nepali language speaking	1945	4548	1514	607	2893	329	2510	14346
	Missing	281	299	257	125	248	157	142	1509
	Total	6826	5942	8952	5449	9636	4306	5155	46266
Student gender	Boys	3274	2902	4397	2681	4685	2084	2520	22543
	Girls	3461	2963	4490	2735	4882	2185	2605	23321
	Missing	91	77	65	33	69	37	30	402
	Total	6826	5942	8952	5449	9636	4306	5155	46266

CHAPTER 3

Test Design and Development

3.1 Introduction

Education Review Office (ERO) conducted NASA 2017 for Grade 8 in three subjects: Mathematics, Nepali language and Science. The focus of the assessment was to assess the basic curricular competencies of Grade 8 students. In order to guide the test design and development process, a NASA framework was developed based on the curriculum approved by the Government of Nepal. Based on the framework, test items were designed and developed.

This chapter describes the assessment framework for Grade 8 in Mathematics, Nepali and Science; various cognitive domains to be assessed; method and process for item development and item booklet preparation; development of scoring key; and designing of OMR sheet.

3.2 Assessment Framework

The assessment framework was developed before designing the test and developing the test items. The assessment framework was developed to:

Provide a clear guideline for a sound assessment approach to inform policy makers and the other concerned stakeholders on quality of education. It includes domains to be assessed, the statement of criteria together with standards, specification of items, framework for contextual variables to be considered while conducting an assessment and brief guidelines for assessment design. (ERO, 2017)

The assessment framework has identified and described the domains and constructs to be assessed in Mathematics, Nepali and Science subjects. It has also proposed a framework for designing background questionnaires for students, teachers and head teachers. In addition, it has presented a brief guideline on overall methodological approach for the assessment.

Framework for Mathematics

The framework for mathematics begins with the overall objectives of teaching mathematics in school, as specified in the national curriculum framework. As stated in the curriculum, the overall objectives of teaching mathematics are to develop students' basic knowledge and understanding in the use of number and mathematical operations; to equip them with basic mathematical and numeracy skills required for solving daily life problems; and to lay foundations for higher and technical education in various fields (CDC, 2013). Besides, the framework builds on the assumption of the curriculum that "mathematics helps students develop critical analysis of problems and situations and enhance their creativity and problem-solving skills" (ERO, 2017).

Building on the above mentioned overall objectives of mathematics teaching at basic level, the framework considers mathematics as an important part of literacy, which generally includes basic mathematical contents and skills including numeracy, arithmetic, geometric shapes and measurement, algebra, sets and data handling in real life contexts, solution of familiar and unfamiliar problems, and decision-making and communication skills (ERO, 2017). After defining mathematics literacy and stating the overall objectives of mathematics teaching at basic school education, the framework analyses the curriculum of Grade 6 to 8 in mathematics. The following are the general competencies specified for basic level mathematics (Grades 6 - 8), as mentioned in national curriculum (CDC, 2012).

1. Construct geometric figures and verify their simple relations;
2. Develop geometric models;
3. Solve simple daily problems on arithmetic;
4. Collect and present data and communicate simple results;
5. Solve simple daily problems using sets; and
6. Develop problem-solving skills on algebraic expressions and equations.

The curriculum elaborates these general types of competencies in each Grade in order for making them more specific. The following are the competencies set by the Grade 8 curriculum for mathematics (CDC, 2012):

1. Verify and apply the properties of adjacent angles and vertically opposite angles;
2. Investigate the relationship between corresponding, alternate and co-interior angles

formed by a transversal with parallels lines;

3. Investigate and verify the angle sum property of a triangle (the sum of interior angles of a triangle is 180°) and the properties of isosceles and equilateral triangles;
4. Verify and use the properties of parallelograms, squares and rectangles;
5. Construct regular polygons (pentagon, hexagon and octagon) and rectangles;
6. State and show the conditions of congruency and similarity of triangles and solve the problems related to similarity of triangles;
7. Investigate the relation between diameter and circumference of a circle, and derive and use the formula for area of a circle;
8. Describe the properties of solids (cube, cuboids, tetrahedron, cone, cylinders, prism and pyramids), and prepare nets of cubes, cuboids, tetrahedrons, cones and cylinders;
9. Define Pythagoras theorem and apply it to find the distance between two points;
10. Find the area of triangles and quadrilaterals by using formulae;
11. Solve the problems related to the area and volume of cubes and cuboids;
12. Reflect, rotate and translate a geometric object by using co-ordinates;
13. Identify the location of an object using bearing; draw a scaled figure and calculate distance by using scale drawings;
14. Simplify the integers with brackets;
15. Convert binary and quinary numbers into decimal numbers and vice versa;
16. Define the real number system and differentiate between decimal and irrational numbers;
17. Express the numbers in a scientific notation;
18. Solve problems related to ratio, proportion and percentage;
19. Solve problems related to profit and loss involving discount and VAT;
20. Solve simple problems by using a unitary method;
21. Solve simple problems related to simple interest;
22. Find the median, mode and range from individual data, and draw a pie chart and line graph;
23. Find the difference of sets and complement of a set, and solve simple verbal problems by using Venn-diagrams;

24. Factorise algebraic expressions of the form of $a^2 - b^2$, perfect square trinomial, trinomial of the form $ax^2 \pm bx \pm c$;
25. Find LCM and HCF of algebraic expressions by using a factorization method;
26. Find the cube of an algebraic expression of two terms;
27. Simplify algebraic expressions by using four operations and brackets;
28. Simplify rational algebraic expressions up to two terms by using four fundamental operations;
29. Simplify the algebraic expressions involving indices;
30. Solve linear equations of one variable and solve linear inequality of one variable;
31. Solve simultaneous linear equations; and
32. Solve quadratic equations by using factorization method.

The content domains and their weightage drawn from the curriculum are presented in Table 3.1.

Table 3.1: Content domains for Mathematics in Grade 8

Content Domain	Sub-domain	Percentage of weightage	
Geometry	Geometry	24	40
	Coordinate Geometry	5	
	Transformation Geometry	6	
	Mensuration	5	
Arithmetic	Numeracy	14	30
	Arithmetic	16	
Data and Sets	Statistics	5	10
	Sets	5	
Algebra	Algebra	20	20

The framework further elaborated the content details in each of the four content domains: Geometry, Arithmetic, Data and Sets, and Algebra.

Based on the contents and general competencies in each content domain, 32 criteria and six standards for each criterion were developed through the involvement of teachers and experts in workshops at different stages. Six standards for each criterion describe different levels of competencies and provide information regarding how well students

demonstrate their competencies. Three standards— Basic, Proficient and Advanced— were categorized first; and then they were further categorized into six levels: 1 and 2 (for basic); 3, 4 and 5 (for proficient); and 6 (for advanced). The following table (Table 3.2) presents the general standards and their descriptors:

Table 3.2: General Standards and their descriptors for Grade 8 in Mathematics

Standard	Levels of Standards	General Descriptors	General Descriptors for Mathematics
Basic : Partial mastery of prerequisite knowledge and skills that are essential for proficient work for the Grade	Level 1	Students demonstrate **basic pre-requisite** knowledge and skills needed for Grade 8 curriculum.	Have the basic pre-requisite knowledge and skills of the content. Perform four basic operations in whole number, fractions and decimals. Read bills, pictographs and bar graphs. Change fractions into decimals and percentage. Draw standard angles up to 90^0 using a straight edge and compass. Recognize, categorize and sketch rectilinear figures. Calculate the area of rectangles and squares, and volume of cube and cuboid. Perform basic operations of binomial algebraic expressions. Locate an ordered pair.
	Level 2	Students demonstrate a **limited basic** understanding of knowledge and skills specified in the curriculum.	Understand the concept of square and square root, cube and cube root, factorization, equation and indices; can simplify integers, find profit and loss, simple interest, unitary method. Calculate area and volume of cuboids/cubes and spheres. Perform simple estimations; simplify algebraic expansions;

			and factorize simple quadratic expressions. Construct standard angles up to 180°; compute interior and exterior angles of regular polygons; have concept of measure of central tendency (mean); read histogram and bar graph and presentation; use scale drawing to estimate the distance; and transform the figure/object using translation, reflection, rotation and enlargement. Use mathematical notations and express them in own words. Solve simple verbal problems involving fraction, decimal and percentage. Have an understanding of similarity and congruency, properties of rectangles and parallelograms.
Proficient: Students demonstrate competency over subject matter, including subject-matter knowledge, application of such knowledge to real-world	Level 3	Students demonstrate an **adequate** understanding of knowledge and skills specified in the curriculum and demonstrate a **partial proficiency** in applying such knowledge and skills.	Solve routine problems, show a little computation ability in a range of mathematical concepts, and read and compare data from the graph. Solve verbal problems with simple operations. Calculate the value of simple interest and amount. Solve one variable linear equation.

situations, and analytical skills appropriate to the subject matter.	Level 4	Students demonstrate an **adequate proficiency** in understanding of and ability to apply knowledge and skills specified in the curriculum.	Have a computational ability in all content areas. Have a limited ability on abstraction of mathematical concepts. Construct and verify geometrical properties of rectilinear figures (triangles, quadrilaterals). Create simple individual data and present them in charts and figures. Solve problems based on multi-operational calculations. Define mathematical terms. Solve one variables linear equation graphically. Solve algebraic rational fractions up to two terms.
	Level 5	Students demonstrate a **thorough proficiency** in understanding of and ability to apply knowledge and skills specified in the curriculum, including the combining of more than one relation together for solving problems.	Have a functional ability of mathematical concepts to solve daily life problems meaningfully; solve all ranges of problems in all content areas (multi-operational), construct polygons, solve simple verbal problems on sets (2 sets), solve linear equations in two variables and quadratic equations; calculate the area and volume of combined shapes; show the relation between two variables and represent graphically. Compare the numbers presented in a binary and quinary system. Define mathematical terms precisely. Solve algebraic rational fractions up to three terms.

Advanced : Outstanding performance with an adequate level of abstraction.	Level 6	Students demonstrate an **advanced** ability to apply knowledge and skills specified in the curriculum in a new and unfamiliar situation, and show an ability to combine and use various relations and components of knowledge and skills in order to solve the problems and develop a new relation.	Have an ability to interpret the data presented in graphs and tables; draw conclusions; solve unseen problems; prove theorems deductively. Describe the process of calculations and create and solve mathematical problems.

Based on these general standards, their levels and descriptors for the six levels of competencies in each criterion have been developed. This standard detail helped to develop the test items to measure various levels of competencies. However, these items were tentative to describe the proficiency levels of students in which the final proficiency levels of students in mathematics were determined with the estimation of students' abilities and transferring in a single scale by using the data from the assessment.

Based on the curricular objectives and contents, the following 32 criteria were defined for assessing students' achievement at Grade 8 in Mathematics:

1. Identification and application of the properties of vertically opposite angles and adjacent angles.
2. Identification and application of the properties on corresponding, alternate and co-interior angles formed by a transversal with parallel lines.
3. Investigation and application of the angle sum property of a triangle, isosceles triangle and equilateral triangle.

4. Construction of regular polygons and rectangle.
5. Verification of the properties of parallelogram, square and rectangle.
6. Familiarity of the conditions of congruency and similarity of triangles, and solution of the problems related to similarity and congruency of triangles.
7. Identification of the relation between the diameter and the circumference of a circle; and deriving and using the formula to solve the related problems.
8. Description of the properties of solids (cube, cuboids, tetrahedron, cone and cylinders, prism and pyramids) and preparation of nets of cube, cuboids, tetrahedron, cone and cylinders.
9. Finding the distance between two points using Pythagoras relation.
10. Calculation of the areas of triangles and quadrilaterals.
11. Solution of problems related to the area and volume of cube and cuboid.
12. Reflection, rotation and translation of geometric objects using co-ordinates.
13. Application of bearing and scale drawing.
14. Simplification of the expressions with brackets.
15. Conversion of binary and quinary numbers into decimal numbers and vice versa.
16. Identification of real number system; differentiation of rational and irrational numbers.
17. Expressing numbers into scientific notation.
18. Solution of problems on Ratio, proportion and percentage.
19. Solution of problems of profit and loss involving discount and VAT.
20. Solution of simple problems using unitary method.
21. Solution of simple problems related to simple interest.
22. Finding median, mode and range of an individual data, and drawing pie chart as well as line graph.
23. Finding the difference and complement of a sets; solution of simple verbal problems using Venn-diagrams.
24. Factorization of algebraic expressionin in the form of $a^2 - b^2$, perfect square trinomial, trinomial of the form $ax^2 \pm bx \pm c$.

25. Finding LCM and HCF by factorization method.
26. Finding the cube of a binomial algebraic expression.
27. Simplification of algebraic expressions using four operations and brackets.
28. Simplification of rational algebraic expressions up to two terms using four fundamental operations.
29. Solution of the problems of simplification involving indices.
30. Solution of the linear equation of one variable; representation of one variable linear inequality in a straight line.
31. Solution of simultaneous linear equations.
32. Solution of quadratic equation using factorization method.

The six standards for each of the above criteria have been defined to identity different levels of proficiency of students in each criterion. The items were developed by considering these standards in each criterion. In addition, the item specification was prepared in developing the test items. The items in mathematics were developed by considering the following item specification framework:

Table 3.3: Table of specification for item selection

Content domain	Criteria No.	Weightage	Item type	Weightage for items of various standards
Geometry	1-13	40%	Both SR (MC) and CR (very short and short answer) items	The weightage of items in each set should be around as follows: Level 1: 10%, Levels 2, 3, 4 and 5 each; 20%, and Level 6: 10%.
Arithmetic	14-21	30%		
Data and Sets	22, 23	10%		
Algebra	24 -32	20%		
Total		100%		

Framework for Science

The framework for science begins with describing the overall objectives of teaching Science in school, as described in the curriculum. As stated in the curriculum approved by the government of Nepal, the overall objective of teaching science is to help students

develop the basic knowledge of scientific concepts, principles and laws. The curriculum states that teaching science plays a vital role in the development of students' scientific attitudes, scientific knowledge and creativity. The efforts to teaching science are concentrated on the development of science and technology literacy among students. In addition, teaching science also helps students utilize their leisure time by involving them in innovative activities; provides them with foundation for further study; and draws their interest towards scientific activities. More importantly, science education imparts the students with the skills of observation and inquiry and helps to develop students' competency in developing knowledge and skills for the solution of problems in daily life (see, CDC, 2012).

After defining scientific literacy and stating the overall objectives of science teaching at basic school education, the framework analyses the curriculum of Grade 6 to 8 in Science. The following are the general competencies for basic level Science (Grades 6 - 8) as mentioned in national curriculum (CDC, 2012).

1. Observe and present the facts, process and impacts of surrounding objects and events;
2. Describe scientific concept, fact, principle and laws and use them in daily life;
3. Develop and use the science process skills;
4. Identify the various forms of energy and orient towards their appropriate use and conservation;
5. Identify the properties of matter and use them into practice;
6. Identify the interrelationship between living beings and environment;
7. Explain the importance of environment and orient towards its conservation and development;
8. Present the life process and life cycle of living things;
9. Describe the characteristics and importance of some important plants and animals of Nepal and be aware for their conservation; and
10. Discover and compare the facts related to earth, space and nature.

These competencies are general in nature. So they were elaborated in each Grade for making them more specific. The following are the competencies set by the curriculum for Grade 8 in Science (CDC, 2012):

Area: Physics

1. Measurement

- Define fundamental and derived units.
- Identify measurement of mass, weight and time.

2. Velocity and acceleration

- Explain velocity and relative velocity.
- Introduce acceleration and retardation.
- Derive and use equations related to velocity and accelerations.
- Solve the numerical problems related to equations of velocity and acceleration.

3. Simple machine

- Define lever and explain its principle.
- Introduce MA, VR and efficiency of lever.
- Solve the numerical problem related to MA, VR and efficiency.

4. Pressure

- Introduce atmospheric pressure and explain its importance.
- Introduce pressure of liquid.
- Derive the formula of liquid pressure and solve the numerical problems related to it.
- Introduce density and relative density and write their formulae.
- Explain the process of floating and sinking.
- Solve simple numerical problems related to density.

5. Work, energy and power

- Show the relation and difference between work, energy and power.
- Explain and demonstrate transformation of energy.
- Solve simple numerical problems related to work, energy and power.

6. Heat

- Introduce heat and temperature and establish the relation between heat and temperature.
- Determine the units of temperature and show the interrelationship between them and convert their units.
- Explain the structure and working system of a clinical thermometer and simple thermometer.

7. Light

- Identify mirror with types and demonstrate the reflection of light through a spherical mirror.
- Demonstrate the image formed by a spherical mirror keeping the object at different positions and draw a ray diagram of each.

8. Sound

- Introduce terms related to sound (frequency, velocity and wave length).
- Introduce the effect of reverberation and echo with differeciation between them.

9. Magnetism

- Explain the molecular theory of magnetism.
- Define magnetic induction.
- Demonstrate and explain magnetic induction.
- Describe the reasons of demagnetization.
- Describe the ways to conserve magnetic energy.

10. Electricity

- Explain and demonstrate structure and uses of a dry cell and simple cell.
- Introduce domestic electrification and its use.
- Introduce fuse and MCB and state their use.

Area: Chemistry

11. Matter

- Define the properties of proton, neutron and electron by demonstrating a model of an atom.
- Write molecular formula of common compounds.
- Introduce Mendeleev's periodic table in brief.
- Define valancy and find out valancy of the first twenty elements on the basis of electronic configuration.
- Define atomic number and atomic weight of an element and find the number of proton, neutron and electron based on it.
- Define molecular weight and solve related numerical problems.
- Define chemical equations and express it in words and formula.

12. Mixture

- Introduce and demonstrate fractional distillation, stem distillation and chromatography.

13. Metal and non-metal

- Introduce metal and non-metals.
- Express the use of metals and non-metals in daily life.
- Give a general introduction of metals (Iron, Cupper, Gold, Silver) used in daily life.

14. Chemistry, acid, base and salt

- Introduce acid base and salt, describe their characteristics and mention their use.
- Introduce indicator and use litmus to separate acid, base and salt.
- Prepare a litmus paper from different parts of plant.
- Give an introduction of a pH scale and its use.

15. Some useful chemicals

- Define and differentiate hard and soft water after explaining the physical and chemical properties.

- Identify the type of hardness of water.
- Introduce sodium carbonate, sodium bicarbonate and glycerol, and describe their properties and use.

Area: Biology

16. Living beings

- Introduce microorganisms (bacteria, virus and fungi).
- Describe modification of root, stem and leaf and their uses.
- Draw a diagram of Dicot and Monocot seed.
- Distinguish between monocotyledonous and dicotyledonous seeds.
- Elucidate the different ways of seed dispersal.
- Demonstrate seed germination process and its requirement.
- Show different parts of a flower and their importance in fertilization.
- Describe life cycle of a flowering plant.

17. Cell and tissue

- Explain the epithelium tissue and meristematic tissue in plants and animals.
- Describe the interrelationship of cells, tissues and organs of human body.

18. Life process

- Describe sexual and asexual reproduction processes in plants.
- Describe different types of sexual reproduction processes in animals.
- Introduce and describe human circulatory system.
- Define and prove experimentally the photosynthesis process of plants and its requirements.

Area: Geology and Astronomy

19. Structure of the earth

- Describe internal and external structures of the earth.

20. Weather and climate

- Define climate with a description of factors affecting climate change.
- Introduce the climate of Nepal.
- Explain the process and effect of monsoon in Nepal.

21. Earth and space

- Explain the hypothesis about the origin of earth.
- Explain the position of the sun and the earth in different seasons.
- Explain the phases of moon.

Area: Environment Education

22. Environment and its balance

- Describe natural resources and human dependency.
- List national parks, wild life reserves, conservation areas and hunting reserves.
- Explain the status, need and importance of forest.
- List protected plants and animals.
- Describe endangered animals of Nepal and the ways of conserving them.
- Show the inter-relationship between plants, animals and ecosystem.

23. Environmental degradation and conservation

- Explain the causes and effects of environmental pollution.
- Describe the causes and impact of greenhouse effect.
- Identify the ways to minimize the effects of climate change in the environment.
- Explain the causes of acid rain and its effect in the environment.
- Explain the ways of conserving the environment.
- Develop knowledge about natural disasters and its causes.
- Build awareness of natural disasters and the knowledge and skills for managing them.
- Discuss the ways of disaster management and ways to minimize the disaster risk.
- List GOs, NGOs, INGOs and describe their role to conserve the environment.

24. Environment and sustainable development

- Introduce and state the importance of sustainable development.
- Explain the interrelationship between population, environment and development.
- Explain local practices for sustainable development.

The content domains and their weightage drawn from the curriculum are presented in Table 3.4.

Table 3.4: Content domains and their weightage for Science Grade 8

Content Domains	Percentage of weightage
Physics	26
Chemistry	22
Biology	20
Geology and astronomy	12
Environment education	20

The framework just presented has elaborated content details in each of the five content domains: Physics, Chemistry, Biology, Geology and Astronomy, and Environment Education.

Based on the contents and general competencies in each content domain, 24 criteria and six standards for each criterion were developed through workshops organized with the involvement of teachers and experts at different stages. Six standards for each criterion describe different levels of competencies and tell how well students demonstrate their competencies. In this assessment, three standards (Basic, Proficient and Advanced) were categorized first; and then they were further categorized into six levels: 1 and 2 (for Basic); 3, 4 and 5 (for Proficient); and 6 (for Advanced). The following table presents the general standards and their descriptors:

Table 3.5: General Standards and their Descriptors for Grade 8 in Science

Standards	Levels of Standards	General Descriptors	General Descriptors for Science
Basic: Partial mastery of prerequisite knowledge and skills that is essential for proficient work at the grade	Level 1	Students demonstrate **basic pre-requisite** knowledge and skills needed for Grade 8 curriculum.	• Use familiar instruments for measurement of length, mass, weight and time in daily life. • Explain the basic concept of magnetic induction, distance, displacement, density of substances. • Give examples of different classes of lever, works and forms of energy, types of energy. • List out the sources of heat, cell, acid, base and salt, natural resources and environment degradation. • Describe the basic concept of atmosphere, atmospheric pressure and liquid pressure. State the laws of reflection of light. • Introduce sound waves, matters, element, compound, atom, molecule, rocks, minerals, ores, and structure of air, sustainable development and natural disasters. • Draw the diagram of electric circuit. • Write physical properties of some useful chemicals like water, glycerol, sodium carbonate and sodium bicarbonate. • Identify the use of metals in daily life, functions of different parts of plants, and • Nname the members of solar system.
	Level 2	Students demonstrate **limited basic** understanding of knowledge and skills set forth in the curriculum.	• Identify the examples of fundamental and derived units. • Describe the relation of weight of an object and mass. • Explain the concept of speed, velocity, production of longitudinal wave, hardness of water. • Differentiate between heat and temperature, the rotation and revolution of earth. • Solve the practical problems related to MA and VR by using given information. • Compare the density of solid, liquid and gas. • Explain the process of magnetic induction. • Identify the relation between height and atmospheric pressure, depth and pressure of liquid. • Explain work, energy, speed and medium of sound. • Measure the temperature of human body.

			• Recognize the types of acid and base (Strong acid, soft acid, alkali, base, strong base, weak base). • Identify the physical characteristics of different metals, components of soil and cell organelles. • Recognize the examples of different organs that take part in respiration, national parks and wild live reserves of Nepal. • Explain the relationship between speed and medium of sound. • Describe the methods of separation of mixtures, structure of atmosphere, degradation of natural resources and their effect, importance of sustainable development. • Recognize the name and symbol of elements up to atomic no. 20, molecular formula of general molecule. • Draw the ray diagram of reflection of light.
Proficient: Students demonstrate competency over subject matter, including subject-matter knowledge, application of such knowledge in real-world situations, and analytical skills appropriate to the subject matter.	Level 3	Students demonstrate **partial proficiency** in understanding and ability to apply knowledge and skills set forth in the curriculum.	• Recognize the formula of velocity, speed and acceleration/relative velocity, work and power. • Differentiate between input work and output work. • Compare the density of different substances. • Verify the relation P= hdg. • Describe the types of work, wave length, velocity and frequency of sound wave. • Identify subatomic particle based on the atomic structure. • Identify the relation of mass and weight. • Explain demagnetization, calibration process in thermometer, image formed by mirror, reflection of sound, household wiring, process of distillation, concept of eco-friendly development and reproduction in animals. • Describe changes in earth surface (erosion and deposition), importance of forest, and classification of animal and plant tissues. • Explain the cause of hardness of water, uses of some important acid, base and salt. • Recognize the molecular formula of general compounds like glycerol, sodium carbonate and sodium bicarbonate.

			• Differentiate between metal and non-metal, weather and climate. • Describe the causes of evolution of life on earth, environmental pollution and their effects in our environment. • Distinguish between matter, element, compound, atom and molecule.
	Level 4	Students demonstrate **adequate proficiency** in the understanding of and ability to apply knowledge and skills set forth in the curriculum	• Describe time, mass, length, area, volume, velocity/ speed etc. as fundamental and derived units. • Explain fractional distillation and chromatography, greenhouse and biodiversity. • Explain relative velocity, conservation of energy and transformation of energy. • Explain the relationship between mass and density, volume and density, and wave length, velocity and frequency of sound. • Compare the subatomic particles with their units and nature, characteristics (position, mass and charge) of atomic particles. • Describe the removal of hardness of water, greenhouse effect, and reproduction in plants. Solve the numerical problems of input and output works of lever. • Recognize the formulae of density and relative density. • Explain the relation of liquid pressure with depth, density and gravitational acceleration. • Describe the relationship among work, energy and power. • Identify the interrelationship between Celsius and Fahrenheit scale. • Differentiate between image formed by convex and concave mirror. • Describe the monsoon, climate and weather of Nepal. • Introduce fuse and MCB with its application. • Identify the uses of some metals, non-metals, metalloids, indicator and universal indicators. • Describe the preparation of litmus paper from petals of flowers. • Classify plant and animal tissues.

			• Compare and contrast minerals and rocks, metallic and non-metallic minerals. • Explain the hypothesis about origin of the earth.
	Level 5	Students demonstrate **thorough proficiency** in understanding of and ability to apply knowledge and skills set forth in the curriculum including the combining more than one relation together for solving the problem.	• Explain the process to measure area and volume of regular surface and objects. • Apply the concept of fundamental and derived units to measure some common derived quantities like area and volume, and express them in their respective units. • Solve the numerical problem related to velocity, accelerations and relative velocity, efficiency of lever, liquid pressure (when the value of density of liquid and gravitational acceleration are given), work done and power. • Explain the principle of flotation, molecular theory of magnetism. • Identify and explain the use of distillation and chromatography, chemical properties of water with chemical reaction, process of blood circulation in human being, characteristics and uses of minerals found in Nepal with their ore, causes of season change. • Propose the ways of conserving environment, disaster management, minimize the risk and the practices about the sustainable development in the context of the world. • Relate the theory of sinking and floating with examples in his or her surroundings. • Solve the numerical problems of conversion of the different units of temperature from one into another. • Draw a ray diagram related to spherical mirror (Concave & convex). • Derive the relationship among speed wavelength and frequency of sound. Demonstrate the structure and function of simple and dry cell. • Construct an atomic model and hence write electronic configuration based on 2n2 formula. • Write the valency of elements up to 20 based on electronic configuration, and physical characteristics of non-metals.

			• Identify acid, base and salt using indicators. • Establish the interrelationship between cell, tissue and organ in human body. • State the monsoon of Nepal, present the effects of monsoon in Nepal. • Measure area and volume of regular surface and objects under given instruction. • Point out the endangered animals.
Advanced: Outstanding performance with adequate level of abstraction	Level 6	Students demonstrate **advanced** ability to apply knowledge and skills set forth in the curriculum in a new and unfamiliar situation, and ability to combine and use various relations and components of knowledge and skills in order to solve the problems and develop a new relation.	• Understand the relation between fundamental and derived units. • Measure volume of objects having irregular shapes by liquid displacement using measuring cylinder perfectly • Derive the equation related to velocity and acceleration and apply it to solve the related numerical problems. • Apply the concept of density, relative density and law of floatation in his or her daily life. • Solve some complex numerical problems (when value of gravitational acceleration and density of water is not given), related to heat and temperature and atomic weight of given atom. • Describe the system of human body based on organs and their functions, photosynthesis process in plants, process of removal of permanent hardness of water reaction, chemical properties of acid, base and salt. • Find out the acidity and basicity by using pH scale, soil formation process, ways of conservation of soil and the principles of suitable development of NTNC, IUCN, WWF, UNEP and ICIMOD and their role for the environment conservation and need and methods of conservation of endangered animals. • Draw ray diagrams keeping the objects at a different partition of concave and convex mirror. • Analyse effect and use of echo and reverberation of sound and solve the simple numerical problems of sound. • Write the molecular formula of compounds by using criss-cross method. • Demonstrate molecular theory of magnetism with figure; explain the process of distillation and

			chromography observing provided diagram and the phases of moon. • Classify the metals, non-metals and metalloids in a simple periodic table. • Establish the interrelationship among weather, climate and monsoon.

Based on these general standards, their levels and descriptors for six levels of competencies have been developed under each criterion. The detailed standards helped to develop the test items to measure the various levels of competencies. However, these items were tentative to describe the proficiency levels of students in which students' final proficiency levels in science were set with the estimation of students' abilities and item difficulties in a single scale.

Based on curricular objectives and contents, the following 24 criteria are defined for assessing students' achievement at Grade 8 in Science:

1. Identification of differences between fundamental and derived units and measurement of mass, weight and time;
2. Derivation of equations of motion and solution of numerical problems using the equations;
3. Solution of the numerical problems related to efficiency of lever;
4. (a) Explanation of Atmospheric pressure, pressure of liquid, and process of floatation; (b) Derivation of the formula of liquid pressure and solution of the numerical problems related to density, relative density and liquid pressure;
5. Identification of the relation of work, energy and power solution of the numerical problems using the relation of work, energy and power;
6. Explanation of relation between heat and temperature, and working system of clinical thermometer and inter-conversion of units of temperature;
7. Explanation of types of mirror and drawing the ray diagrams formed by spherical mirror keeping the object in different positions;
8. Explanation of molecular theory of magnetism, magnetic induction, demagnetization and ways to conserve the magnetic energy;
9. Explanation of molecular theory of magnetism, magnetic induction, demagnetization and ways to conserve magnetic energy;

10. (a) Explanation and demonstration of the structure of different types of cells;
    (b) Introduction and use of domestic electrification, fuse and MCB;
11. (a) Identification of subatomic particles, finding the valency, atomic number, atomic weight of the first twenty elements;
    (b) Introduction of periodic table and writing some chemical equations;
12. Introduction and demonstration of fractional distillation, stem distillation and chromatography;
13. Classification of elements based on metallic property and introduction to the uses of metals (Iron, Cupper, Gold, and Silver) ;
14. (a) Introduction to acid, base, and salt in terms of their properties and uses;
    (b) Classification of matters with the help of indicators;
    (c) Introduction of pH scale and its use;
15. Classification of types of water in terms of hardness and introduction to some useful chemicals like sodium carbonate, sodium bicarbonate and glycerol with their properties and uses;
16. Introduction to micro-organisms and description of flower, modified parts of plants, structure of seed, its germination and dispersal, life cycle of flowering plants;
17. Explanation of plant and animal tissues and interrelationship of cell, tissues, and organs of human body;
18. Explanation of reproduction in organisms, blood circulation in human body and photosynthesis process in plants;
19. Description of internal and external structure of the earth;
20. Description of weather and climate change, monsoon formation and its effect in Nepal;
21. Explanation of the origin of earth, season change and phases of moon;
22. Description of natural resources and their importance and conservation;
23. Explanation of environmental degradation, conservation and introduction to organizations involved in environmental conservation;
24. Explanation of sustainable development and interrelationship among population, environment and development;

Six standards to each of the above criteria have been defined to identity different levels of proficiencies of students in each criterion. The items were developed considering these

standards in each criterion.

The item specification grid was also prepared to develop test items. The items in Science were developed by considering the following item specification table:

Table 3.6: Table of specification for item selection

Domain	Criteria No.	Weightage	Item type	Weightage of items of various standards
Physics	1-10	26%	Both SR (MC) and CR (very short and short answer)	The weightage of items in each set should be around as follows: Level 1: 10%, Level 2, 3, 4 and 5 each: 20%, and Level 6: 10%.
Chemistry	11-15	22%		
Biology	16-18	20%		
Geology and astronomy	29-21	12%		
Environmental Education	22-24	20%		
Total		100%		

Framework for Nepali

नेपाली भाषा सरकारी काम काजको भाषा हुनुको साथै विभिन्न भाषाभाषीका नेपालीबीचको सञ्चार र सम्पर्कको माध्यम भाषा (lingua franca) का रुपमा पनि स्थापित छ । विभिन्न प्रकारका ज्ञान विज्ञानका लेख्य सामग्री यही भाषामा उपलब्ध हुने हुँदा ज्ञान तथा सूचना आर्जन गर्न यही भाषाको सामर्थ्य आवश्यक पर्दछ । सूचना तथा प्रविधिको क्षेत्रमा पनि नेपाली भाषाको प्रयोग बढ्दै गएको छ । यसरी विभिन्न क्षेत्रमा नेपाली भाषा प्रयोगको व्यापकताले व्यक्तिको दैनिक सामाजिक, आर्थिक, साँस्कृतिक जीवनका व्यवहारिक कार्य सञ्चालनका लागि नेपाली भाषाको सामर्थ्य अपरिहार्य मानिन्छ । विद्यालयदेखि उच्च तह सम्मको शिक्षामा शिक्षण सिकाइको प्रमुख माध्यम नेपाली भाषा नै भएकोले विद्यालय तहको पाठ्यक्रममा नेपाली भाषा शिक्षणले महत्त्वपूर्ण स्थान पाउँदै आएको छ ।

विद्यालय शिक्षाको प्रारम्भिक तह देखि नै नेपाली भाषा अनिवार्य विषयका रुपमा पठनपाठन हुँदै आएको छ । आधारभूत शिक्षा पाठ्यक्रम २०६९ ले कक्षा ८ मा नेपाली विषयको साप्ताहिक पाठ्यभार ५ र पूर्णाङ्क १०० निर्धारण गरेको छ । यो विषय अध्ययन अध्यापनको उद्देश्य नेपाली भाषामा भाषिक सीप र सिर्जनात्मक क्षमता विकास गराउनु रहेको छ । तसर्थ भाषाका मुख्य सक्षमता–भाषिक सक्षमता र कार्यसम्पादन (Compentence and performance) लाई लक्ष्य बनाई भाषिक सीप विकासमा कक्षा ८ को पाठ्यक्रम केन्द्रित रहेको छ ।

नेपाली भाषाका अपेक्षित सक्षमता र कार्यसम्पादनलाई सुनाइ, बोलाइ, पढाइ र लेखाइ गरी ४ भाषिक सीपमा सक्षमताहरु निर्धारण गरिएको छ ।

पाठ्यक्रमद्वारा निर्धारित उल्लिखित भाषिक सीपमा सक्षमता विकास गर्न कथा, कविता, जीवनी, प्रबन्ध, निबन्ध, रुपक/ संवाद, चिठी जस्ता विधाका सामग्रीहरु पाठ्यवस्तुमा समावेश गरिएका छन् । पाठ्यवस्तुका रुपमा रहेका विधा शिक्षण सिकाइबाट पाठ्यक्रमद्वारा निर्धारित सीपमा सक्षमता हासिल भए नभएको सुनिश्चित गर्न सिकाइ परीक्षण तथा मूल्याङ्कन खाका समेत निर्धारित गरिएको छ। यसै खाका अनुसार विभिन्न विषयवस्तुका क्षेत्र सुनाइ, बोलाइ, पढाइ, लेखाइ, व्याकरण र शब्द भण्डारका क्षेत्रहरुमा भाषिक सीपको परीक्षण गर्न निर्देश गरिएको छ भने परीक्षा साधनका रुपमा वस्तुगत, विषयगत तथा प्रयोगात्मक कार्यहरु निर्धारण गरिएको छ ।

कक्षा ८ का विद्यार्थीहरुमा भाषाका सुनाइ, बोलाइ, पढाइ र लेखाइका सीपगत सक्षमताहरु निर्धारण गरिएका छन्। ती सीपगत सक्षमताअन्तर्गत नै शब्दभण्डार तथा कार्यमूलक व्याकरणसम्बन्धी सक्षमताहरुसमेत समावेश गरिएको छ । यस कक्षाका विद्यार्थीहरुमा हासिल हुनुपर्ने भाषिक सीपगत सक्षमताहरु निम्नानुसार निर्धारण गरिएका छन् ।

- ***सुनाइ र बोलाइ (Listening and Speaking)***
  - शब्दहरुमा प्रयुक्त उच्चार्य वर्णहरुको भिन्नता पहिल्याउन र तदनुरुप शब्द उच्चारण गर्न,
  - शब्दहरुको शुद्ध र स्पष्ट उच्चारण गर्न,
  - अरुले वर्णन गरेका कुराकानी आफ्ना शब्दमा व्यक्त गर्न,
  - सञ्चार माध्यमका सूचना सुन्न र भन्न,
  - विभिन्न किसिमका वर्णन तथा अभिव्यक्ति सुनी तिनका मुख्य कुरा भन्न,
  - साहित्यिक विधाका पाठहरु आनन्द लिने गरी सुन्न र प्रतिक्रिया जनाउन,
  - कुराकानी, प्रश्नोत्तर, संवाद, वादविवाद, छलफल जस्ता मौखिक अभिव्यक्ति ध्यानपूर्वक सुनी तिनमा भाग लिन,
  - आफूले देखेका, सुनेका, पढेका, अनुभव गरेका वस्तु, वातावरण तथा घटनाका विषयमा सिलसिला मिलाई मौखिक वर्णन गर्न,
  - मौखिक अभिव्यक्ति सुनेर प्रतिक्रिया दिन तथा हाउभाउ र अभिनयको ख्याल गर्न,
  - भन्न चाहेका कुरालाई शिष्ट भाषा प्रयोग गरी हाउभाउपूर्ण र प्रभावकारी ढङ्गले व्यक्त गर्न,
  - समुदायका व्यक्तिहरुसँग शिष्टतापूर्वक कुरारानी गर्न,
  - वक्ताहरुको अभिव्यक्ति सुनी भाषिक मौलिकता पहिचान गर्न ।

- ***पढाइ (Reading)***
  - लिखित सामग्रीलाई गति यति मिलाइ शुद्ध र स्पष्टसँग सस्वर वाचन गर्न,
  - पाठमा व्यक्त भावअनुसार गति, यति, लय मिलाई पढ्न,
  - पाठहरु पढी तिनका मुख्य मुख्य कुराहरु बताउन,
  - विभिन्न उद्देश्यले लिखित सामग्रीहरुको मौनवाचन गर्न,
  - विभिन्न प्रयोजनका लागि प्रबन्ध/निबन्ध, जीवनी र कथा पढ्न,
  - साहित्यिक विधाका पाठहरु आनन्द लिने गरी पढ्न र प्रतिक्रिया जनाउन,
  - विभिन्न स्रोतका सामग्री तथा विधाका पाठ पढी शब्द भण्डार वृद्धि गर्न,
  - पढेका पाठका शब्दहरुको उपयुक्त प्रयोग गर्न,
  - उखान टुक्काको अर्थ बुझी उपयुक्त ढङ्गले प्रयोग गर्न ।

- ***लेखाइ (Writing)***
  - हिज्जे र वाक्य गठन मिलाई सफा र शुद्धसँग लेख्न,
  - विभिन्न चिन्हको उपयुक्त ढङ्गबाट प्रयोग गर्न,
  - शब्द,वाक्य र पाठका अंश सुनेर लेख्न,
  - आफूले देखेका, सुनेका, पढेका, अनुभव गरेका वस्तु, वातावरण तथा घटनाका विषयमा लिखित वर्णन गर्न,
  - सुनेका र पढेका विषयवस्तुको सारांश लेख्न,
  - विभिन्न विषयहरुमा अनुच्छेद, चिठी, निबेदन, निमन्त्रणा पत्र, समवेदना, कथा, जीवनी र वादविवाद सिलसिला मिलाई लेख्न,
  - स्तर अनुसारका विषयमा सिलसिला मिलाएर प्रबन्ध लेख्न,
  - आफ्ना रुचि अनुसारका विषयमा मौलिक रचना गर्न,
  - शब्दहरुलाई लिखित रुपमा उपयुक्त ढङ्गले प्रयोग गर्न,
  - पाठका विशिष्ट अंशहरुको भाव विस्तार/व्याख्या गर्न,
  - व्याकरणसम्मत वाक्य रचना गर्न,
  - पाठमा प्रयुक्त उखान टुक्काहरुको अर्थ बुझी वाक्यमा प्रयोग गर्न,
  - परियोजना कार्यका माध्यमले भाषिक समस्या समाधान गर्न ।

पाठ्यक्रमद्वारा निर्धारित उल्लिखित भाषिक सक्षमताहरूमध्ये यो परीक्षणमा पढाइ र लेखाइसम्बन्धी सक्षमता मात्र परीक्षण गरिने छ। यस परीक्षणका लागि पढाइ र लेखाइसम्बन्धी निम्नानुसारका सीपगत क्षेत्रहरु निर्धारण गरिएको छ।

Table 3.7: Content domain and weightage of Nepali subject at Grade 8

सीप (Skill)	क्षेत्र (Domain)	विधा (Area)	समेटिने विषय (Contents covered)
पढाइ र लेखाइ (Reading and writing)	शब्दभण्डार	शब्दार्थ शब्द पहिचान शब्दको वाक्यमा प्रयोग	पर्यायवाची, विपरीतार्थी, अनेकार्थी, उखान टुक्काको अर्थ र प्रयोग
	वर्णविन्यास	शुद्धीकरण	ह्रस्व, दीर्घ, श, स, ष, व र ब उ, ऊकार इत्यादि
	व्याकरण	पहिचान र प्रयोग	पदवर्ग, वाक्य र वाच्य, काल, पक्ष, उपसर्ग परसर्ग आदि
	बोध	विभिन्न विधाका गद्य सामग्री	पाठ्यक्रमद्वारा निर्दिष्ट सबै विधा
	बुँदा टिपोट र सारांश लेखन	गद्य विधा	
	निर्देशित रचना	कथा, जीवनी, प्रबन्ध, वादविवाद/संवाद, चिठी	
	भाव विस्तार/व्याख्या	कथा, कविता, प्रबन्ध, निबन्ध, जीवनी	
	पाठगत प्रश्नोत्तर	कथा, कविता, प्रबन्ध, निबन्ध, जीवनी, तार्किक सीप/समस्या समाधान	
	विवेचना	कथा, कविता, प्रबन्ध, निबन्ध, जीवनी	
	स्वतन्त्र रचना	प्रबन्ध, निबन्ध	

Table 3.8: General standards and their descriptors for Grade 8 in Nepali

भाषिक सक्षमता स्तर (Standards of language competency)	सक्षमता तह (Level of competency)	भाषिक स्तर (Languagre competency)	स्तरको सामान्य व्याख्या (General description)
आधारभूत सक्षमता (Basic competency): सीमित भाषिक सक्षमता	१	सीमित बोध तथा अभिव्यक्ति सक्षमता	• परिचित व्यक्तिगत सन्दर्भका शब्द/पदावली/वाक्य प्रयुक्त मौखिक तथा लिखित भाषिक सङ्कथन (Text) बाट सीमित सूचना/तथ्य बोध तथा अभिव्यक्ति । • व्यक्तिगत दैनिक/जीवन/परिवेश/अनुभवका विषयमा दैनिक बोलिचालीका प्रचलित शब्द/पदावली/वाक्यका साथ सीमित अभिव्यक्ति । (सीमित गति र प्रवाहका भाषिक अभिव्यक्तिबाट सीमित सूचना/अर्थ ग्रहण गर्ने; प्रचलित र सामान्य बोलिचालीका शब्द/वाक्यका साथ दैनिक जीवन/परिवेश/अनुभवका विषयमा सीमित सञ्चार; अभिव्यक्तिमा स्थानीयता झल्कने; सामान्य उच्चारणका साथ सीमित पठन प्रवाह; भाषिक अभिव्यक्तिमा वर्ण विन्यास, उच्चारण तथा वाक्य गठन सम्बन्धी त्रुटी रहने)
	२	सामान्य बोध तथा सीमित अभिव्यक्ति सक्षमता	• परिचित व्यक्तिगत र सामाजिक सन्दर्भका देखेका/सुनेका/विषयवस्तुका विषयमा र प्रचलित शब्द/पदावली/वाक्य प्रयुक्त भाषिक सङ्कथन पढी स्पष्ट उल्लिखित सूचना/तथ्य/अर्थ ग्रहण गर्ने र सीमित शब्द पदावली, वाक्यका साथ अभिव्यक्ति दिने । • परिचित सन्दर्भ, परिवेश विषयवस्तुका विषयमा संक्षिप्त मौखिक तथा लिखित अभिव्यक्ति दिने । (उच्चारणमा शुद्धता, पठन तथा अभिव्यक्तिमा सीमित र अपर्याप्त गति, यति, लय, आरोह अवरोह र हाउभाउ; सीमित गति र प्रवाहका भाषिक अभिव्ज्यक्तिबाट आधारभूत सूचना/अर्थ ग्रहण; अभिव्यक्तिमा सामान्य

भाषिक सक्षमता स्तर (Standards of language competency)	सक्षमता तह (Level of competency)	भाषिक स्तर (Languagre competency)	स्तरको सामान्य व्याख्या (General description)
			स्थानीयता झल्कने सामान्य वाक्य गठन; वाक्य गठन तथा वर्ण विन्यासमा आंशिक त्रुटिको विद्यमानता)
प्रवीणता (Proficiency): कार्यमूलक भाषिक सक्षमता	३	साधारण बोध तथा अभिव्यक्ति सक्षमता	● परिचित शब्द/पदावली वाक्य प्रयुक्त सीमित दैनिक सामाजिक परिवेशका सरल र संक्षिप्त मौखिक तथा भाषिक सङ्कथनबाट मुख्य बुँदा/सूचना /आशय ग्रहण गर्न; सीमित सन्दर्भको वर्णन गर्न; परिचित विषय/वस्तु/परिवेश/घटनाको सामान्य शव्द/पदावली/सरल वाक्यमा वर्णन गर्न । (गति/यति/लय/आरोह अवरोह/हाउभाउमा अर्याप्तता; उच्चारणमा शुद्धता भए पनि कम स्तरीयता; अभिव्यक्तिमा यदाकदा स्थानीयता झल्कने; वाक्य गठन तथा वर्ण विन्यासमा आंशिक त्रुटिको विद्यमानता)
	४	कार्यमूलक बोध तथा अभिव्यक्ति सक्षमता	● परिचित शब्द/पदावली/वाक्य प्रयुक्त सीमित दैनिक परिवेशमा सरल र संक्षिप्त मौखिक तथा लिखित भाषिक सङ्कथनवाट मुख्य बुँदा शब्द वाक्य, सामान्य आशय बोध गर्न, सङ्कथनका केही सन्दर्भको वर्णन गर्न र आशय बताउन, परिचित विषय वस्तु/परिवेश/घटनाको संक्षिप्त रुपमा मौखिक तथा लिखित अभिव्यक्ति दिन । (उच्चारणमा शुद्धता भए तापनि गति, यति लय आरोह अवरोहमा अपूर्णता, सामान्य पठन प्रवाह, सरल वाक्य गठनका अभिव्यक्तिमा व्याकरणिक त्रुटिको न्यूनता, परिचित सन्दर्भका शब्द प्रयोगमा वर्ण विन्यास त्रुटि नभएपनि नवीन शब्द प्रयोगमा आंशिक त्रुटिको विद्यमानता)

भाषिक सक्षमता स्तर (Standards of language competency)	सक्षमता तह (Level of competency)	भाषिक स्तर (Languagre competency)	स्तरको सामान्य व्याख्या (General description)
स्वतन्त्र वा उच्च सक्षमता (Fluent/ independent or Advance competency): स्तरीय भाषिक बोध तथा अभिव्यक्ति सक्षमता	५	विस्तृत बोध तथा सीमित अभिव्यक्ति सक्षमता	● परिचित शब्द/पदावली/वाक्य प्रयुक्त विविध परिवेशका संगठित मौखिक लिखित भाषिक सङ्कथनवाट मुख्य शब्द/वाक्य सहित विस्तृत आशय र सन्दर्भ बोध गर्न; मुख्य शब्दको वर्णन र सान्दर्भिक अर्थ व्यक्त गर्न ; सीमित सूचना सन्दर्भ संश्लेषण गर्न ; टेवुल/ग्राफ/चार्ट प्रस्तुत गर्न ; परिचित विषयमा वस्तु/घटना/ परिवेशको साामान्यस्तरमा संगठित मौखिक लिखित अभिव्यक्ति दिन; टेबुल/ग्राफ/चार्टमा प्रस्तुत परिचित सूचना/विवरण/तथ्यको सामान्य वर्णन गर्न । ● उच्चारणमा शुद्धता र स्पष्टता, गति/यति/लय/आरोह/अवरोहमा अपर्याप्तता, सामान्य पठन प्रवाह, वाक्य गठन तथा अभिव्यक्तिमा सीमित व्याकरणीय त्रुटि, वर्ण विन्यासमा सचेत
	६	स्तरीय बोध तथा स्वतन्त्र अभिव्यक्ति सक्षमता	● स्तरीय शब्द/ पदावली/ वाक्य प्रयुक्त विविध परिवेशका संगठित मौखिक/लिखित भाषिक सङ्कथनबाट विस्तृत सन्दर्भ तथा आशय बोध गर्न; वुँदा टिपोट तथा सारांश तयार गर्न; पठित/सुनेको सङ्कथनका मुख्य आशयको सान्दर्भिक व्याख्या विश्लेषण तथा पुनवर्णन/पुर्नलेखन गर्न; परिवेश अनुसारका शब्द/पदावली/ वाक्य गठन सहित संगठित संङ्कथन तयार गर्न; तालिका/ग्राफ/चार्टमा प्रस्तुत विवरण तथा तथ्यहरुको आधार भूत वर्णन तथा व्याख्या गर्न र परिचित तथ्य/सूचना/विवरणलाई तालिका ग्राफ चार्टमा वर्णन र प्रस्तुत गर्न । ● उच्चारणमा शुद्धता र स्पष्टता; उपयुक्त गति/यति/लय र आरोह अवरोह सहित स्तरीय पठन प्रवाह; वाक्य गठन तथा अभिव्यक्तिमा मौलिक शिल्प र शैली झल्कने/व्याकरणिक नियम तथा वर्णविन्यासको सचेत प्रयोग ।

कक्षा ८ को नेपाली विषयको पाठ्यक्रमका निर्धारित उद्देश्य र विषयवस्तुसमेतलाई आधारमा कक्षा ८ को नेपाली विषयमा पढाइ र लेखाइ अन्तर्गत विद्यार्थीको उपलब्धि परीक्षणका लागि निम्नअनुसार २६ ओटा मापदण्डहरू परिभाषित गरिएको छ :

पढाइ

१. आफू, आफ्नो घर, परिवार, र विद्यालयसँग सम्बन्धित लिखित वर्णनहरू पढी सम्बन्धित प्रश्नहरुको उत्तर दिन ।

२. समाज, विद्यालय तथा आफ्नो परिवेशसँग सम्बन्धित लिखित वर्णनहरूसम्बन्धी प्रश्नहरुको उत्तर दिन ।

३. चिठी, निमन्त्रणा कार्ड, समवेदना, शुभ कामना कार्डलगायत पढी व्यक्त भाव व्यक्त गर्न ।

४. विभिन्न उद्देश्यले परिचित सन्दर्भका लिखित सामग्रीहरूको मौन वाचन गरी बोध गर्न ।

५. कुनै खास विषयसँग सम्बन्धित वर्णनात्मक अभिव्यक्तिहरू पढी तिनका मुख्य कुराहरू लेख्न ।

६. चित्र, ग्राफ, तालिका लगायतको सान्दर्भिक वर्णन गर्न ।

७. सञ्चार माध्यमबाट प्रकाशित सामग्री र यसका अंशको आशय प्रकट गर्न र बोध गर्न ।

८. प्रश्नोत्तर, भावार्थ, सारांश, व्याख्यालगायत विभिन्न प्रयोजनका लागि प्रबन्ध/निबन्ध, जीवनी र कथा पढ्न र बोध गर्न ।

९. पढेका पाठका शब्दहरूको अभिधागत र सन्दर्भगत प्रयोग गर्न, उखान टुक्काहरूको प्रयोग गर्न र सन्दर्भअनुसार व्याख्या गर्न ।

१०. पठित सामग्रीबाट व्याकरणिक कोटीको पहिचान र प्रयोग गर्न ।

११. लिखित सामग्रीको पूर्वानुमान, परिकल्पना, सन्दर्भ र सूचनाको उपयोग गर्न (कविता तथा अन्य विधाका) ।

१२. विभिन्न विधामा प्रयोग भएका पात्रको समीक्षा गर्न ।

१३. निर्दिष्ट अनुच्छेदलाई निर्देशनअनुसार परिवर्तन गर्न, अनुच्छेदका आधारमा नयाँ अनुच्छेद सिर्जना गर्न तथा अनुच्छेदका आधारमा समस्या समाधान र कारण खोजी गर्न ।

लेखाइ

१४. नेपाली लेख्य ढाँचा अनुसारका वर्ण, शब्द, र वाक्य रचना गर्न ।

१५. नेपाली लेख्य ढाँचा (लिङ्ग, वचन) अनुसार अनुच्छेद मिलाएर लेख्न।

१६. विभिन्न चिह्न, हिज्जे र वाक्य गठन (लिङ्ग, वचन, पुरुष र आदर) मिलाई सफा र शुद्धसँग लेख्न ।

१७. वातावरण तथा घटनाका विषयमा सिलसिला मिलाई निर्देशन पालना गरेर लिखित वर्णन गर्न ।

१८. आफूले देखे सुनेका, पढेका, अनुभव गरेका विषयमा सिलसिला मिलाई स्वतन्त्र वर्णन गर्न ।

१९. सुनेका र पढेका विषय वस्तुको सारांश लेख्न ।

२०. पाठका विशिष्ट अंशहरूको भाव विस्तार/व्याख्या गर्न (कविता लगायतका विधा) ।

२१. शब्दभण्डार (पर्यायवाची, विपरीतार्थी, अनेकार्थी, समावेशक, प्राविधिक, पारिभाषिक र अनुकरणात्मक) र उखान टुक्काको उपयुक्त प्रयोग गर्न ।

२२. चिठी, निवेदन, निमन्त्रणा, शुभकामना, समवेदना जस्ता व्यवहारिक लेखन तयार गर्न ।

२३. आफ्नो रुचिअनुसारका विषयमा मौलिक रचना गर्न ।

२४. परिचित सन्दर्भ र निर्देशनमा आधारित भई मौलिक लेखन गर्न ।

२५. विभिन्न सन्दर्भमा उपयुक्त शैली र संरचनाको प्रयोग गरी स्तरीय भाषामा स्वतन्त्र लेखन गर्न ।

२६. सन्दर्भ अनुसार र समसामयिक विषयमा तर्कपूर्ण प्रस्तुति गर्न र समस्या समाधानका उपाय सुझाउन ।

उल्लिखित भाषिक सक्षमता स्तरका आधारमा पाठ्यक्रमद्वारा निर्दिष्ट विषय तथा पाठ्यवस्तु क्षेत्र र भाषिक सीपगत सिकाइस्तरको विस्तृत खाका तयार गरी प्रश्नपत्रहरु तयार गरिएको थियो । यस उपलब्धि परीक्षणमा पढाइ र लेखाइका सीपहरु मात्र परीक्षण गरिने भएकाले यसमा सुनाइ र बोलाइका सीपसम्बन्धी क्षेत्र तथा स्तरहरु समावेश गरिएको छैन । यो विद्यार्थी सिकाइ उपलब्धि परीक्षण प्रयोजनका लागि पढाइ र लेखाइका क्षेत्रहरुबाट परीक्षा साधन निर्माण गरी सिकाइ उपलब्धि परीक्षण गर्ने गरी स्तर निर्धारण तथा व्याख्या गरिएको छ ।

शब्द भण्डार, व्याकरण तथा वर्ण विन्यासलाई अलग्गै विषयवस्तुका रुपमा समावेश नगरी पढाइ र लेखाइका क्षेत्रमै समावेश गरिएको छ । यसो गर्नाले शब्द भण्डार, व्याकरण तथा वर्ण विन्यासलाई विद्यार्थीले कार्यमूलक रुपमा उपयोग गर्न सके नसकेको परीक्षण गर्न सकिन्छ ।

तल दिइएको विशिष्टिकरण तालिकामा विषयवस्तुको क्षेत्र, मापदण्ड, भार प्रतिशत, प्रश्नका सङ्ख्या र प्रकार, अङ्कको विभाजन र विभिन्न ६ स्तरमा प्रश्नको विभाजन प्रस्तुत गरिएको छ ।

Table 3.9: Table of specification for item selection

विषयवस्तुको क्षेत्र (Content domain)	मापदण्ड सङ्ख्या (Criteria No.)	भार (Weightage)	प्रश्नका किसिम (Types of items)	जम्मा पूर्णाङ्क (Marks)	विभिन्न स्तरमा अङ्क विभाजन (Weightage for items of various standards)
पढाइ (शब्द भण्डार)		40%	SR and CR	28	प्रत्येक स्तरको भार देहायको प्रतिशतको नजिक हुनेछ ।
लेखाइ (शब्द भण्डार तथा कार्यमूलक व्याकरण र वर्ण विन्यास समेत)		60%	SR and CR	42	Level 1: 10%, Levels 2, 3, 4 and 5 each; 20%, and Level 6: 10%.
Total		100%		70	

यहाँ विचार पुऱ्याउनु पर्ने कुरा के छ भने तालिकामा दिइएको विभिन्न स्तरको भार प्रारम्भिक मात्र हो । वास्तविक भारको गणना विद्यार्थीको उत्तर समेतलाई आधार मानी स्तर निर्धारणसम्बन्धी विधिहरुमध्ये कुनै एक विधि प्रयोग गरी प्रत्येक स्तरको न्यूनतम अङ्क (Cut score) निर्धारणबाट गर्नु पर्नेछ । माथि सुझाव गरिएको वर्गीकरण र स्तरले प्रत्येक स्तरका लागि प्रश्नहरु छनोट गर्न सहयोग गर्दछ ।

3.3 Cognitive Domain

In addition to content domains, the assessment items of each subject also represented various levels of cognitive domain, which are generally hierarchical in terms of complexity and abstraction of knowledge and skills and their applications. The levels of cognitive domain were adopted from the revised Bloom's Taxonomy for learning (see, Aderson & Karthwohl, 2001). Among the six levels of this taxonomy, the first three (*remembering, understanding* and *applying*) are considered separately and the remaining three (*analysing, evaluating* and *creating*) are put under a broad *reasoning* skill for the purpose of data analysis.

As Bloom defines, *remembering* shows the ability to memorize previously learned knowledge by recalling facts, terms, basic concepts and answers. *Understanding*

demonstrates the task of understanding the facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas. *Applying* includes solving problems in new situations by applying the acquired knowledge, facts, techniques and rules in a different way (see, Aderson & Karthwohl, 2001). *Reasoning* is not limited to the solution of routine problems but also includes unfamiliar situations, complex contexts, and solving multi-step problems by using more than one relations and contexts (IEA, 2015).

Table 3.10: Representation of various cognitive domains in each of the subjects (Mathematics, Science and Nepali)

Cognitive Domain	Weightage
Remembering	15%
Understanding	35%
Applying	30%
Reasoning	20%
	100%

3.4 Item Development and Selection

Item development workshop

First, a 10-day workshop was organized to develop test items for each of the subjects (Mathematics, Science and Nepali). School teachers teaching the respective subjects, experts and university teachers were the participants of the item development workshop. Before starting to write test items, the experts provided teachers with some knowledge and skills in developing test items. During the orientation training, in addition to the overview of the framework including domains, criteria, standards, cognitive domains and item specification, some practice sessions were conducted in writing items by focusing particularly on preparing items to measure specific competencies. The workshop drafted about 300 test items of different types (SR and CR items) in each subject.

Item revision

The draft test items were edited and translated into English for Mathematics and Science. The draft individual items were trialled among some students in Kathmandu. Moreover, the draft items and students' answer sheets of the trialled items were provided to a group

of subject experts and teachers for review. The experts' workshop reviewed and edited the items and prepared six sets of items for pilot testing. The experts assessed each item against the competencies to be measured, level of standards, representation of various contents and cognitive domains, available time, clarity and level of language, appropriateness of distractors in MC items, and so on.

Editing, layout and item booklet preparation for piloting

The subject experts and language editors worked together in editing the test items. The edited items were grouped into six sets that require 2 hours for students to take the test. While preparing the six test booklets, the sets were developed in similar formats, with the estimated level of standards and difficulties close to each other. The layouts of the booklets were developed with necessary instructions for the students – giving sufficient space for writing CR items, and appropriate size of the font.

Review and finalization of items and test booklets for piloting by the subject committee

In ERO, there are subject committees for each subject included in NASA studies. The subject committees comprised of experienced subject teachers, subject experts, and the university faculty. The items and the six sets of booklets prepared by the expert workshops and edited by the subject and language experts were presented in the subject committee meeting. The subject committee reviewed and revised the items as well as the test booklets of each subject, and prepared the final test items and booklets for piloting. The items and booklets finalized by subject committee were again sent to the language editor for final correction.

At this point, the scoring keys and plans were prepared for each set of questions. During the preparation of scoring key and plan, some revisions were made in test items, which were again discussed in the subject committee meetings and finalized for piloting.

Piloting the items

The six test booklets were printed and packed alternatively for each school. In the piloting of the test, one student took test in only one subject. The packing of the item booklets were

arranged alternatively so that the students sitting adjacent could not copy each other's response. Each set of items was piloted at least among 300 students from 60 schools. The following table shows the number of piloted schools and students in each subject:

Table 3.11: Pilot testing: number of schools and students

S. No.	Subject	No. of sets piloted	No. schools piloted	No. of students participated
1	Mathematics	6	60	1800
2	Science	6	60	1800
3	Nepali	6	60	1800
Total		18	180	5400

The schools for the test piloting were selected from different locations including geography and province. The piloting of test was carried out in the last month of the previous session (2016). Those schools selected for the final assessment were not selected for the purpose of piloting. Likewise, the students' answer sheets were collected at ERO immediately after pilot test was over in schools. After collecting the answer sheets, subject teachers scored, following conference marking system. The scorers followed the prepared scoring keys and rubrics.

Item analysis and selection of items

Students' answer sheets were scored by using scoring keys and scoring guidelines. The scores for each item were tabulated in an Excel sheet. During item analysis, item difficulty, item discrimination and appropriateness of distractors were also assessed. The test items were considered as problematic when one or more of the following conditions were present:

- Point-biserial correlation remaining less than 0.20,
- p-value less than 0.20,
- p-value equal to or greater than 0.90,
- Less than 5 percent of students selecting one of the distractors of MC item,

The test items having a range of difficulties were included in the test; however, the test items having a less than 0.20 difficulty index (very difficult) and the test items having more

than 0.90 difficulty index (every easy) were generally excluded. Within the acceptable range of item difficulty, item discrimination was also calculated and the items having 0.20 and more discrimination indexes (Point-Biserial correlation) were included for final test. For multiple choice items, the appropriateness of distractors was assessed by calculating the frequencies of responses. In some cases, the subject experts, instead of rejecting the very easy or very difficult items as well as relatively low discriminating (discrimination index greater than 0 to less than 0.20) items, preferred revising them slightly. Similar conditions were found in the case of effectiveness of distractors. The following table shows an example of the item analysis of piloted items.

Table 3.12(a): Example of item analysis and decision in Mathematics

Item	Difficulty/facility	Discrimination/item rest correlation	Decision
1M1	0.80	0.322	1
2M1	0.46	0.198	2
3M1	0.77	0.177	2
4M1	0.33	0.385	1
5M1	0.50	0.291	1
6M1	0.82	0.236	1
7M1	0.82	0.329	1
8M1	0.82	0.283	1
9M1	0.60	0.482	1
10M1	0.30	-0.031	3
11M1	0.74	0.348	1
12M1	0.47	0.315	1
13M1	0.39	0.357	1
14M1	0.68	-0.154	3
15M1	0.78	0.477	1
16M1	0.70	0.524	1
17M1	0.58	0.542	1
18M1	0.58	0.503	1
19M1	0.62	0.63	1
20M1	0.50	0.552	1

Remark: 1: selected; 2: to be discussed with subject experts; 3: discarded.

In the above example, the item numbers 10 and 14 were discarded due to their negative item rest correlation. Items 2 and 3 have item rest correlation less than 0.20 but their value is positive. The subject experts discussed and decided whether these items could be excluded or included in the final test. In this situation, the subject experts, in some cases, also suggested some refinement in the item statements or distractors for MC items to make them clearer.

Table 3.12(b): Example of item analysis and decision in Nepali

Item	Facility/item difficulty	Item-rest correlation	Remarks
1N1	0.94	0.07	2
2N1	0.64	0.37	1
3N1	0.45	0.61	1
4N1	0.73	0.48	1
5N1	0.66	0.14	2
6N1	0.70	0.53	1
7N1	0.25	-0.06	3
8N1	0.71	0.32	1
9N1	0.91	0.41	1
10N1	0.44	0.41	1
11N1	0.81	0.42	1
12N1	0.56	0.44	1
13N1	0.76	0.36	1
14N1	0.36	0.33	1
15N1	0.52	0.43	1
16N1	0.15	0.34	1
17N1	0.41	0.52	1
18N1	0.24	0.46	1
19N1	0.66	0.48	1
20N1	0.32	0.42	1

Remark: 1: selected; 2: to be discussed with subject experts; 3: discarded

Table 3.12(c): Example of item analysis and decision in Science

Item	Difficulty/facility	Discrimination/item rest correlation	Remarks
1S1	0.39	0.25	1
2S1	0.39	0.409	1
3S1	0.37	0.368	1
4S1	0.37	0.60	1
5S1	0.36	0.55	1
6S1	0.36	0.50	1
7S1	0.35	0.645	1
8S1	0.34	0.57	1
9S1	0.34	0.61	1
10S1	0.33	-0.04	3
11S1	0.32	0.109	2
12S1	0.32	0.362	1
13S1	0.31	0.15	2
14S1	0.31	0.20	1
15S1	0.31	0.68	1
16S1	0.31	0.37	1
17S1	0.29	0.34	1

Remark: 1: selected; 2: to be discussed with subject experts; 3: discarded

In addition to the item analysis statistics, the subject experts reviewed each item and took three types of decisions as mentioned in the table above: select the item as it was; revise the items, and reject the item.

Items by content domain and type of items

Items were of both SR and CR type. The following table shows the total number of items selected in each subject in different content domains:

Table 3.13: Number of items selected by content domain

Subject	Content domain	Selective response	Constructive response	Total
Mathematics	Geometry	38	21	59
	Arithmetic	21	16	37
	Data and Sets	3	8	11
	Algebra	8	16	24
	Total	70	61	131
Nepali	पढाइ (शब्द भण्डार)	21	46	67
	लेखाइ (शब्द भण्डार तथा कार्यमूलक व्याकरण र वर्ण विन्यास समेत)	11	13	24
Total		32	59	91
Science	Physics	19	15	34
	Chemistry	13	16	29
	Biology	9	11	20
	Geology and astronomy	10	7	17
	Environment Education	9	10	19
	Total	60	59	119

Items by content and cognitive domain

Selected items can be categorised in different cognitive domain. The classification used in the assessment was adopted from Bloom's revised Taxonomy of objectives. The categories are remembering, understanding, applying and reasoning.

Table 3.14 (a): Selected items by content domain and cognitive domain

Subject	Domain	Selective response (SR)	Constructed response (CR)	Total
Mathematics	Remembering	26	5	31
	Understanding	32	20	52
	Applying	5	25	30
	Reasoning	7	11	18
	Total	70	61	131

Subject	Domain	Selective response (SR)	Constructed response (CR)	Total
Nepali	Remembering	13	11	24
	Understanding	7	21	28
	Applying	9	7	16
	Reasoning	3	20	23
	Total	32	59	91
Science	Remembering	24	9	33
	Understanding	28	15	43
	Applying	8	19	27
	Reasoning	0	16	16
	Total	60	59	119

While designing item booklets, items from different sources were used. Newly developed and piloted items were bigger in number, but it also selected items from previous NASA and used them as anchor or linking items in each subject. Similarly, some items were used from the released items of TIMSS Grade 8 Mathematics and Science as the linking items. The following table shows the various sources and number of items in each subject.

Table 3.14 (b): Different sources of items in each subject

Subject	New items	Items from previous NASA	Items used in TIMSS	Total number of items
Mathematics	106	9	16	131
Science	98	11	10	119
Nepali	83	8	-	91

Among selected items for final test, NASA 2017 used 9 items in Mathematics, 8 in Nepali and 11 in Science from the from NASA 2013 of Grade 8 test as the linking items (to establish link with the NASA 2013). Similarly, in Mathematics and Science, NASA 2017 used 16 and 9 items respectively from TIMSS Grade 8 questions as the linking items (to establish link between TIMSS and NASA 2017).

3.5 Item Booklet, Scoring Key and OMR Design

Selected items, in each subject, were arranged into three booklets with some linking items between the booklets. Scoring keys for SR items and scoring schemes for CR items were prepared for each booklet. Based on the booklets and scoring schemes, OMR sheets were designed to use for data generation and entry process.

Item booklet preparation for final test

A week-long workshop of the subject experts and teachers was organised for each subject to select the items and prepare the test booklets for the final test of NASA 2017 at Grade 8. ERO provided the team with the final version of multiple sets of test that included the feedback from the test piloting, item analysis statistics, items from previous NASA studies and TIMSS test items for Mathematics and Science with their parameters.

The following process and steps were followed to select the test items and to prepare the three test booklets for each subject:

- The workshop first selected some items from TIMSS released items of Mathematics and Science of Grade 8. The selected items were translated into Nepali and administered among some Grade 8 students, based on which some of the items and data were contextualized as required.
- Some of the items from the previous NASA studies of Grade 8 were also chosen to use them in NASA 2017 of Grade 8.
- Based on the experiences of the previous years' NASA studies as well as pilot test and the specification in the framework, the workshop first estimated the number and types of test items for each test set as planned in the three test booklets of each subject.
- The piloted questions of Mathematics and Science subjects were organized separately with the content domains and test items from the previous NASA studies; and the selected test items from TIMSS were also sorted out separately with the content domains. Similarly, the piloted test items of Nepali were also revised according to their reading and writing domains; and the test items from the previous NASA studies were also reorganized in relation to their reading and writing domains.

- Similar types of items (MC, CR with very short and CR with short answer) having the similar sub-domain with similar content areas in each domain were marked 1, 2 and 3, if the test items are available; and they were sorted with the same marked in a group. The test items from the previous NASA studies and TIMSS were also reorganized within the same group with some distinct identification.
- The set of test items marked with 1 was reviewed based on the specification as well as estimated number of questions and types of questions. If the test items were more than enough for a booklet, some of them were removed from the set whereas if test items were not sufficient for a booklet in number the remaining test items from the accumulated test sets were selected.
- When set 1 was completed, some test items from the first set were identified to use them to set 2; and these items were placed to the other sets with a unique ID as planned.
- Similar process as in set 1 was repeated for the sets 2 and 3.
- In each set in Mathematics and Science, MC items were placed first, followed by other items.
- After reviewing each set of questions, a brief instruction for the students was prepared, and spaces for answers to all the CR items were arranged in the test paper.
- Six persons were assigned to develop a marking scheme with an answer key; generally, one set of questions was given to two persons.
- In the next round of workshop, all the sets were finalized with some formatting guidelines.

Preparation of the scoring scheme and guidelines

A group of teachers and experts of the respective subjects worked for compilation, review and finalization of the scoring schemes for each subject. For multiple choice and other selected response (SR) types of items, answer keys were reviewed and reconfirmed. For created response types of items, the possible answers as well as marks to be provided in each step were reviewed and confirmed. For dichotomise items, conditions for 0 and 1 credit was clearly specified. For CR items with the partial credit conditions, each of the credits 0, 1, 2 and so on were clearly mentioned. Along with the preparation of scoring

scheme for each subject, some guidelines for scoring were also prepared. Particularly for writing test in the Nepali, rubrics were developed including score distribution in various skills of writing and levels of proficiency.

Review of test booklets and scoring schemes

At the final stage of item selection and item booklet preparation, subject committee of each subject reviewed the items and item booklets with editing, confirming data, and formatting. The committees prepared the final test booklets which were then sent for preparing Printing Ready Copy (PRC). The subject committees also reviewed the scoring schemes.

While selecting the items and preparing the test booklets for the final test, the following principles were considered:

- **Curriculum based:** Content domains and criteria for the assessment were based on the learning objectives of the curriculum approved by the Government of Nepal. However, the assessment framework developed by ERO defines the standards and level of standards by analyzing the curriculum of not only Grade 8 but also of the other grades, particularly Grade 6 and 7. In this way, the assessment has focused on students' overall grade level competencies in each subject rather than just testing their curricular content-knowledge. While defining the six levels of standards– pre-basic, basic, proficient 1, proficient 2 and 3, and advanced— the hierarchy of knowledge, skills and competencies were arranged from lower to higher. As there were students with various levels of proficiencies, these levels would help to locate students' respective position.
- **Coverage of contents:** In order to cover the curricular contents, the items were prepared from different content areas. Similarly, multiple test booklets were prepared to cover the contents specified in the curriculum and criteria defined in the framework. The multiple booklets were calibrated in the same scale by using some linking items. While developing and arranging the test items, attention was paid to measure the competencies of each standard for each criterion.
- **Proper representation of various cognitive domains:** Following Bloom's revised taxonomy, the test items were developed and selected by ensuring the proper

representation of cognitive domains: remembering, understanding, applying and reasoning as defined in the assessment framework. Therefore, the selected items would measure the students' abilities in various cognitive levels.

- **Assessing the various levels of proficiencie**s: Following the assessment framework, the test items were developed and selected to assess their levels of competencies. As the levels of competencies are hierarchical in nature, items were also developed and selected in similar manner.
- **Items having a range of difficulties**: Based on the pilot test results, items were analyzed by calculating their difficulty level. For this, the items were evaluated by calculating the item difficulty parameter (p-value). The items having a range of difficulties were included in the test; however, very difficult items (having less than 0.20 difficulty index) and very easy items (having more than 0.90 difficulty index) were generally excluded.
- **Proper discrimination power of the items**: Within the acceptable range of item difficulty, item discrimination was also calculated, and generally the items having 0.20 and more discrimination indexes (Point-Biserial correlation) were included for the final test. In some cases, subject experts, instead of rejecting relatively low discriminating items (discrimination index between 0 and 0.20), preferred slight revision of the test item. However, items having negative discrimination index were not used.
- **Comparability with previous NASA and TIMSS:** One of the objectives of this assessment was to compare the results with the previous NASA studies as well as TIMSS scale (for Mathematics and Science). For this, some items were used from the previous NASA studies as well as TIMSS Grade 8 Mathematics and Science test items. The parameters of these selected items were used to calibrate the items and equate the scores.

Preparation of item register

Working with subject experts, ERO prepared an item register in each subject in an excel sheet. Item ID (unique), item descriptor for each item and scoring keys for MC items and various credits as well as description of each credit of CR items were included in the item register. The following is the example of an item register:

Table 3.15: Example of Item register (Mathematics, Grade 8)

SN	Item Id	Set A	Set B	Set C	Max score	Type	Key	Item descriptors	Cognitive_ level	Item level	Content Area	Source
20	M817_020	20	24		1	SR	A	Apply Pythagorean relation to determine the given triangle (with given lengths of the sides) as a right triangle.	Reasoning	2	Geometry	TIMSS, 2011
21	M817_021	21			1	SR	B	Convert simple rational fraction into decimal representation	Remembering	2	Arithmetic	TIMSS 2011
26	M817_026	26			1	SR	B	Find the best estimate of the given numerical expression of the fractional form in which both numerator and denominator are given in numbers containing decimal numbers or product of decimal numbers.	Remembering	3	Arithmetic	TIMSS 2011
27	M817_027	27			1	SR	D	Find true mathematical sentence (relation) of equality out of given expressions containing different operations	Remembering	3	Arithmetic	TIMSS 2011
28	M817_028	28	23		1	SR	D	Recognize the correct position of geometric figure (e.g. triangle) under half-turn (clockwise)	Understanding	3	Geometry	TIMSS 2011
29	M817_029	29			1	SR	A	Find the area of rectangular garden excluding the rectangular path in it, given the dimensions containing variable measures.	Applying	5	Algebra	TIMSS 2011
48	M817_048	48.1			1	CR	1	Calculate the mean for the given numbers(given number of things/ persons)	Applying	4	Data and sets	TIMSS 2011
49	M817_049	48.2			1	CR	1	Find median for individual distribution (median number of things/persons)	Applying	5	Data and sets	TIMSS 2011

Designing OMR sheets

Based on the three sets of test booklets for each subject, Optical Mark Recognition (OMR) sheets were designed for each set. Student background information from the questionnaire was also incorporated in the same OMR sheet. Similarly, teachers' background questionnaires for each subject were developed in a separate OMR sheet. Altogether nine OMR sheets for students in three subjects; three OMR sheets for teachers of three subjects; and one for head teachers were designed and printed out. The consulting firm with a technical person worked together with ERO to design the OMR sheets (see, Annex 1).

CHAPTER 4

Background Information Questionnaires

4.1 Introduction

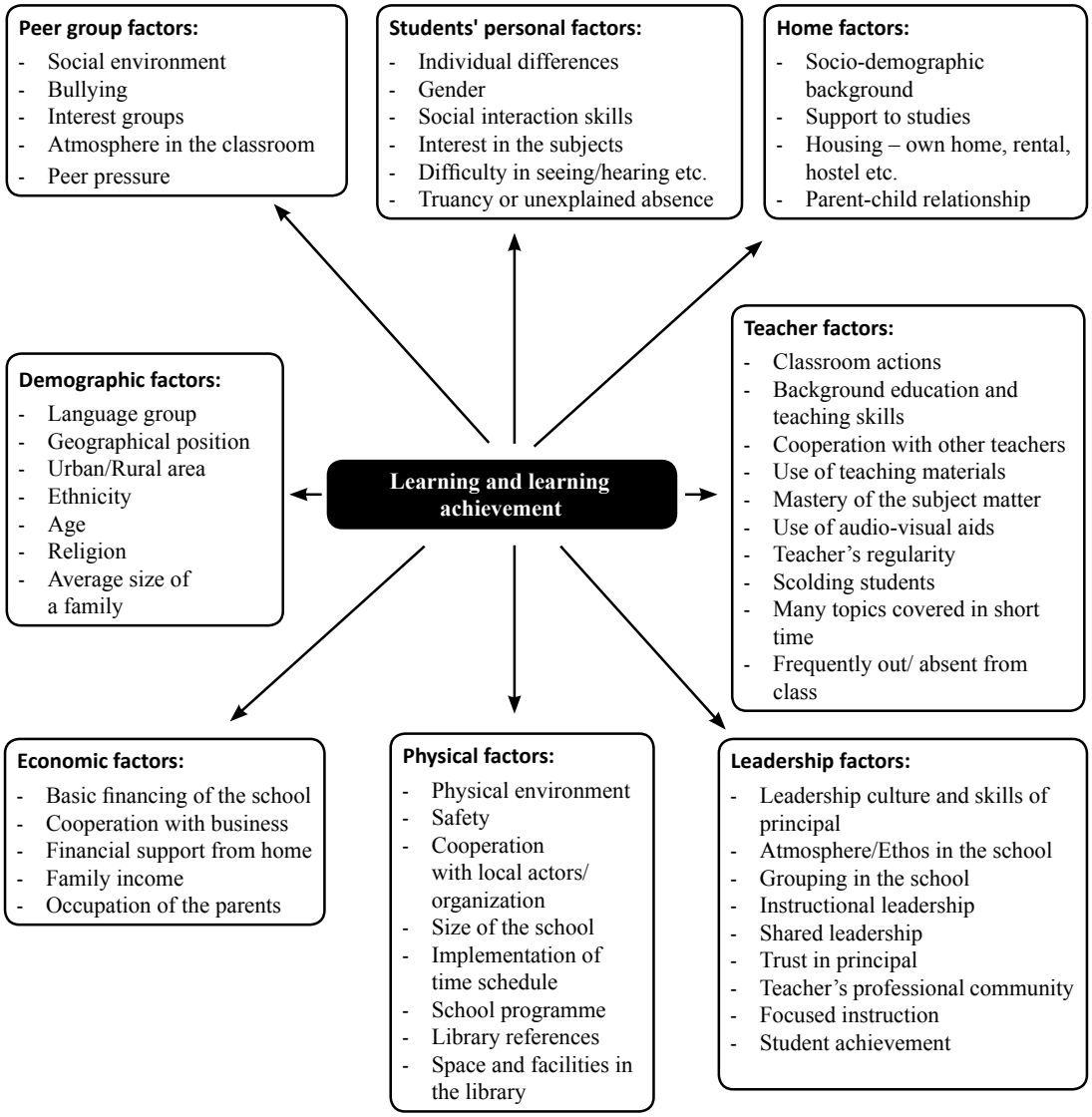
Achievement scores alone are not sufficient to explain the variation on students' performance, as several factors influence the achievement of students. Such contextual factors that affect the achievement of students need to be assessed as the integral part of the national assessment of student achievement. Assessment framework for NASA 2017 for Grade Eight also included a framework for contextual factors that can influence the achievement level of students. As the assessment of contextual factors, framework for three types of background questionnaires is suggested. They are: students' questionnaire, teachers' questionnaire and school survey questionnaire for head teacher. Based on the framework, background questionnaires for students, teachers and head teachers were also developed and administered along with test items, during the administration of test.

4.2 Framework for Background Information Questionnaires

ERO developed the framework for background information questionnaires after studying students, teachers, and school survey instruments used in various international assessments such as Programme for International Student Assessment (PISA), Trends in International Mathematics and Science Study (TIMSS), and Pan-Canadian Assessment Program (PCAP) together with the tools used in previous NASAs conducted by ERO together with some discussions with academicians, practitioners, parents, teachers and students. Besides, student attitude scale used in previous NASA was revised and used.

The following figure shows the overall framework for background information questionnaires used in the study.

Figure 4.1: Framework for the background information for NASA 2017



Source: ERO, 2017, p. 84

The following factors were considered while developing and revising the questionnaires:

Student questionnaire

Student questionnaire was used to collect the following information.

- Gender, age, home language

- Educational background of parents
- Socio-economic status of parents/family (SES)
- Home environment such as facilities, availability of books and other study materials
- Level of parental/family support for study
- Activities beyond the school hours/home
- School bullying
- Perception of classroom environment, such as sense of safety, friendliness of other students, support from teachers
- Teaching-learning process in classroom/school

Teacher questionnaire

Teacher questionnaire was used to collect the following information.

- Gender, age, first language
- Teaching conditions including class size, access to resources, percentage of students having textbooks, access to substitute teachers in case of absence
- Educational experience, teacher qualifications and teaching experience
- Teaching-learning practice and conditions at school
- Professional engagement with learning, such as access to and interest in professional development, interest in teaching, and time spent on preparation for classes
- Availability of instructional support such as classroom visits and feedback by head teacher, school supervisor
- Teaching methodology, such as language of instruction, use of assessment, and style of teaching
- Satisfaction with working conditions, such as tenure, pay rate, and level of supervision
- Relationship between the school and community, such as interactions with parents, involvement in school committees
- Attitude of cooperation from students

Head teacher questionnaire

Questionnaire for head teachers was used to collect the following information:

- Gender and age
- Educational and management experience and qualifications
- School environment, including the quality of buildings and facilities, as well as availability of resources
- School records, such as fluctuations in student number, student and teacher absenteeism
- Professional engagement of school leadership, such as access to and interest in professional development and interest in education
- Leadership style and use of time
- Assessment of teachers' work
- Satisfaction with working conditions
- Relationship with the community

Students' attitude survey

In order to find the relation between attitude of students towards the subject and achievement, the attitude survey questionnaire was administered. The questionnaire was adapted from shorted version of FSMAS, Fennema Sherman Mathematics Attitude Scales (Fennama & Sherman, 1976). The attitude survey questionnaire was included in the students' background information questionnaire. The following are the statements used to identify the attitude of students towards the subject.

Self-confidence

1. Studying mathematics makes me feel nervous.
2. I am always under a terrible strain in a math class.
3. I am able to solve mathematical problems without much difficulty.

Value

4. Mathematics is important in everyday life.
5. Mathematics is one of the most important subjects for people to study.

6. High school math courses will be very helpful to me no matter what I decide to study.

Enjoyment

7. I have usually enjoyed studying mathematics in school.
8. Mathematics is dull and boring.
9. I am happier in a mathematics class than in any other classes.

Motivation

10. I would like to avoid using mathematics in college.
11. I am willing to take more than the required classes of mathematics.
12. I plan to take as much courses of mathematics as I can during my education.

Based on the above framework, the questionnaires for students, teachers and head teachers were developed. Several questions from previous NASA were adopted with some revision. During the development and revision of questionnaire, several discussions were carried out with parents, teachers, head teachers, students, educational managers and experts. Most of the questionnaires were set into 3 to 5 points Likert scale. Developed questionnaires were tried out with some students, teachers and head teachers from which some questionnaires were revised and finalized.

Socio-economic status (SES) survey

The questionnaire to assess the socio-economic status of the family was included in the students' background questionnaire. The aggregate of the students' responses to the questions on the following seven factors indicates the SES of the student's family.

- Two variables related to parental education, including mother's and father's education;
- Two variables related to parental occupation, including mother's and father's occupation;
- Availability of various home accessories;
- Availability of home possessions; and
- Type of school (public or private) attended by student.

CHAPTER 5

Test Administration

5.1 Introduction

Preparation for test administration begins with printing, packing and delivery of test items and background questionnaires. ERO conducted a one-day orientation on test administration and test booklet collection process to the head teachers of each sample school in 26 districts. With the help of two teachers, the head teacher of each sample school administered the test. Subject teacher and head teacher of the sample school (in which test was administered) filled teachers' and head teachers' questionnaires respectively. Then students' answer sheets as well as teacher's and head teacher's responses were collected in the scoring centre in Kathmandu. The process followed for the purpose of test administration is described in this chapter.

For completion of the works, some of the tasks of test administration were outsourced to a consulting firm, while others were carried out by DEOs and schools. On the whole, the sub-headings that follow will deal with the tasks and process adopted to accomplish the work of test administration of NASA 2017.

5.2 Printing, Packing and Delivery of Tools

A consultancy firm, contracted by ERO, was given the responsibilities of printing, packing and delivery of tools, including: (i) three sets of item booklets in each subject; (ii) student and teacher questionnaires in each subject; and (iii) head teacher questionnaire. The consultancy firm was given these responsibilities in close monitoring of ERO. For this, ERO provided PRC copies of each tool to the consulting firm to print and pack them in a secure printing press.

Packing of item booklets for each sample school was done in a sequence of set 1, 2, 3 so that students sitting in an adjacent seat could receive different sets of questions of the same subject. As only one subject was administered in a school, packing of question of one subject was sufficient for a school. Besides, students' questionnaire for each participated

student, questionnaire for subject teacher and head teacher were also provided to each sample school.

5.3 Orientation to the District Focal Person

An officer at each District Education Office (DEO) was assigned the role of focal person for ERO. ERO conducted a two-day orientation workshop for the focal persons of all the 26 districts selected for NASA 2017. The main focus of the orientation programme was to orient them with the process of test administration, roles of DEO, school (head teacher) and teachers who managed the test as invigilators, and the subject teachers of the sample school. Conducting orientation to the head teacher/teacher of the sample school, method of sampling the students at school, administration of test and questionnaires, collection of test papers and monitoring of test administration were the major areas covered in the focal person orientation programme.

5.4 Orientation to the Head Teacher/Teacher of the Sample Schools

The consulting firm delivered the tools to the district headquarters of the sample districts in a secure manner. ERO provided District Education Office and the consulting firm with the list of sample schools and the number of students in each sample school. The District Education Office informed the sample schools about the date of test administration and participation of school head teacher/ teacher in the orientation programme. The focal person who participated in the one-day focal person orientation programme on test administration conducted this orientation programme. The head teachers/teachers from all sample schools of the districts participated in the orientation in which they were oriented on the details of their works in test administration. The consulting firm also supported for the orientation. In most of the districts an officer from ERO/MOE also facilitated the orientation programme. The orientation programme was concentrated on test administration process, student sampling method, questionnaire administration process and collection of questionnaires and test booklets. The questionnaires for head teacher, subject teacher and students and sealed test booklets were provided to each head teacher/teacher at the end of the orientation programme. A copy of test and questionnaire administration guidelines (see, Annex 2) prepared by ERO was provided to each school; and the details given in it was clarified during the orientation as well.

5.5 Test and Questionnaire Administration

Test was administered in all the sample schools on March 2, 2017 (19 Falgun, 2073). The head teacher/teacher who had participated in the district level orientation programme was given the responsibility of orienting at least one additional teacher in their school. The teacher to be oriented in this way was one who was not currently teaching the subject (in which the test was conducted) in Grade Eight in the school. This teacher was oriented, in this way, towards the administration of test; and then the two teachers worked together in the sample school to administer the NASA test.

Student selection for the test

All students of Grade Eight in a sample school participated in the assessment if the number of students was less than or equal to the sample size fixed for the school. But, in the case of students' number remaining more than the fixed sample size, students in the required number were sampled randomly. Girls and boys were sorted separately and students were selected randomly for sample, so that girls and boys would be sampled almost in the proportion of their number in the class.

Administration of background information questionnaire

Students' background information questionnaire was administered first of all. The time estimated to complete the questionnaire by students was 30 minutes. This being the estimated time, some minutes more might be needed for some students if they did not complete. As mentioned in the test administration guidelines, teacher administering the test may support students by clarifying the questions for responding to the questionnaire. Thus, arrangement was made during the administration of the questionnaire to ensure that students would provide accurate response as they experienced in the home and school.

At the same time, head teacher and the subject teacher responded separately to the school survey questionnaire and teacher's questionnaire respectively.

Test administration

Test of only one subject was administered in a sample school, but there were three different test booklets (sets of test items) for each subject. Test booklets were distributed

alternatively in such a way that student sitting adjacent to each other (or nearby) would get different sets. With this arrangement, the students were unable to copy and discuss with each other (event if they wanted). And, teachers were not allowed to support students in answering the questions. In each booklet, sufficient spaces were given for the answer – not only for 'selected response' type of questions but also for the questions of 'created response' type. This message was communicated to the students before test administration. The test of each subject was of two hours in duration.

Collection of test booklets and questionnaires

After the completion of test, students' test booklets and background information questionnaires responded by them were stitched together and packed in an envelope. Similarly, teacher's and head teacher's responses in the given questionnaires were packed together in an envelope. The unused test booklets were also packed in a separate envelope. Next, immediately, the three envelopes were packed in a separate packet and the packet was sealed writing necessary information, including name and code number of school, subject and grade of assessment, number of students participated, and number of unused test booklets in packing.

The school sent the sealed packet of answers and response papers to the respective DEO with the shortest possible means. Then the DEO handed the collected packets of answers and response sheets over to the representative of the consulting firm. The representative of the consulting firm packed all the packets received from schools and brought them to scoring centre in Kathmandu in a secure manner.

Monitoring of test administration

To ensure proper administration of test, monitoring and sample school visits were made by different agencies during test administration. District Education Office not only managed the whole process of test administration, but also monitored the administration process at school level. ERO also sent at least one person in each district to facilitate and monitor the administration of test. Besides, the consulting firm also monitored the process of test administration.

CHAPTER 6

Marking and Data Entry

6.1 Introduction

Scoring process started after all the answer booklets and questionnaires were collected at the scoring centre in Kathmandu. The booklets and questionnaires were sorted subject-wise before starting the task of scoring. For the purpose of marking and data entry also, the same consulting firm that worked in test administration process was contracted. This chapter describes preparatory works for scoring, which included preparation for scoring, scoring and transferring the scores and other data to OMR sheet, and OMR sheet scanning and data preparation.

6.2 Preparation for Scoring

Scoring was an important task conducted in the course of NASA study. The process followed for this task is described below.

Selection of scorers and scoring coordinators

Bachelor's degree in the related subject was set as the minimum qualification for the scorer of NASA 2017 Grade Eight. In addition, some teaching experience, experience of scoring test papers, or some relevant training/short courses on item development and scoring was also essential for a scorer. Therefore, based on the required qualification and experience of the candidates, the consultant selected scorers, who were 30 persons in each subject to a minimum.

Along with selecting the scorers, the consulting firm also hired one scoring coordinator for each subject. The hired scoring coordinators had a minimum qualification of Master's degree in related subject with 10 years of teaching experiences or 5 years of experience in teacher training, assessment design and scoring, or working as a teacher educator for 5 years to a minimum. The main task of scoring coordinators was to maintain quality

and uniformity in scoring. The scoring coordinators supported the scorers in the task of scoring; and their work included giving orientation to the scorers and providing regular feedbacks to them by checking the papers they scored. In addition, scoring coordinators worked to ensure accuracy in OMR writing.

Training of scorers

ERO, first, conducted a one-day orientation programme on scoring and OMR writing to the scoring coordinators and team leaders from the consultancy. In the next phase, ERO together with scoring coordinators conducted orientation to the scorers in each subject. The orientation programme was conducted in two stages – first for the scoring of CR items using marking schemes; and in the second stage, orientation was concentrated on OMR writing. During the training process, some practice and feedback sessions were also organized.

6.3 Scoring and Transferring Scores and Other Data to OMR Sheet

The scorers scored CR items and then transferred the scores and the responses of SR items as well as responses on background information questionnaires (filled by the students) to the OMR sheet.

Scoring of CR items using scoring schemes and guidelines

Trained scorers scored the CR items using the scoring guidelines prepared in advance (see, annex 3). Scoring coordinators monitored the process of scoring and provided feedback as and when required. Subject experts from ERO also monitored and supported the scorers in scoring the items in a uniform manner.

Transferring scores and other data to OMR sheet

After scoring CR items, scores were transferred to OMR sheet. Along with the task of transferring scores to OMR sheet, the scorers also transferred the answers given by students on background information questionnaire in the same OMR sheet.

In the same way, responses on teachers' and head teachers' questionnaires were also transferred to separate OMR sheets.

6.4 OMR Sheet Scanning and Data Preparation

After reviewing the OMR sheets, each sheet was scanned using OMR scanner. The scanned OMR image was then transferred in the data set. In the data set there were two unique identifications (UIDs) given to each student: the barcode of each OMR sheet and school code (school ID) together with student ID.

Each OMR sheet of the responses of teacher's and head teacher's questionnaires was also scanned with two identifications: the barcode and school code (school ID). Then the scanned images were transferred into the data sheet.

Using these two IDs, errors in every the data set (if occurred at all) were corrected. This initial data cleaning task carried out by the consulting firm helped in correcting some errors on the data occurred due to various causes in OMR writing and data transferring process.

Finally, the consulting firm provided ERO with data set in excel format together with scanned image as well as hard copies of OMR sheets; and all the scored answer booklets and students', teachers' and head teachers' questionnaires with their responses, in the first week of July, 2017.

CHAPTER 7

Preparing for Data Analysis

7.1 Introduction

This chapter describes the steps and process of preparing data for analysis. It includes data cleaning and codebook preparation. Data cleaning is a process of improving data quality by identifying and correcting errors including checking duplicate cases, missing cases and invalid entries. Codebook, on the other hand, is an excel file prepared to document the items and their characteristics. It starts with placing unique item ID and mentioning some basic characteristics of items.

7.2 Data Cleaning

Data cleaning is a process of improving data quality. This process generally includes: Defining and determining errors (if any) and correcting them; checking duplicate cases and removing them; examining the missing cases; checking invalid entries and making decision on them. The following table presents the summary of data cleaning activities done for NASA 2017 grade Eight.

Table7.1: Summary of data cleaning

Objective	Tasks performed
Remove duplicate case	- Checked and removed duplicate cases
Decide measures to be taken for invalid entries	- Checked and made decision on invalid entries, if any
Smooth noisy data	- Identified and removed outliers and nonsense values, if any - Resolved inconsistencies, if any
Fix the missing values	- Checked missing values and filled them up, or indicated missing if data are not found

Objective	Tasks performed
Check, fix and decide on any other error	- Checked errors and identified if the errors are random or systematic - Corrected systematic errors - Checked random errors and identified the possible ways of correcting them or deciding how to deal them
Fix variable and value labels	Checked variable and value level; then corrected and redefined them to make uniform
Make uniform structure of data	Checked structure of data and made them uniform for each of the data set Provided unique ID (UID) for an individual data

Students' data were received in three files for each subject – with one file for responses in each question set as well as the information on background variables, another for teachers respose data on background information questionniare and the third one for data on head teachers responses on school survey questionnaire. These data were in Excel file. The following variables were included in each data set of students.

Table 7.2 : List of major variables

S. N.	Variable
1	School Id
2	Location of School
3	Student's gender
4	Student's age
5	Language spoken at home
6	Caste/ethnicity
7	Identity with geography
8	Time spent on beyond school time
9	Support for study at home
10	Availability of textbook
11	Time to reach school
12	School opening and attendance days in last month
13	Homework and feedback

S. N.	Variable
14	Student's future aim
15	Attitude of student towards subject
16	Student's subject related activities in classroom
17	Mother's education
18	Mother's occupation
19	Father's education
20	Father's occupation
21	Number of family members
22	Home possession and accessories
23	Activities in leisure time at school
24	Frequency of extra activities at school
25	Frequency of participation in extra activities
26	Attitude towards teacher
27	Attitude towards school
28	Bullying at school

7.3 Codebook Preparation

A codebook was prepared in each subject with the help of subject experts. After the completion of data cleaning process, the cleaned data sets together with code book in each subject were prepared, which completed the initial preparation of data for calculation of item parameters, calibration, item and test analysis as well as further analysis of assessment results. The codebook includes basic information on items and variables. Item register and information on variables are basic components of codebook. Item resister includes item ID for all the items of three sets of test, answer keys, domain to be tested by the question, cognitive classification of questions, type of question, content areas and item descriptors. The following is the format used for preparing codebook.

Table 7.3: Example of Codebook (Mathematics, Grade 8)

SN	Item Id	Set A	Set B	Set C	Max score	Type	Key	Item_descriptors	Cognitive_ level	Item level	Topic	Source	Facility	Item-Rest Cor	Avg Delta
1	M817_020	20	24		1	SR	A	Apply Pythagorean relation to determine the given triangle with given lengths of the sides) as a right triangle.	Reasoning	2	Geometry	TIMSS 2011	55.52	0.51	-0.93
2	M817_021	21			1	SR	B	Convert simple rational fraction into decimal representation	Remembering	2	Arithmetic	TIMSS 2011	45.82	0.37	-0.04
3	M817_026	26			1	SR	B	Find the best estimate of the given numerical expression of the fractional form in which both numerator and denominator are given in numbers containing decimal numbers or product of decimal numbers.	Remembering	3	Arithmetic	TIMSS 2011	48.99	0.46	-0.20
4	M817_027	27			1	SR	D	Find true mathematical sentence (relation) of equality out of given expressions containing different operations	Remembering	3	Arithmetic	TIMSS 2011	63.03	0.40	-0.88
5	M817_028	28	23		1	SR	D	Recognize the correct position of geometric figure (e.g. triangle) under half-turn (clockwise).	Understanding	3	Geometry	TIMSS 2011	24.82	0.38	0.76
6	M817_029	29			1	SR	A	Find the area of rectangular garden excluding the rectangular path in it, given the dimensions containing variable measures.	Applying	5	Algebra	TIMSS 2011	26.70	0.11	0.93
7	M817_048	48.1			1	CR	1	Calculate the mean for the given numbers (given number of things/persons)	Applying	4	Data and sets	TIMSS 2011	17.80	0.56	0.93
8	M817_049	48.2			1	CR	1	Find median for individual distribution (median number of things/persons)	Applying	5	Data and sets	TIMSS 2011	19.65	0.49	0.97
9	M817_050	48.3			1	CR	1	Analyze the effect of increasing/ decreasing the sum of the distribution by some number on the mean and median.	Reasoning	6	Data and sets	TIMSS 2011	27.50	0.63	0.34

CHAPTER 8

Sampling Weights

8.1 Introduction

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 minimized. 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; and
- To adjust the weighted sample distribution for key variables of interest to make it conform to a known population distribution. (Yansaneh, 2003)

NASA 2017 adopted two-stage stratified cluster sample design with unequal probabilities of selection. Schools as well as students' non-response adjustments were also considered while calculating sample weights.

8.2 School Weight

School level base weights were calculated using the formula:

$$BW^{i}_{sc} = \frac{N_{pop}}{n_{sc} \times N^{i}_{mos}}$$

where N_{pop} was the population size (students), n_{sc} was the total number of schools sampled within each explicit stratum; and N^{i}_{mos} was the measure of size (MOS) assigned to the school (i). School level base weights were calculated for all sampled schools that satisfied the condition that the eligible students actually participated in the study. For example, in mathematics, altogether 650 schools were sampled, out of which 1 school did not

participate in testing due to some unavoidable circumstance. For this, a school-level non-response adjustment was calculated separately for each explicit stratum, using the formula:

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

where n_{sc} is the total number of originally sampled schools; and n_{psc} was the number of schools that participated.

The final school weight was then calculated with non-participation adjustment to the base school weight. The final school weight is then equal to the product of the school base weight and non-participation adjustment,

$$W_{sc} = BW^{i}_{sc} \times Sc_{adj}$$

8.3 Student Weight

For schools with 28 Grade Eight students, student base weight was 1; and for schools with more than 28 students and fewer, the base weight was calculated using the formula:

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

where N_{st} was the total number of students at Grade 8 in the sampled school and n_{st} were the number of sample students from the class.

A student non-participation adjustment was calculated for any school that had at least one student who was sampled and eligible to do the test but did not participate for some reason. This was calculated with the formula:

$$St_{adj} = \frac{n_{st}}{n_{pst}}$$

where n_{st} was the number of sample students and n_{pst} was the number of students who participate in the particular school.

The final student weight of a particular school (say, i^{th} school) is then equal to the product of the student base weight and non-participation adjustment: $W^{i}st = BW^{i}_{st} \times St_{adj}$

The final weight is the adjustment between the product of the school and student final weights: $W_{i} = W^{i}_{sc} \times W^{i}_{st}$.

CHAPTER 9

Item Parameter Estimation, Item Review and Calibration

9.1 Introduction

Item parameter estimation of each item was carried out and items were reviewed accordingly. During the analysis, decisions were made on whether or not to use any particular item in the analysis. Classical as well as IRT parameters were estimated to review the items. Item parameters in IRT were used not only for item selection but also to estimate students' latent ability. Based on the item parameters of linking items, three versions of tests were calibrated and these three sets were made as a single set for analysis. Item parameter estimation, item review and calibration of test ware some of the key processes of IRT analysis from which students' ability was estimated and data were further analysed.

9.2 Item Parameter Estimation

Preparation for test-by-test analysis

To estimate item parameters and calibrate the items to the same parameters, item analysis was carried out using Item Response Theory (IRT). As three different versions of test were administered in each subject (Mathematics, Nepali and Science), individual versions were analyzed separately before calibrating these three versions of test in each subject. This was done to estimate item parameters. For this, Excel data files were transferred into SPSS file and test-by-test analysis of the three sets was carried out using Conquest software.

Before performing test-by-test analysis in Conquest, the following preparations were made:

- Checked and worked with unique item IDs, codebooks and data file with uniform

structure;

- Checked the matches of codes in codebook with the question paper;
- Checked the item register of all items and their linkages with item information;
- Checked and prepared the data set by making uniform structure;
- Ensured that items in the data set are in the same order as in the codebook;

Item review with test-by-test analysis

The data files prepared in Excel were transferred into SPSS as data files; and created label files, command/syntax file for Conquest; and then test-by-test analysis was performed. As there were selected response (SR) type of multiple choice items (MC) as well as created response (CR) type of partial credit items, 1 PM model and Partial Credit Model (PCM) of IRT analysis was used in analysing the test.

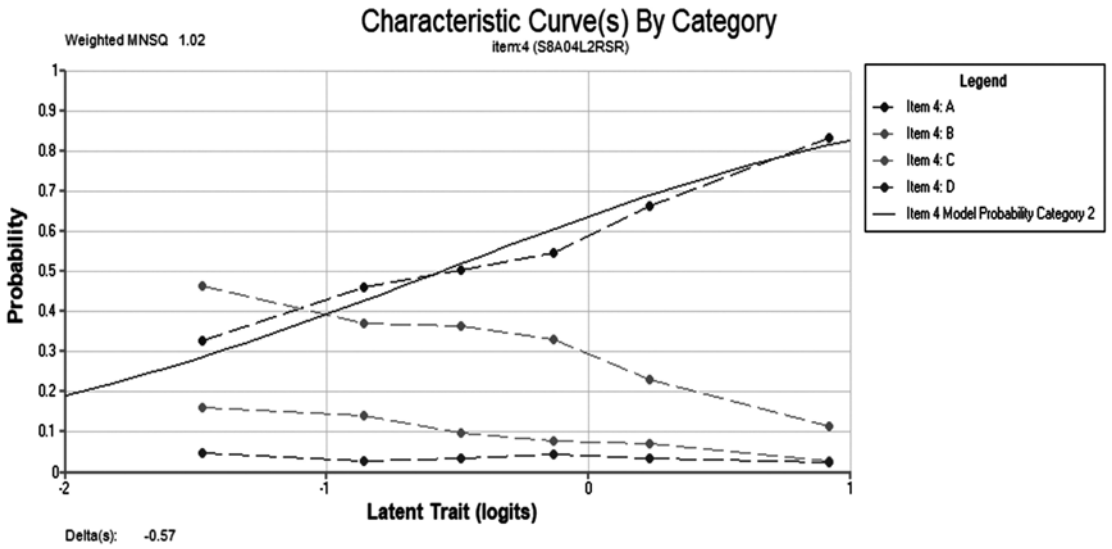
One Parametric Logistic Model (1 PM), called Rasch model and the partial credit model (PCM; Masters, 1982) were used to estimate item difficulty parameters (calibrate/scale the items). The Rasch model is "a mathematical model for the probability that an individual will respond correctly to a particular item, given the individual's location in a reference domain or dimension" (OECD, 2016, p. 141). The model assumes that the probability of response *x* to item *i* by a respondent n depends only on two parameters, the difficulty of the item i (δ) and the respondent's ability or trait level (θ) where,

$$P(\theta, \delta) = \frac{e^{(\theta - \delta)}}{1 + e^{(\theta - \delta)}}$$

The expected probability of a correct response is equal to 0.50, at the point where $\theta = \delta$.

An example of item characteristic curve is presented below for the item number 4 (MC) of science, where the solid line is the expected model for the item, A is the correct response and others are distractors. As the students' response on correct answer follows the expected model and the responses on distractors do not, this question fit well in the model.

Figure 9.1 (a): An example of ICC for multiple choice items in Science subject (1PM)



The partial credit model is an extension of the Rasch model with more than two ordered response categories for an item (see, Masters & Wright, 1997). If θ is the latent variable, and x the item score with values k = 0, 1, 2, ... m_i, the probability of person j scoring x on item i can be written as;

$$Pijx = \frac{e^{\sum_{k=0}^{x} (\theta_j - \partial_{ik})}}{\sum_{h=0}^{mi} e^{\sum_{k=0}^{h} (\theta_j - \partial_{ik})}}$$

where x = 1, 2, 3, ... m.

The following two figures, Fig 9.1(b) and Fig 9.1(c) are the ICCs for dichotomous response type (for item 5) and polytomous response type (for item 20) item respectively in Nepali subject.

Figure 9.1 (b): An example of ICC for dichotomous response type item in Nepali subject (PCM)

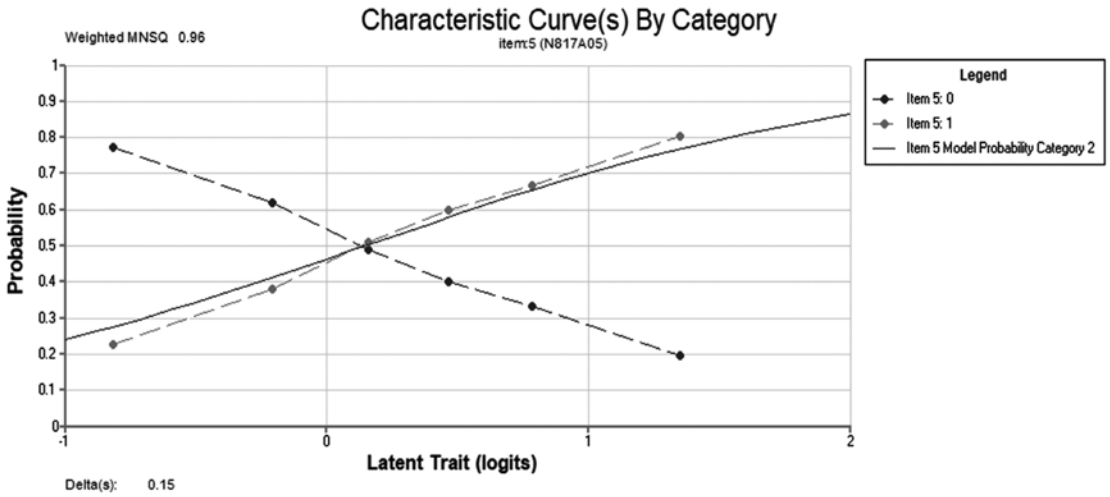
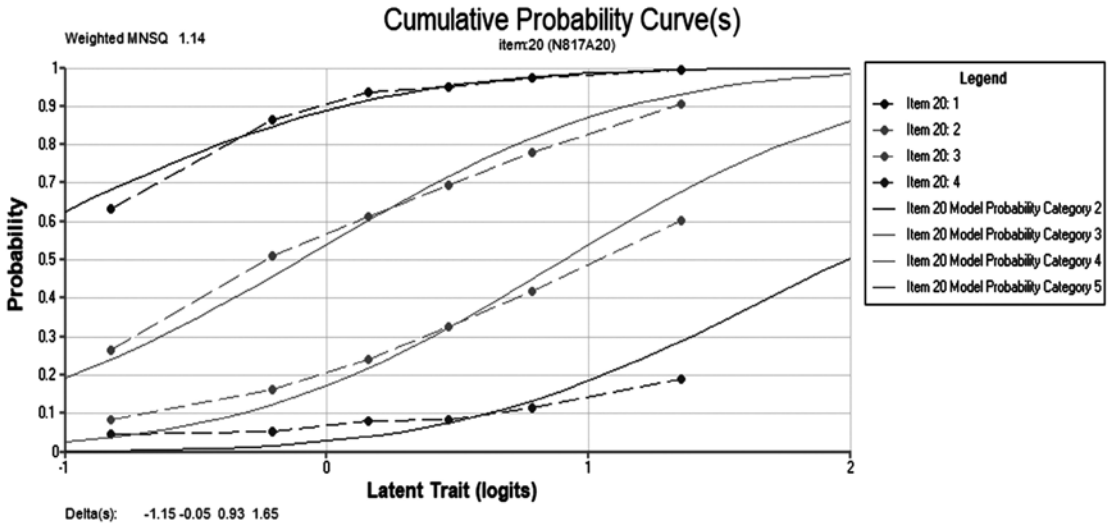


Figure 9.1 (c): ICC curve with polytomous response type item in Nepali subject (PCM)



The outputs of test-by-test analysis of each set of tests were reviewed item-wise, using item statistics and ICC (Item characteristic curve) for each item. Item statistics calculated for item analysis were item facility, item rest correlation (Point-Biserial correlation) and MNSQ.

The following table shows the example of a summary of item statistics as well as decisions on items in each test (set) for each subject. Items having negative item rest

correlations were excluded from the analysis. Items having the MNSQ from 0.8 to 1.2 with the items having 0.2 and above item rest correlation were first decided to include in the assessment. For the items having item rest correlation between 0 and 0.2, subject experts were consulted; and based on their suggestion decision was made on which item should be included or not in the analysis.

Table 9.1: Item analysis results (item statistics) of Science Grade 8, set A

Item ID	N	Facility	Item rest correlation	MNSQ	Avegdelta
G8SA1	5002	53.78	0.22	1.07	-0.53
G8SA2	5140	77.22	0.29	0.97	-1.73
G8SA3	4942	63.05	0.23	1.05	-0.97
G8SA4	5080	56.54	0.31	1.00	-0.66
G8SA5	5078	52.58	0.32	0.989940405	-0.4830425
G8SA6	5099	58.16827	0.349742946	0.965030573	-0.734780295
G8SA7	5055	28.17013	0.393299665	0.929904134	0.68846716
G8SA8	4993	38.23353	0.42152653	0.921337061	0.176010408
G8SA9	4969	36.52646	0.261090936	1.034054487	0.251626543
G8SA10	4955	53.98587	0.347493451	0.971951899	-0.542581624
G8SA11	4852	25.98928	0.329793067	0.967188431	0.809599885
G8SA12	4962	52.5796	0.319247433	0.996574753	-0.482517463
G8SA13	4871	42.04475	0.310464377	1.001368918	0.0011111
G8SA14	5010	52.89421	0.429132362	0.913768747	-0.500523794
G8SA15	4873	13.17464	0.136334973	1.052074945	1.711366415
G8SA16	4981	58.02048	0.214397267	1.063633635	-0.72637425
G8SA17	4871	27.30445	0.179432979	1.076530381	0.722844475
G8SA18	4997	17.1703	0.229437793	1.011949884	1.387449391
G8SA19	5083	76.45091	0.313514057	0.955956075	-1.682724449
G8SA20	5036	27.10485	0.065141641	1.143868149	0.74321519
G8SA21	5008	48.5024	0.202634918	1.078107208	-0.304069737
G8SA22	5085	69.95084	0.224165427	1.022756143	-1.315995726
G8SA23	4992	47.47596	0.286617374	1.020620405	-0.257117168
G8SA24	4954	46.85103	0.18111783	1.090492588	-0.223141771
G8SA25	2808	47.93447	0.498323156	1.20340881	-0.136571713
G8SA26	3365	29.25706	0.558862573	0.962655684	0.516336595
G8SA27	3789	13.30166	0.398786532	0.89267262	1.355126133

Item ID	N	Facility	Item rest correlation	MNSQ	Avegdelta
G8SA28	4232	43.78544	0.38157508	0.956836521	-0.053951225
G8SA29	4165	36.05042	0.573629308	0.836567616	0.212083407
G8SA30	4366	47.37746	0.472462153	1.01266181	-0.248818896
G8SA31	2717	24.67795	0.508004441	1.061608415	0.831694239
G8SA32	3536	22.70928	0.536583563	0.731075182	0.817591975
G8SA33	3047	23.54775	0.542759459	0.992098213	0.838073018
G8SA34	2743	23.11338	0.509134987	0.855744674	1.096945283
G8SA35	3949	36.11041	0.496496114	0.81433358	0.208015369
G8SA36	4202	21.12486	0.400921172	0.989432114	0.691701924
G8SA37	3539	51.05962	0.610664262	0.731075182	-0.281811878
G8SA38	3897	39.62022	0.500576699	0.927543624	0.065706925
G8SA39	3099	41.36818	0.590276117	0.731075182	0.100947258
G8SA40	3918	57.32517	0.552629945	0.847538132	-0.549036361
G8SA41	4234	46.84695	0.50074355	0.731075182	-0.200027811
G8SA42	3913	49.52722	0.559174134	0.927947588	-0.27161471
G8SA43	3324	35.19856	0.606385118	0.731075182	0.274340835
G8SA44	4390	61.58694	0.517218298	0.883134383	-0.715356374
G8SA45	3325	39.09774	0.622392261	0.942265465	0.091194071

The above table shows the item statistics of the version 1 (set A) of Science Grade eight test booklet generated by test-by-test analysis. Item 15, 17 and 24, for example, have item rest correlation less than 0.20 but greater than 0. Subject experts' suggestion was taken into consideration for deciding whether these items should be included in or discarded from the analysis – whereby item 20 with item rest correction 0.065141641 which is less than 0.1 was discarded from the analysis and others were included. Similarly, items having less than 0.8 (items 32, 37, 39, 41, 43) and greater than 1.2 (item 25 with MNSQ 1.20340881) MNSQ were also reviewed by subject experts; and these items were not discarded.

Item parameters such as facility value, MNSQ (mean-square fit statistics) and item rest correlation were calculated for each version of test in each subject. Then the items parameter of all the versions of tests were stored in separate excel files for each test version in the name of parameter file.

9.3 Item Calibration and Equating

The purposes of item calibration in this assessment were to join together the different versions of the test of the same Grade and subject; compare with the result of TIMSS by equating the test using linking items; and comparing the results with previous years' results of the same grade and subject.

As NASA 2017 used three versions of tests in each subject, reporting based on the number of correct responses or percentage of score is inappropriate. Three test versions in each subject administered in NASA 2017 may not be necessarily parallel and may have different levels of difficulty; and therefore reporting the total or percentage of scores and comparison of student competencies could be meaningless. In order to overcome such limitations of reporting test results using Classical Test Theory (CTT), an alternative test theory – Item Response Theory (IRT) has been followed for equating. Equating is a process of identifying some regularity in response pattern (difficulty) and modelling such regularity for the test, which can be used to describe students' abilities as well as items in terms of a common scale, even if all students do not take identical sets of items (OECD, 2017). This type of calibration of items and scaling of test will make possible to interpret the results using a common scale.

There are three commonly used methods for item calibration and equating: (i) Concurrent analysis, (ii) Anchoring method, and (iii) mean shift method. Among the three methods, concurrent analysis was used to calibrate the items in this assessment. This calibration is also known as joint scaling or equating, which is widely used for equating among various booklets with rotated design within a Grade or among the groups having similar abilities. Three sets of questions were merged into one set through concurrent analysis – by using the average of the parameter of common/linking items for calibrating, for the first two booklets (booklets 1 and 2) first, and then for the last two booklets (booklets 2 and 3).

Using the output of concurrent run (item parameters as well as ICC) items were reviewed for model fit, and inefficient or violating items were deleted. Thereafter, next run was performed for the remaining items after deleting inefficient and violating items. A scale was created for item parameters from the outputs of concurrent analysis.

The tables 9.2, 9.3 and 9.4 below present the item statistics after calibration of items from three booklets into one in Mathematics, Nepali and Science respectively.

Table 9.2: Item statistics (parameters) after calibration of items in Mathematics

Item ID	Mean	Facility	Item rest corr	Wghtd MNSQ	Avg delta
G8M1	5099.00	87.88	0.29	0.95	-2.37
G8M2	9945.00	77.88	0.36	0.94	-1.59
G8M3	4977.00	74.26	0.34	0.98	-1.34
G8M4	9704.00	70.23	0.48	0.87	-1.12
G8M5	4954.00	71.17	0.40	0.94	-1.16
G8M6	4953.00	79.16	0.34	0.96	-1.64
G8M7	14853.00	75.76	0.26	1.05	-1.46
G8M8	5005.00	60.82	0.44	0.92	-0.62
G8M9	4852.00	66.78	0.20	1.12	-0.93
G8M10	5079.00	57.67	0.46	0.91	-0.47
G8M11	5023.00	54.95	0.52	0.86	-0.33
G8M12	4884.00	56.37	0.47	0.92	-0.41
G8M13	4934.00	54.28	0.36	1.01	-0.31
G8M14	4430.00	43.43	0.16	1.20	0.19
G8M15	4689.00	38.22	0.31	1.05	0.48
G8M16	4455.00	59.33	0.22	1.12	-0.51
G8M17	14261.00	60.92	0.44	0.93	-0.65
G8M18	5016.00	48.41	0.39	0.98	-0.03
G8M19	9978.00	33.97	0.27	1.09	0.67
G8M20	9714.00	55.06	0.42	0.97	-0.37
G8M21	5067.00	69.49	0.42	0.92	-1.07
G8M22	9795.00	41.23	0.33	1.04	0.30
G8M23	4607.00	41.96	0.19	1.17	0.25
G8M24	4841.00	43.17	0.20	1.16	0.23
G8M25	4993.00	26.06	0.29	1.02	1.13
G8M26	4827.00	29.36	0.19	1.14	0.93
G8M27	4854.00	43.33	0.17	1.19	0.22
G8M28	9726.00	29.21	0.17	1.17	0.94
G8M29	4855.00	10.42	0.07	1.11	2.38
G8M30	9490.00	57.87	0.58	0.92	-0.40
G8M31	4473.00	62.74	0.60	0.86	-0.49
G8M32	4550.00	51.42	0.33	1.37	-0.10
G8M33	4398.00	59.13	0.47	1.12	-0.34
G8M34	3866.00	39.08	0.60	0.95	0.40

Item ID	Mean	Facility	Item rest corr	Wghtd MNSQ	Avg delta
G8M35	4540.00	50.11	0.60	0.93	-0.04
G8M36	8725.00	48.68	0.60	0.92	0.01
G8M37	4177.00	38.09	0.63	0.87	0.42
G8M38	7871.00	34.26	0.61	0.92	0.57
G8M39	4056.00	35.73	0.63	1.01	0.51
G8M40	3330.00	46.85	0.62	0.93	0.20
G8M41	3596.00	24.65	0.58	0.90	1.00
G8M42	3591.00	28.03	0.60	1.06	0.80
G8M43	3455.00	15.99	0.53	1.02	1.42
G8M44	3356.00	34.79	0.63	0.86	0.68
G8M45	2608.00	33.32	0.51	0.88	0.96
G8M46	3227.00	48.37	0.53	1.03	0.19
G8M47	2434.00	22.84	0.48	1.04	1.34
G8M48	3073.00	46.24	0.59	0.82	0.29
G8M49	2947.00	41.87	0.54	0.86	0.53
G8M50	2038.00	18.25	0.41	0.95	1.89
G8M51	4999.00	89.14	0.21	1.01	-2.56
G8M52	4971.00	85.33	0.27	0.99	-2.18
G8M53	4950.00	83.43	0.23	1.04	-2.02
G8M54	4950.00	74.14	0.31	1.02	-1.38
G8M55	4898.00	61.47	0.35	1.02	-0.69
G8M56	9827.00	67.38	0.35	0.99	-1.00
G8M57	4919.00	59.61	0.50	0.87	-0.60
G8M58	4869.00	58.37	0.46	0.93	-0.53
G8M59	4677.00	53.03	0.32	1.05	-0.28
G8M60	4749.00	59.36	0.37	1.01	-0.59
G8M61	4863.00	58.17	0.38	0.99	-0.53
G8M62	4747.00	54.06	0.37	1.01	-0.33
G8M63	4943.00	49.54	0.32	1.06	-0.12
G8M64	4866.00	35.18	0.23	1.14	0.58
G8M65	4937.00	63.74	0.28	1.07	-0.81
G8M66	4501.00	38.86	0.32	1.06	0.38
G8M67	4960.00	59.01	0.40	0.97	-0.58
G8M68	4804.00	20.05	0.06	1.22	1.51

Item ID	Mean	Facility	Item rest corr	Wghtd MNSQ	Avg delta
G8M69	9749.00	17.38	0.11	1.16	1.71
G8M70	4685.00	32.40	0.35	1.02	0.75
G8M71	7477.00	34.06	0.37	1.03	0.76
G8M72	8421.00	67.64	0.50	0.88	-0.93
G8M73	3763.00	26.47	0.40	0.98	1.17
G8M74	3129.00	29.75	0.63	0.88	0.82
G8M75	4219.00	48.60	0.61	0.90	-0.01
G8M76	3690.00	50.11	0.63	0.90	-0.01
G8M77	3856.00	48.81	0.65	0.76	0.03
G8M78	8847.00	64.50	0.50	1.06	-0.59
G8M79	4547.00	39.01	0.54	1.27	0.32
G8M80	3890.00	43.19	0.58	1.01	0.22
G8M81	2749.00	38.61	0.69	0.84	0.50
G8M82	2793.00	41.32	0.60	1.03	0.44
G8M83	2150.00	30.33	0.63	1.16	0.81
G8M84	3240.00	36.37	0.66	0.88	0.53
G8M85	3508.00	34.14	0.64	0.87	0.68
G8M86	3309.00	56.57	0.64	0.88	-0.15
G8M87	3536.00	27.67	0.53	1.03	0.86
G8M88	3462.00	25.62	0.56	0.94	1.07
G8M89	3006.00	20.16	0.50	0.85	1.71
G8M90	6111.00	12.04	0.38	1.08	1.73
G8M91	4553.00	20.87	0.42	0.94	1.65
G8M92	7118.00	53.10	0.60	0.80	-0.11
G8M93	4905.00	84.30	0.25	1.01	-2.09
G8M94	4904.00	74.43	0.35	0.99	-1.40
G8M95	4824.00	69.03	0.39	0.98	-1.08
G8M96	4835.00	77.87	0.40	0.94	-1.60
G8M97	4914.00	55.17	0.45	0.94	-0.38
G8M98	4932.00	58.37	0.44	0.95	-0.54
G8M99	4879.00	61.04	0.53	0.86	-0.67
G8M100	4898.00	60.78	0.41	0.97	-0.66
G8M101	4867.00	57.16	0.45	0.94	-0.48
G8M102	4776.00	57.12	0.40	1.00	-0.47

Item ID	Mean	Facility	Item rest corr	Wghtd MNSQ	Avg delta
G8M103	4735.00	50.39	0.40	1.00	-0.14
G8M104	4867.00	36.45	0.34	1.04	0.53
G8M105	4784.00	36.37	0.45	0.94	0.53
G8M106	4925.00	56.14	0.18	1.19	-0.44
G8M107	4892.00	47.94	0.36	1.03	-0.04
G8M108	4792.00	58.51	0.38	1.00	-0.56
G8M109	4747.00	34.97	0.23	1.14	0.62
G8M110	4882.00	50.49	0.31	1.08	-0.16
G8M111	4883.00	51.32	0.44	0.95	-0.20
G8M112	4961.00	65.01	0.38	0.99	-0.88
G8M113	4706.00	29.03	0.11	1.25	0.93
G8M114	3724.00	53.95	0.40	1.01	-0.23
G8M115	3607.00	47.96	0.41	1.00	0.07
G8M116	3550.00	33.44	0.46	0.93	0.81
G8M117	4534.00	66.66	0.50	1.06	-0.75
G8M118	4096.00	64.28	0.54	1.01	-0.52
G8M119	4375.00	55.22	0.54	1.02	-0.24
G8M120	3734.00	46.30	0.63	0.90	0.17
G8M121	4176.00	47.09	0.61	0.96	0.06
G8M122	4003.00	33.91	0.57	0.95	0.64
G8M123	3596.00	39.00	0.62	0.93	0.42
G8M124	3137.00	55.21	0.53	1.12	-0.10
G8M125	3303.00	40.12	0.55	1.24	0.43
G8M126	3078.00	47.34	0.46	1.15	0.19
G8M127	3329.00	25.65	0.55	0.96	1.05
G8M128	2887.00	12.94	0.37	1.21	1.56
G8M129	3398.00	26.81	0.55	0.98	0.93
G8M130	3110.00	32.35	0.45	0.93	0.97
G8M131	3138.00	44.84	0.63	0.79	0.34

Table 9.3: Item statistics (parameters) after calibration of items in Nepali

Item ID	N	Facility	Item-Rest Cor	Wghtd MNSQ	Avg Delta
N817A01	4901.00	74.47	0.30	0.97	-0.90
N817A02	4918.00	81.46	0.26	0.99	-1.35
N817A03	Discarded due to poor fit				
N817A04	4723.00	33.79	0.11	1.11	1.03
N817A05	4765.00	53.24	0.35	0.96	0.15
N817A06	5074.00	77.89	0.32	1.04	-1.16
N817A07	5028.00	76.25	0.19	1.06	-1.03
N817A08	4702.00	55.30	0.35	0.97	0.06
N817A09	4650.00	77.51	0.41	0.91	-1.06
N817A10	4959.00	90.84	0.23	0.97	-2.22
N817A11	4912.00	34.32	0.19	1.06	1.02
N817A12	4702.00	44.07	0.20	1.06	0.58
N817A13	4804.00	57.18	0.40	0.95	-0.18
N817A14	3810.00	53.31	0.25	1.03	0.19
N817A15	5021.00	48.18	0.35	0.97	0.35
N817A16	4832.00	77.73	0.41	0.91	-1.10
N817A17	4775.00	23.75	0.33	0.95	1.59
N817A18	4341.00	14.97	0.22	1.00	2.21
N817A19	3443.00	32.91	0.41	0.92	1.17
N817A20	4843.00	48.27	0.40	1.14	0.35
N817L21	9312.00	43.92	0.51	0.98	0.54
N817L22	14949.00	56.61	0.34	0.97	-0.01
N817L23	14129.00	42.06	0.35	1.04	0.69
N817L24	14904.00	58.96	0.24	1.04	-0.11
N817L25	14441.00	33.89	0.17	1.07	1.05
N817A26	4488.00	38.44	0.62	0.87	0.93
N817A27	3998.00	32.94	0.58	0.89	1.31
N817L28	14620.00	40.52	0.38	1.05	1.15
N817A29	4117.00	42.68	0.56	0.87	0.89
N817A30	4069.00	32.97	0.46	1.19	1.03
N817A31	3984.00	51.13	0.49	1.17	0.38
N817A32	4063.00	50.94	0.47	0.97	0.45

Item ID	N	Facility	Item-Rest Cor	Wghtd MNSQ	Avg Delta
N817B33	4989.00	89.46	0.29	0.95	-2.05
N817B34	4928.00	51.24	0.24	1.04	0.25
N817B35	4651.00	62.55	0.42	0.92	-0.24
N817B36	4953.00	60.65	0.16	1.10	-0.19
N817B37	4828.00	71.23	0.35	0.96	-0.71
N817B38	4967.00	58.19	0.32	1.06	-0.16
N817B39	4799.00	73.31	0.36	0.95	-0.81
N817B40	4554.00	41.06	0.36	0.96	0.74
N817B41	4663.00	45.46	0.36	0.96	0.53
N817B42	4815.00	43.97	0.43	1.12	0.62
N817B43	5015.00	55.25	0.27	1.02	0.05
N817B44	4996.00	61.79	0.31	1.00	-0.25
N817B45	5007.00	81.49	0.21	1.03	-1.36
N817B46	4929.00	57.23	0.27	1.02	-0.04
N817B47	4932.00	64.84	0.31	1.09	-0.42
N817B48	4933.00	58.62	0.38	1.00	-0.19
N817B49	3966.00	47.00	0.30	1.01	0.46
N817B50	4443.00	16.88	0.21	1.01	2.09
N817B51	4755.00	58.25	0.60	0.92	0.11
N817B52	4078.00	48.36	0.58	0.97	0.58
N817B53	4527.00	45.06	0.56	1.01	0.58
N817B54	4148.00	50.11	0.59	1.00	0.49
N817B55	4774.00	69.96	0.33	0.97	-0.62
N817B56	4766.00	28.35	0.16	1.06	1.34
N817B57	4684.00	56.68	0.42	0.92	0.02
N817B58	4559.00	58.57	0.38	0.94	-0.04
N817B59	4816.00	67.82	0.37	0.99	-0.68
N817B60	4692.00	58.15	0.43	0.95	-0.19
N817B61	3821.00	43.98	0.53	0.94	0.78
N817C62	5008.00	85.94	0.17	1.04	-1.69
N817C63	5007.00	85.38	0.23	1.01	-1.64
N817C64	4995.00	83.48	0.26	1.00	-1.48
N817C65	4977.00	81.56	0.25	1.00	-1.34

Item ID	N	Facility	Item-Rest Cor	Wghtd MNSQ	Avg Delta
N817C66	4895.00	58.67	0.37	0.96	-0.09
N817C67	4803.00	54.07	0.39	1.01	0.12
N817C68	4726.00	74.82	0.44	0.89	-0.90
N817C69	3370.00	23.06	0.23	1.02	1.71
N817C70	4727.00	70.00	0.39	0.93	-0.61
N817C71	4829.00	41.42	0.25	1.03	0.71
N817C72	4682.00	68.82	0.23	1.03	-0.53
N817C73	4180.00	39.80	0.41	0.99	0.80
N817C74	4155.00	34.93	0.55	0.88	1.02
N817C75	4137.00	53.11	0.58	0.94	0.33
N817C76	4778.00	88.13	0.33	0.94	-1.89
N817C77	4408.00	70.03	0.33	0.98	-0.62
N817C78	4303.00	56.47	0.30	1.00	0.08
N817C79	3470.00	41.61	0.39	0.94	0.76
N817C80	4205.00	49.22	0.63	0.89	0.53
N817C81	3919.00	48.47	0.58	0.98	0.60
N817C82	4525.00	51.04	0.47	1.46	0.32
N817C83	4723.00	89.73	0.33	0.93	-2.04
N817C84	4669.00	52.15	0.29	1.01	0.25
N817C85	4740.00	78.90	0.39	0.92	-1.12
N817C86	4601.00	66.36	0.31	0.99	-0.41
N817C87	4752.00	81.23	0.29	0.98	-1.30
N817C88	4681.00	71.52	0.37	0.94	-0.69
N817C89	4144.00	48.96	0.20	1.07	0.42
N817C90	4432.00	66.63	0.26	1.02	-0.42
N817C91	3432.00	48.57	0.44	0.91	0.46

Table 9.4: Item statistics (parameters) afler calibration of items in Science

Item	N	Facility	Item-Rest Cor	Wghtd MNSQ	Avg Delta
G8M1	5001.00	53.79	0.22	1.09	-0.43
G8M2	15093.00	76.53	0.28	0.99	-1.63
G8M3	4941.00	63.06	0.23	1.06	-0.89
G8M4	5079.00	56.55	0.30	1.02	-0.57

Item	N	Facility	Item-Rest Cor	Wghtd MNSQ	Avg Delta
G8M5	5077.00	52.57	0.32	1.00	-0.39
G8M6	5098.00	58.16	0.35	0.98	-0.64
G8M7	5054.00	28.18	0.39	0.94	0.80
G8M8	4992.00	38.24	0.42	0.92	0.28
G8M9	4968.00	36.51	0.26	1.04	0.36
G8M10	4954.00	54.00	0.35	0.99	-0.45
G8M11	4851.00	25.99	0.33	0.97	0.92
G8M12	4961.00	52.59	0.32	1.01	-0.39
G8M13	4870.00	42.05	0.31	1.01	0.10
G8M14	9957.00	53.92	0.41	0.94	-0.56
G8M15	9863.00	34.54	0.32	1.02	0.51
G8M16	4980.00	58.01	0.22	1.08	-0.64
G8M17	4870.00	27.31	0.18	1.09	0.83
G8M18	4996.00	17.17	0.23	1.01	1.50
G8M19	5082.00	76.45	0.32	0.96	-1.61
G8M20	Discarded due to poor fit				
G8M21	5007.00	48.51	0.20	1.10	-0.21
G8M22	5084.00	69.96	0.23	1.04	-1.24
G8M23	4991.00	47.47	0.29	1.03	-0.16
G8M24	14639.00	45.31	0.19	1.10	-0.08
G8M25	2808.00	47.93	0.50	1.06	-0.03
G8M26	3365.00	29.26	0.56	0.91	0.59
G8M27	7144.00	13.21	0.40	0.97	1.51
G8M28	4231.00	43.80	0.38	0.97	0.05
G8M29	4164.00	36.06	0.57	0.88	0.34
G8M30	4365.00	47.39	0.47	1.02	-0.15
G8M31	2716.00	24.69	0.51	0.96	0.87
G8M32	3535.00	22.72	0.54	0.89	1.16
G8M33	3046.00	23.56	0.54	0.89	0.88
G8M34	2742.00	23.12	0.51	0.85	1.21
G8M35	11771.00	37.40	0.48	0.97	0.32
G8M36	4201.00	21.13	0.40	1.14	0.97
G8M37	7536.00	36.56	0.46	0.94	0.22
G8M38	3896.00	39.62	0.50	1.07	0.29
G8M39	3099.00	41.37	0.59	0.86	0.25

Item	N	Facility	Item-Rest Cor	Wghtd MNSQ	Avg Delta
G8M40	3918.00	57.33	0.55	0.90	-0.46
G8M41	8143.00	45.17	0.49	0.93	-0.08
G8M42	3912.00	49.54	0.56	0.92	-0.16
G8M43	3323.00	35.21	0.61	0.90	0.54
G8M44	7530.00	50.13	0.47	1.03	-0.28
G8M45	3324.00	39.11	0.62	1.02	0.29
G8M46	4906.00	57.44	0.30	1.00	-0.82
G8M47	4757.00	27.14	0.17	1.06	0.63
G8M48	4890.00	31.43	0.31	0.99	0.39
G8M49	4878.00	36.67	0.10	1.12	0.13
G8M50	9739.00	45.74	0.39	0.95	-0.12
G8M51	4857.00	26.58	0.12	1.10	0.65
G8M52	4923.00	61.00	0.16	1.08	-0.98
G8M53	Discarded due to poor fit				
G8M54	4683.00	28.21	0.22	1.04	0.56
G8M55	4787.00	42.43	0.13	1.11	-0.13
G8M56	4899.00	35.19	0.28	1.00	0.21
G8M57	Discarded due to poor fit				
G8M58	4857.00	58.25	0.33	0.98	-0.84
G8M59	9886.00	23.30	0.12	1.11	1.03
G8M60	4807.00	26.25	0.21	1.03	0.68
G8M61	4781.00	52.56	0.22	1.05	-0.59
G8M62	4968.00	73.01	0.27	1.00	-1.59
G8M63	4562.00	48.41	0.47	1.14	-0.45
G8M64	3752.00	37.17	0.53	0.89	0.13
G8M65	3158.00	26.21	0.55	1.02	0.31
G8M66	9089.00	56.63	0.56	0.86	-0.57
G8M67	4032.00	32.76	0.27	1.02	0.35
G8M68	3235.00	36.54	0.52	0.96	0.06
G8M69	3052.00	36.42	0.48	1.00	0.11
G8M70	2716.00	26.91	0.40	0.94	0.68
G8M71	3311.00	52.43	0.56	0.89	-0.43
G8M72	3292.00	28.77	0.36	0.97	0.59
G8M73	3465.00	31.08	0.41	1.07	0.25
G8M74	3560.00	23.90	0.56	0.84	0.60

Item	N	Facility	Item-Rest Cor	Wghtd MNSQ	Avg Delta
G8M75	2929.00	37.65	0.58	0.92	0.23
G8M76	4235.00	59.14	0.47	0.95	-0.80
G8M77	8206.00	47.78	0.43	0.96	-0.14
G8M78	3990.00	58.15	0.42	0.92	-0.81
G8M79	4119.00	50.42	0.53	0.97	-0.44
G8M80	4253.00	71.63	0.39	0.99	-1.31
G8M81	3906.00	51.14	0.58	0.91	-0.46
G8M82	4877.00	60.20	0.21	1.08	-0.60
G8M83	4869.00	42.43	0.32	1.00	0.21
G8M84	4958.00	39.79	0.35	0.97	0.32
G8M85	4856.00	57.04	0.14	1.13	-0.47
G8M86	4875.00	37.62	0.33	0.99	0.44
G8M87	4965.00	21.31	0.30	0.98	1.34
G8M88	4971.00	34.56	0.20	1.09	0.58
G8M89	4967.00	68.43	0.30	0.99	-1.02
G8M90	4814.00	47.09	0.16	1.12	0.00
G8M91	5001.00	86.42	0.20	0.99	-2.20
G8M92	4938.00	44.69	0.20	1.09	0.09
G8M93	4822.00	37.89	0.14	1.13	0.41
G8M94	5009.00	61.89	0.16	1.09	-0.70
G8M95	4964.00	56.61	0.19	1.09	-0.45
G8M96	4983.00	65.62	0.38	0.94	-0.88
G8M97	4994.00	70.60	0.25	1.01	-1.14
G8M98	Discarded due to poor fit				
G8M99	5014.00	92.12	0.17	0.98	-2.84
G8M100	4925.00	30.52	0.16	1.10	0.78
G8M101	2630.00	38.33	0.58	0.92	0.39
G8M102	3416.00	34.26	0.56	1.06	0.43
G8M103	3449.00	41.58	0.45	0.92	0.36
G8M104	3304.00	45.58	0.44	0.93	0.18
G8M105	3906.00	42.56	0.54	0.92	0.21
G8M106	2748.00	37.19	0.52	0.86	0.59
G8M107	3696.00	33.29	0.44	1.07	0.51
G8M108	3286.00	48.60	0.56	0.84	0.01
G8M109	3403.00	57.77	0.61	0.79	-0.40

Item	N	Facility	Item-Rest Cor	Wghtd MNSQ	Avg Delta
G8M110	3800.00	45.17	0.54	1.06	0.11
G8M111	3107.00	30.30	0.52	0.91	0.93
G8M112	4028.00	38.94	0.54	1.16	0.30
G8M113	3987.00	40.88	0.31	1.01	0.30
G8M114	2875.00	27.85	0.61	0.87	1.07
G8M115	4641.00	71.31	0.37	1.05	-0.96
G8M116	4195.00	33.11	0.35	0.98	0.66
G8M117	3358.00	35.22	0.62	0.97	0.53
G8M118	3677.00	50.99	0.56	1.01	-0.09
G8M119	3270.00	46.13	0.62	0.84	0.12

9.4 Case Estimation

Using the parameters of the concurrent analysis, Weighted Likelihood Estimation (WLE) was performed to estimate cases. WLE is the estimation of students' individual ability scores-latent ability (θ value) in logits, which has the value of 0 as the mean ability, positive for above average and negative for below average. Merging this file with student data set gives individual ability score in logits, called case estimation. Latent ability is the estimation of latent trait of the student based on the obtained score in relation to the items having certain characteristics. It is a transformed score (theta) with a mean of 0 and a standard deviation of 1 with some range to cover the latent trait to be measured.

Table 9.5: Example of student ability from WLE (Grade 8 Nepali)

Stu-ID	Stu-ability
16194	-0.28
16195	-0.44
16196	0.44
16197	0.23
16198	0.23
25951	0.89
25952	-0.2
25953	0.4
25954	0.25
25955	-1.47

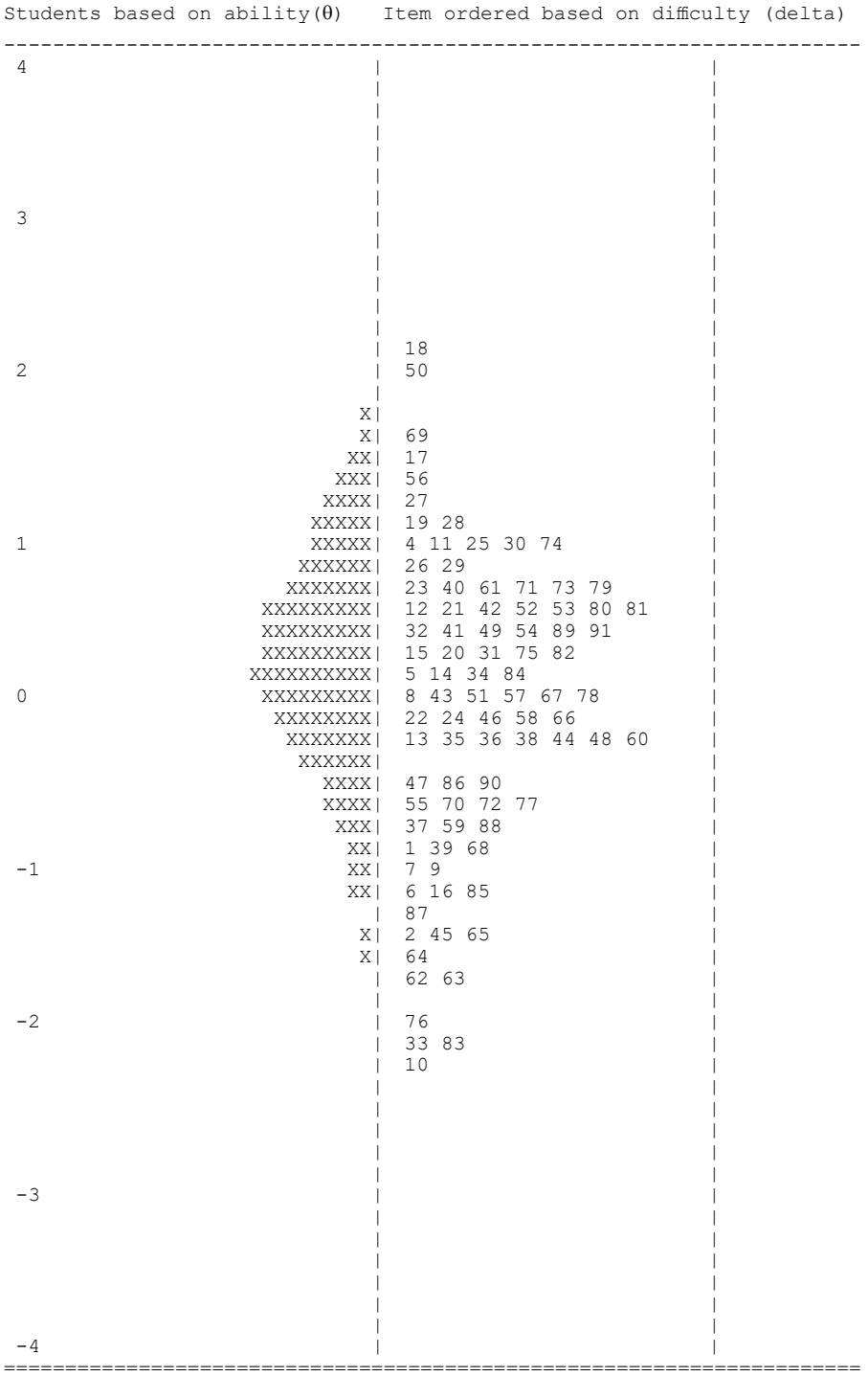
Stu-ID	Stu-ability
30050	-0.28
30051	0.22
30052	0.33
30053	0.27
30054	-0.14
16161	-0.14
16162	0.33
16163	0.11
16164	-0.21
22039	0.2

Stu-ID	Stu-ability
30030	-0.89
30031	0.58
30032	-0.01
30033	0.43
30034	0.67
19915	0.54
19916	0.69
19917	0.23
19918	-0.01
19919	-0.07
25972	0.09
25973	0.61
25974	0.56
25975	0.3
25976	0.4

Stu-ID	Stu-ability
25924	-0.07
25925	0.25
25926	0.2
25927	-1.11
30007	0.63
30008	0.38
30009	0.72
30010	-0.7
30011	-0.52
19920	0.79
19921	-0.14
19922	-2.11
19923	0.11
19924	-0.01
25977	0.25

The following figure shows the item-person map, which place items (with difficulty scale) and persons (with their latent ability) in the same scale. The vertical scale in the figure shows increasing proficiency that is student ability distribution on the left side, whereas the items are located on the right side in the order of difficulty of items with the easiest items at the bottom.

Figure 9.2: Item-person map of Grade 8 in Nepali



The above figure shows that the items cover a wide range of difficulty levels with the average item difficulty (δ value) and the average ability (θ value-zero logit), which shows that item difficulty and person's ability are matching quite well.

The case estimation using WLE explains the individual student's ability fairly, but it may not be appropriate for population estimation.

CHAPTER 10

Generating PVs for Population Estimation

10.1 Introduction

This chapter presents the method and process adopted for estimating the assessment results for the whole population. The method used for population estimation is the calculation of plausible values, which is described in this chapter. The possible errors that occur while estimating the population were estimated using replicable techniques. Replication methods draw multiple replicates (sub-samples) from a full sample as per specific re-sampling scheme. Among different methods of replication, Jackknife method has been used in this assessment. The method and process of calculating replicable weights and estimating standard errors are also discussed in this chapter.

10.2 Plausible Values (PVs)

For population estimation, Plausible Values (PVs) were generated with the sample weight of students. It produces unbiased estimate of population parameters if assumption of scaling are reasonable, but it is not fair to use for level of student ability. As Yamamoto & Kulick (2000) mention, the PVs approach "uses students' responses to the items together with all background data in order to estimate directly the characteristics of student populations and sub-populations" (cited in Laukaitytė, 2016, p. 9). But, PVs are not individual test scores; they are the measures of the performance of population.

The following inputs were prepared to generate the PVs:

- Case estimation using weighted likelihood estimation (WLE)
- Student sample weight
- Dummies for background variables
- School index
- School mean
- Count

Performing conditional run with the student data 5 PVs were generated.

Table 10.1: 5 PVs and RWGT (example from Grade 8 Mathematics)

School ID	PID	SCH_M _index	MPV1	MPV2	MPV3	MPV4	MPV5	RWGT1	RWGT2	RWGT3	RWGT4	…	W_STU	MSSPV1	MSSPV2
710240009	36369	-1.14	-2.06	-1.51	-1.54	-1.24	-1.75	31.99	31.99	31.99	31.99		31.9878	415.11	442.84
710240009	36370	-1.18	-0.21	-0.35	-1.06	-0.5	-0.64	31.99	31.99	31.99	31.99		31.9878	508.61	501.32
710240009	36371	-1.15	-0.8	-0.82	-0.82	-0.33	-1.21	31.99	31.99	31.99	31.99		31.9878	478.94	477.79
710240009	36372	-1.13	-1.89	-1.27	-1.63	-1.91	-1.44	31.99	31.99	31.99	31.99		31.9878	423.95	454.95
710240009	36373	-1.14	-1.34	-1.21	-1.53	-1.72	-1.21	31.99	31.99	31.99	31.99		31.9878	451.69	458.15
710240009	36374	-1.14	-0.98	-0.97	-0.69	-0.7	-1.18	31.99	31.99	31.99	31.99		31.9878	469.76	470.41
710240009	36375	-1.15	-1.11	-0.66	-0.45	-1.54	-1.04	31.99	31.99	31.99	31.99		31.9878	463.21	485.58
710240009	36376	-1.16	-0.68	-0.58	-0.6	-0.74	-0.9	31.99	31.99	31.99	31.99		31.9878	485.01	490.08
710240009	36377	-1.15	-0.99	-0.81	-0.76	-1.2	-1.01	31.99	31.99	31.99	31.99		31.9878	469.25	478.17
710240009	36378	-1.12	-1.21	-2.38	-1.6	-1.71	-1.42	31.99	31.99	31.99	31.99		31.9878	458.01	399.22
710240009	40072	-1.2	0.34	0.19	0.24	-0.14	0.22	31.99	31.99	31.99	31.99		31.9878	536.43	528.5
710240009	40073	-1.18	-0.06	-0.28	-0.28	0.09	0.05	31.99	31.99	31.99	31.99		31.9878	515.8	504.97
710240009	40074	-1.16	-0.85	-0.76	-0.94	-0.61	-0.83	31.99	31.99	31.99	31.99		31.9878	476.18	480.52
710240009	40075	-1.15	-0.97	-0.53	-0.9	-0.9	-1.18	31.99	31.99	31.99	31.99		31.9878	470.18	492.42
710240009	40076	-1.1	-1.75	-1.6	-2.26	-2.14	-1.91	31.99	31.99	31.99	31.99		31.9878	430.75	438.31
710240009	40077	-1.14	-0.72	-1.3	-0.93	-1.43	-1.26	31.99	31.99	31.99	31.99		31.9878	482.71	453.39
710240009	40078	-1.16	-0.49	-0.39	-0.28	-0.75	-0.75	31.99	31.99	31.99	31.99		31.9878	494.39	499.36
710240009	40079	-1.16	-0.95	-0.3	-1.1	-0.83	-0.64	31.99	31.99	31.99	31.99		31.9878	471.18	504.17
710240009	40080	-1.09	-2.48	-2.24	-2.36	-2.04	-2.26	31.99	31.99	31.99	31.99		31.9878	393.85	406.07
710240009	48261	-1.13	-1.58	-2.09	-1.53	-1.84	-1.72	31.99	31.99	31.99	31.99		31.9878	439.55	413.74

10.3 Regression Model and Population Modelling

An IRT model together with a regression model was used in NASA 2017 data analysis. To increase the accuracy of the estimation of proficiencies of population and sub-populations, plausible values methodology or the multiple imputations method was used. For the purpose of population estimation, 5 plausible values were computed to each student. The combined model used in NASA 2017 as in PISA 2015 (OECD, 2017) includes IRT measurement modelling to provide information about test performance and the latent regression to provide information about predictability of proficiency by the background variables. The following combined model was worked out for population estimation:

- **Item calibration (equating) using IRT:** Items of test were of both SR (MC) and CR types. CR type items were of both dichotomous and polytomous response types. For this, one parametric logistic/Rasch model (1 PM) and a Partial Credit Model (PCM) of IRT were used to estimate parameters and to calibrate the items of various versions in a common scale.
- **Latent regressions and plausible value generation:** A latent regression model has been set to the data to obtain regression weights for population estimation. Similarly, 5 plausible values were generated for each student using the estimated item parameter.
- **Variance and standard error estimation:** Using replicates approach, variances and standard error of population estimation were calculated for required variable.

10.4 Replicable Weight and Standard Errors

Replication methods have been used for estimating sampling errors in a complex survey design. Replication methods draw multiple replicates (sub-samples) from a full sample as per specific re-sampling scheme. Among different methods of replication, balanced repeated replication (BRR) method and the Jackknife method have been used most commonly.

In this assessment sampling errors or variability was estimated using Jackknife repeated replication (JRR) method. Jackknife repeated replication (JRR) is a method to estimate the sampling variability of the sample design, which provides unbiased estimates of the sampling error. It was done by splitting a single sample into multiple sub-samples and using fluctuation among the sub-samples, the overall sampling variability was estimated.

The following three steps were followed to find the variability using JRR:

- Formed random groups from the sample schools (Primary Sample Units -PSUs);
- Constructed the replicate weights, which were later used to calculate the parameter of interest for the sub-samples; and
- Calculated variance of the parameter of interest.

To form the replicate weight, first of all the schools were organized into pairs in the order they were sampled. Replicates were formed by altering one of these pairs in turn where one randomly selected school from the pair was dropped and the weights for the schools were doubled; and the weights for the other sample schools were unchanged. Based on the number of schools participated in the assessment, replicates were formed in each subject.

For NASA 2017, 324 replicates were formed in Mathematics, and the same number of replicates was maintained in Nepali subject. In Science there were 326 replicates as there were 649 participating schools in Mathematics and Nepali each; and 652 schools in the case of Science.

Replicate weights, therefore, were used to estimate the standard error of population estimate. As the population is stratified into various strata, JK_2 was used to calculate variance, which is

$\sigma^2 = \Sigma(\theta i - \theta)^2$, where

or, $\sigma = \sqrt{\Sigma(\theta i - \theta)^2}$

And

$$SE = \frac{\sigma}{\sqrt{n}} = \sqrt{\frac{\sum(\theta i - \theta)^2}{n}}$$

SE is the standard error, σ is the standard deviation and n is the number of samples.

The confidence interval (CI) can be calculated using the formula,

$CI = \text{mean} \pm z \times SE$

$$= \text{mean} \pm z \times \frac{\sigma}{\sqrt{n}} = \text{mean} \pm 1.96 \times \frac{\sigma}{\sqrt{n}}$$ (for 95% confidence level, z = 1.96 standard score).

CHAPTER 11

Estimation of Students' Abilities

11.1 Introduction

The main purpose of using Item Response Theory (IRT) in an assessment is to estimate students' ability and locate that person on the ability scale. For ability estimation, first, the examinee should be evaluated in terms of how much underlying ability he or she possesses. Secondly, comparisons can be made among the examinees for various purposes (Beker, 2001). As test is an indirect measure of latent trait (ability) of a student, there are several methods of estimating the ability. The maximum likelihood (MLE), the weighted maximum likelihood (WLE), and the maximum a posteriori (MAP or BMLE) have been widely used to estimate students' ability in using IRT. In NASA 2017 of Grade Eight, ERO used WLE method to estimate the ability of students.

Case estimation, as presented in chapter nine of this report, is an estimation of sample students' abilities (Theta value) in logits, but the students' abilities to be discussed and estimated in this chapter are the estimation of the abilities of student population.

11.2 Scale Transformation

In order to facilitate the interpretation, the logit score ie. ability scores (Theta value) was transferred into score having 500 as mean score with 50 as standard deviation. One of the reasons of choosing this scale is to avoid negative values on the scale of proficiency in which a standard deviation of 50 gives how far is a certain proficiency level from the mean. The transformation formula used to transfer logit score to the proficiency scale was:

Score on proficiency scale = Logit × standard deviation + mean score = Logit × 50 + 500.

The logit score is based on the NASA 2017; and therefore, it could be taken as base score so that we can compare this value with the score of previous years or the assessments to be done in the coming years using some linking items and scaling the scores with the

parameters of NASA 2017.

Here, mean of 500 is fixed as the national mean, which was calculated using student sampling weights to present the average achievement of all Grade 8 students of Nepal in respective subjects.

When we prepare item map with students' ability score, it indicates the situation: "If a student's proficiency level exceeds the item's demands, the probability that the student can successfully complete that item is relatively high, and if the student's proficiency is lower than that required by the item, the probability of success for that student on that item is relatively low" (OECD, 2017, p. 279).

11.3 Proficiency Scales

The reporting scale of NASA 2017 is proficiency scale as the proficiency describes what students typically know and can do at given level of proficiency. It reports the results for population-level but not for individual students – assuming that the selected sample of grade 8 students will represent all the grade 8 students of Nepal. Results from statistical analysis were transformed in the scale score with 500 as the mean score (proficiency); and it was then reported by dividing proficiency scores into six levels. There is specific proficiency description to each level of proficiency defined on the basis of competencies described by item descriptors (see, Zieky & Perie, 2006).

Comparison of student achievement against the proficiency levels is a convenient way of describing student achievement. Students having a certain level of proficiency are able to demonstrate the understandings and skills associated with that level. Any student within a band/level would be expected to successfully answer at least 50% of items in a test. In general, the proficiency scale shows that the students whose ability estimate places them at a certain point on a proficiency scale would be more likely to be able to successfully complete tasks at or below that point (OECD, 2017).

The width of each band/level, except for the highest and lowest band/level, has been uniformly distributed. The cut points for proficiencies were decided from the students' score together with subject experts' judgment based on item descriptors.

Proficiency levels for mathematics Grade 8

Five cut-points were decided for 6 proficiency levels in mathematics. In mathematics of NASA 2017, two extreme levels were taken – the lowest and highest level with below -2 and above +2 logits. This yields the lower and higher levels of proficiency in mathematics below 395 and above 606 respectively. Computing 4 levels of proficiency of score from 395 to 606 (score range 211), we get 52.75 as the width of each of the four levels. Table 11.1 presents the range of scores in each level of proficiency and Table 11.2 describes each proficiency level by stating what students can typically do at certain level.

Table 11.1: Proficiency levels and the score range in Mathematics

Level	Score	SE
Level 6 (Advanced)	606 <	0.13
Level 5 (Proficient 3)	553–606	0.72
Level 4 (Proficient 2)	501–553	1.01
Level 3 (Proficient 1)	448–501	0.9
Level 2 (Basic)	395–448	0.79
Level 1 (Pre-basic)	< 395	0.33

Table 11.2: Summary descriptions of the six proficiency levels on Mathematics scale of Grade 8

Level	Score	What students can typically do
6	606 <	Students at level 6 can analyse, synthesize and show relationship among different mathematical concepts. They can analyse the pattern and get the solution in unfamiliar problems in some content areas. For example, they can find the angles of a triangle by using the angle relationship of isosceles triangles; and analyse the effect of increased/decreased distribution by some numbers on the mean and median; transfer a geometric figure using multiple transformations.
5	553–606	Students at level 5 can solve daily problems using learnt mathematical concepts and analyse the problems and synthesize the process of solving mathematical problems. They can solve varieties of problems of their level. For example, they can solve

Level	Score	What students can typically do
		verbal problems of simultaneous equations; use the formula of (a^3+b^3) to factorize algebraic expressions; calculate the area of the given right triangle; simplify the algebraic fractions with different denominator and indices; find the number when two numbers are given in different base of number (binary and quinary); solve the verbal problems on finding cost price when marked price and discount are given; find the cardinal number of the intersecting sub-sets, complement; solve the simple problems using angle sum relation of a triangle, co-interior angles, alternative angles and corresponding angles formed by the parallel lines; use mean and median in solving daily life problems.
4	501–553	Students at level 4 can apply the different mathematical concepts to solve simple problems. For example, student can use four simple operation to simplify expression; round off a decimal number; convert the decimal number into the number having other bases; solve the problems of profit and loss involving discount and percentage; rationalize the denominator of irrational number; solve very simple problems on unitary method/time and work; solve the linear and quadratic equation; find HCF and LCM of two algebraic expressions of degree 2, construct a square and other shapes with the given length using compass and scale; find the image points of a given point using transformations (reflection, rotation and translation); find the distance between two points by using distance formula; deduce the relation to find an exterior angle of a n-sided regular polygon; find the union/intersection of two sets using Venn diagram; identify the rational and irrational numbers; find mean and median of discrete series; explain the angle sum relation of a triangle, relation between co-interior angles, alternative angles and corresponding angles formed by the parallel lines..

Level	Score	What students can typically do
3	448–501	Students at level 3 can apply the limited mathematical concepts in solving problems and they can plan how to gather data necessary to solve simple problems. For example, they can calculate area; volume and length of a cube or cuboid; calculate radius from diameter of a circle; use Pythagorean triples; explain the conditions of congruency of triangles, convert different units of measurement; rationalize the denominator of a fraction; calculate the simple interest using formula; solve liner equation of one variable and two variables; simplify the monomials, identify union, intersection and complement two sets, factorize algebraic expressions using $a^2 - b^2$; identify images after reflection, translation and rotation, find the mean and median of individual series.
2	395– 448	Students at level 2 can describe basic mathematical concept and relations, and calculate simple results using these concepts and relations. For example, students recognize congruent triangles, recognize rectangle, square and parallelogram, identify the pair of angles between parallels, calculate profit and loss percentage from verbal information, multiply simple index numbers convert rational and decimal to each other, identify regular polygon, solve linear equation of one variable.
1	< 395	Students at level 1 have very rudimentary understanding on mathematical concepts such as integers, fraction/decimals, percentage and operations as they perform very basic and only few direct calculations of results, mostly learnt in previous grades. For example, students of this level recognize two dimensional geometric shapes and three dimensional objects; add/subtract polynomials; multiply/divide monomials, calculate profit when cost price and selling price are given.

Proficiency levels for Nepali in Grade 8

In the same way, proficiency scale for Nepali was computed by taking the lower and higher levels of proficiency below 383 and above 605 respectively. Computing 4 levels of proficiencies of score from 383 to 605 (score range 222), we get 55.50 as the width of each of the four levels together with two extreme levels – below 383 and above 605. Table 11.3 presents the range of scores in each level of proficiency and Table 11.4 describes each proficiency level by stating what students can typically do at certain level.

Table 11.3: Proficiency levels and the score range in Nepali

Proficiency Level	Score	SE
Level 6 (Advanced)	605 <	0.038736
Level 5 (Proficient 3)	549–605	0.530654
Level 4 (Proficient 2)	494–549	0.759241
Level 3 (Proficient 1)	438–494	0.733396
Level 2 (Basic Level)	383–438	0.315963
Level 1 (Pre-basic)	< 383	0.126922

Table 11.4: Summary descriptions of the six proficiency levels on Nepali Scale of Grade 8

Level	Score range	Description
Level 1	<383	दिइएका अनुच्छेदको सीमित बोध गरी अनुच्छेदबाट सोधिएका के, कहाँ, को र कुन जस्ता सरल र सोझो उत्तर आउने प्रश्नको उत्तर दिन, सूची तयार गर्न र साधारण घटनाको क्रम मिलाएर सार्न।
Level 2	383-438	अनुच्छेदमा प्रयुक्त सूचनाको सामान्य बोध गर्न तथा सूचनाको पहिचान गरी सो का आधारमा प्रश्नको उत्तर दिन । नक्सामा प्रयुक्त चिन्हका आधारमा सही सूचना पहिचान गर्न। साधारण र सरल प्रकारका वाक्य वाक्य लेखन गर्न।
Level 3	438-494	अनुच्छेदको बोध गरी सोधिएका प्रश्नको कारण सहित उत्तर दिन, अप्रत्यक्ष सूचना पहिचान गर्न, सरल शब्दहरुको पयार्यवाची शब्द पहिचान गर्न, निर्देशन अनुसार ढाँचा मिलाई सामान्य स्तरको निर्देशित लेखन तथा सामान्य वाक्य रचना गर्न।
Level 4	494-549	अनुच्छेदको मुख्य विषय आसय पत्ता लगाउन। उपयुक्त शीर्षक चयन गर्न। निर्देशित जीवनी, प्रवन्ध/निबन्ध, कथा लेख्न । संवाद पूरा गर्न । दिइएका वाक्यमा उपयुक्त चिह्न प्रयोग र शुद्धाशुद्धि मिलाउन । चिठीको सामान्य स्तरको प्रत्युत्तर लेख्न र सामान्य स्तरको निवेदन तयार गर्न, चित्रको सामान्य लिखित वर्णन गर्न तथा वादविवादको विषयमा सामान्य तर्क प्रस्तुत गर्न।

Level	Score range	Description
Level 5	549-605	दिइएका घटनाका आधारमा साधारण समाचार र निर्देशित कविता तयार गर्न । अनुच्छेदको विषयवस्तुको वोध सहित तुलना गर्न, सो अनुसार तर्क दिन, मूल्याङ्कन गर्न । अनुच्छेदको साराशं लेख्न । उपयुक्त चिह्नको प्रयोग सहित व्याकरणीक रुपमा शुद्ध वाक्य रचना गर्न ।
Level 6	605 <	अनुच्छेदको पूर्ण बोध गरी त्यसमा प्रयुक्त पारिभाषिक/प्राविधिक शब्दको सन्दर्भगत अर्थ बताउन, अर्थ खुल्ने गरी वाक्यमा प्रयोग गर्न तथा उच्चस्तरीय व्यवहारिक लेखन क्षमता प्रस्तुत गर्न ।

Proficiency levels for science in Grade 8

Similarly, proficiency scale for Science was also computed by taking the lower and higher levels of proficiencies below 390 and above 575 respectively. Computing 4 levels of proficiencies of score from 390 to 575 (with the score range of 185), we get 46.25 as the width of each of the four levels together with two extreme levels – below 390 and above 575. Table 11.5 presents the range of scores in each level of proficiency and Table 11.6 describes each proficiency level by stating what students can typically do at certain level.

Table 11.5: Proficiency levels and the score range in Science

Level	Score	SE
Level 6 (Advanced)	575<	0.158
Level 5 (Proficient 3)	529-575	0.643
Level 4 (Proficient 2)	482– 529	0.829
Level 3 (Proficient 1)	436– 482	0.830
Level 2 (Basic)	390-436	0.692
Level 1 (Pre-basic)	<390	0.159

Table 11.6: Summary descriptions of the six proficiency levels on Science Scale of Grade 8

Level	Score	What students can typically do
6	575 <	Students of level 6 can analyse and justify the solution of complex problems in Science; such express the complete information about revolution period of moon and justify the reason behind redness of the sun during early morning.

5	529-575	Students of level 5 can apply the learnt concepts and relations in solving problems in a new situation, and analyse the solutions. For example, apply the concept of atmospheric pressure , cause of refraction of light and express the boiling point of water at sea level in Fahrenheit; state Mendeleev's periodic law, name of liquid metal, write molecular formula, use of sodium hydroxide and name of zero group of element. Reaction of vinegar and sodium carbonate. Draw a labelled diagram of life cycle of flowering plant and plant cell. Explain the importance of wild life conservation, relation of weather and climate, cause of growth of plant
4	482— 529	Students of level 4 have adequate knowledge and skills in science; they can describe the some complex concepts, and use basic concepts and relations in Science to solve the problems. For example, calculate the volume of irregular object and potential energy, analyse the relation of echo and distance, effect of temperature on gaseous molecule, sound produced by metal and non-metals Compare the image formed by plane and spherical mirror, new and full moon, open and closed circuit and wave length of two waves. Describe global environmental problems as acid rain, climate change and greenhouse effect. Analyse the relation of Carbon dioxide and photosynthesis; explain atomic structure, distinguish acid and base and write molecular formula of acids, bases and pollutant gases. Find molecular weight; describe the method of removing hardness of water Draw labelled diagram of animal cell and cubical epithelium and write function of cell organelles. Distinguish plant cell and animal cells, androecium and gynoecium, classify animals and plant, explain biodiversity, evolution of life and, describe the relation among cell, tissue and organ. Function of condenser in distillation; mention the type of asexual reproduction in mushroom and importance of vegetative propagation.

3	436— 482	Students of level 3 have basic knowledge and skills in Science; they can state and use concepts and simple relation in solving direct problems in science. For example, write the formula of relative velocity, calculate the distance by using equation of motion, explain the relation of height and atmospheric pressure, define, soft water, ore, work and mechanical advantage. Recall the atomic number, define select the method of separation of mixture classify lever, write relation of liquid pressure and density, Use method of conserving magnetic strength, distinguish heat and temperature, apply the concept of fundamental unit; write the conditions for seed germination, state reproductive part of a plant and write location of epithelial tissue, analyse the impacts of air pollution and soil erosion, write effects of monsoon, sustainable development, economic importance of forest and name of national parks of Nepal. Classify planet and satellite and name the climatic zones of Nepal.
2	390- 436	Students of level 2 have some basic scientific knowledge and skills of the grade level; they can define and state some of the terms and concepts in Science such as define acceleration, name the largest planet, and enlist factors for environmental degradation, example of medicinal plant and most useful metal for ornaments.
1	390	Students at level 1 have basic prerequisite knowledge and skills of recognize and recall the simple information and objects. For example, recognize medicinal plants; instruments used to measure length, mass, weight and time; define magnetic induction, distance, displacement, density of substances; give examples of different classes of lever, work and forms of energy, types of energy; list out the sources of heat, cell, acid, base and salt, natural resources and environment degradation; identify the use of metals in daily life, functions of different parts of plants and name of the members of solar system.

CHAPTER 12

NASA 2017 Results

12.1 Introduction

At the final stage of data analysis, subject-wise results of NASA were prepared. The results include basic results which cover proficiency definition and range of scores in each proficiency, provincial mean score and percentage of students in various proficiencies. Next, results based on the background variables were analysed in each subject. The analysis process is described in this chapter, but the main tables of results are included in annex (see annex 5).

12.2 Basic Results

As the basic results of NASA 2017 of Grade 8 students, the results in Mathematics, Nepali and Science are classified into six proficiency levels based on the transformed ability score – with 500 as the national mean. Average score of each province for each of the three subjects is also calculated and compared with the national mean. Using sample weights and reapplication, these results were estimated at population level.

12.3 Background Variables and Results Based on these Variables

After performing data cleaning and preliminary analysis, descriptive statistics were calculated for students' background variable related questionnaire in each subject. We calculated frequency, percentage distribution as well as mean and standard deviation for all items. Missing data were coded with 9. Next, factor analysis was carried out for some of the variables. Finally, correlational analysis was performed between student achievement and given background variable to explain the level of effects of background variables in students' achievement.

Results of every subject were generated separately in relation to several influencing factors of students' results. These influencing factors were taken from the variables included in

the student background questionnaire. First, frequencies were calculated to each of the categories of background questionnaire (see Annex 4), and then based on the frequencies the mean scores of selected categories were calculated (see Annex 5) and compared. Results in each subject were presented in the following variables with selected categories.

1 Geographical location of School
2 Students' gender
3 Students' age
4 Language spoken at home
5 Caste/Ethnicity
6 Identity with geography
7 Time spent on beyond school time
8 Support for study at home
9 Availability of textbook
10 Homework and feedback
11 Students' future aim
12 Attitude of student towards subject
13 Student's subject related activities in classroom
14 Mother's education
15 Mother's occupation
16 Father's education
17 Father's occupation
18 Home possession and accessories
19 Activities in leisure time at school
20 Attitude towards teacher
21 Attitude towards school
22 Bullying at school

12.4 Comparing the Overall Results of NASA 2017 with the Results of 2013

NASA 2013 score of Grade 8 is compared with NASA 2017 based on the Classical Test Theory (CTT), percentage of correct answers (p-value or facility index), using score of linking items, the raw scores of both NASA tests (2013 and 2017) of the linking items were transformed into z-score with zero mean. Then the standardized score was shifted into mean 500 and standard deviation 50, total for all students.

It should be noted that this comparison is based on the sample data. The data has not been weighted for the population, and result is based on linking items.

12.5 Provincial Results

Provincial results are prepared separately in each subject. The provincial results provide the opportunity of comparing the results in major variables. In each subject, provincial report begins with comparing overall mean scores of provinces and then presents the mean scores in relation to various influencing variables on the achievement of students.

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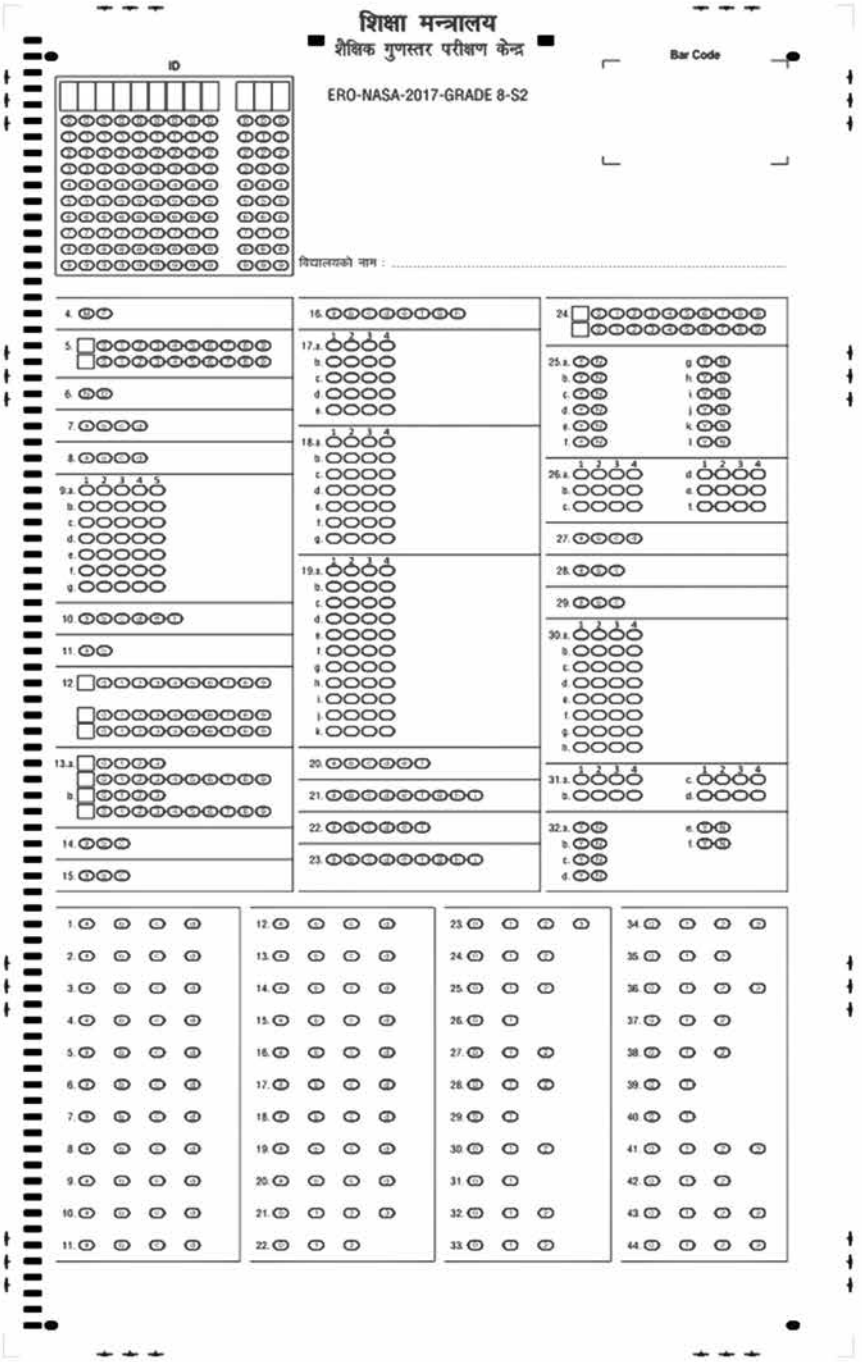
Annexes

Annex 1: OMR sheet (Example: Science set 2)



Annex 2: Test Administration Guidelines

विद्यार्थी उपलब्धिको राष्ट्रिय परीक्षण, २०७३ (कक्षा ८) सञ्चालनका लागि प्रधानाध्यापकलाई मार्गदर्शन

विद्यार्थी उपलब्धिको राष्ट्रिय परीक्षण, २०७३ (कक्षा ८) सञ्चालनका लागि प्रधानाध्यापकले निम्नानुसारको व्यवस्थापन तथा सहजीकरण गर्नु पर्नेछ :

१. परीक्षण २०७३ फागुन २१ गते दिनको ११ देखि १ बजेसम्म तोकिएको विद्यार्थी सङ्ख्यामा सञ्चालन गर्नु पर्ने छ ।

२. यो परीक्षणले विद्यार्थीलाई पास/फेल गर्ने वा शिक्षक/विद्यालयको मूल्याङ्कन गर्ने नभई विद्यार्थीले दिएका उत्तरका आधारमा सिकाइ उपलब्धिको राष्ट्रिय स्तर निर्धारण र शैक्षिक सुधारका लागि सहयोग गर्दछ । यस परीक्षणबाट विभिन्न आधारमा उपलब्धिको तुलना गर्न, सिकाइका कारक तत्वहरू पहिचान गर्न र सिकाइ उपलब्धि न्यून तथा उच्च भएका विद्यालयका बीचमा भएका भिन्नताहरू पहिचान गर्न सहयोग पुग्दछ । परीक्षणको यस्तो महत्वलाई ध्यान दिई यो परीक्षणमा विद्यार्थीले जानेका कुरा सही, स्वच्छ एवम् मर्यादित रुपले लेख्ने वातावरण सिर्जना गर्नु पर्नेछ ।

३. प्रश्नको उत्तर दिनका लागि विद्यार्थीलाई कसैले पनि सिकाउने वा सघाउने गर्न हुदैन भने विद्यार्थीहरूले पनि परीक्षण अवधिमा आपसमा कुराकानी तथा छलफल गर्न हुँदैन ।

४. यस परीक्षणमा प्रश्नावलीको गोपनीयता अत्यन्तै महत्वपूर्ण पक्ष हो । कुनै प्रश्नपत्र विद्यालय वा शिक्षकले राख्ने, कुनै प्रश्न वा प्रश्नपत्र कुनै माध्यमले सार्ने वा कपी गर्ने, फोटो खिच्ने वा फोटोकपी गर्नेजस्ता कुनै पनि कार्य गर्न हुँदैन । शैक्षिक गुणस्तर परीक्षण केन्द्र (ERO) द्वारा विद्यालयलाई उपलब्ध गराइएका प्रश्नपत्रहरूमध्ये केही प्रयोग नभएमा सुरक्षित साथ प्रश्न प्राप्त भएकै खाममा खामबन्दी गरी पठाउनु पर्नेछ । प्रश्नावलीहरू हराएमा, फोटो खिचिएको वा फोटोकपी गरी राखिएको पाइएमा संलग्नलाई नियमानुसार विभागीय कारवाही हुने पक्षमा सचेत गराउने, प्रयोग भएका र नभएका सबै प्रश्नावलीहरू अनिवार्य रुपमा गन्ती गरी फिर्ता गर्नु पर्नेछ ।

५. परीक्षण सञ्चालन भएको समयमा सम्बन्धित विषयको विषय शिक्षक परीक्षण सञ्चालन भएको कक्षामा प्रवेश नगरी अन्य शिक्षकहरुबाट परीक्षण सञ्चालन गर्नु पर्नेछ । तर विद्यालयमा जुन विषयको परीक्षण सञ्चालन हुने हो सो विषयको शिक्षकले नै शिक्षक प्रश्नावली भर्नु पर्नेछ ।

६. विद्यालयमा प्राप्त भएका प्रश्नावली सङ्ख्या भन्दा विद्यार्थी सङ्ख्या बढी भएमा Random Sampling विधिबाट तोकिएको सङ्ख्यामा विद्यार्थी छनौट गरी परीक्षण सञ्चालन गर्ने व्यवस्था मिलाउनु पर्नेछ । विद्यार्थी छनोट गर्दा छात्र र छात्राको अनुपात मिलाउनु पर्नेछ ।

७. प्रश्नावलीमा दुई ओटा खण्ड रहेका छन् । पहिलो खण्डमा विद्यार्थीको व्यक्तिगत तथा पारिवारिक विवरणसम्बन्धी प्रश्नावली र दोस्रो खण्डमा विषयगत प्रश्नहरू रहेका छन् । पहिलो खण्डका प्रश्नावलीमा निरीक्षकले विद्यार्थीलाई आवश्यक सहयोग गर्न सक्नेछन् । सबै विद्यार्थीले पहिलो खण्डको प्रश्नावली भरिसकेपछि प्रश्नावली यथास्थानमा राख्न लगाई ५ देखि १० मिनेटसम्म ब्रेक दिई सबैलाई एउटै समयबाट दोस्रो खण्डको विषयगत प्रश्नहरू (गणित, नेपाली र विज्ञानमध्ये कुनै एक विषयका प्रश्पत्रहरू हुनेछन्) हल गर्ने गरी परीक्षण सुरु गराउनु पर्नेछ ।

८. परीक्षणमा सहभागी हुने हरेक विद्यार्थीको लागि एउटा कालो मसी भएको एकै किसिमको डटपेन विद्यालयले उपलब्ध गराई (विद्यालयलाई उपलब्ध गराइएको मसलन्दबाट खरिद गर्ने) सोही डटपेन प्रयोग

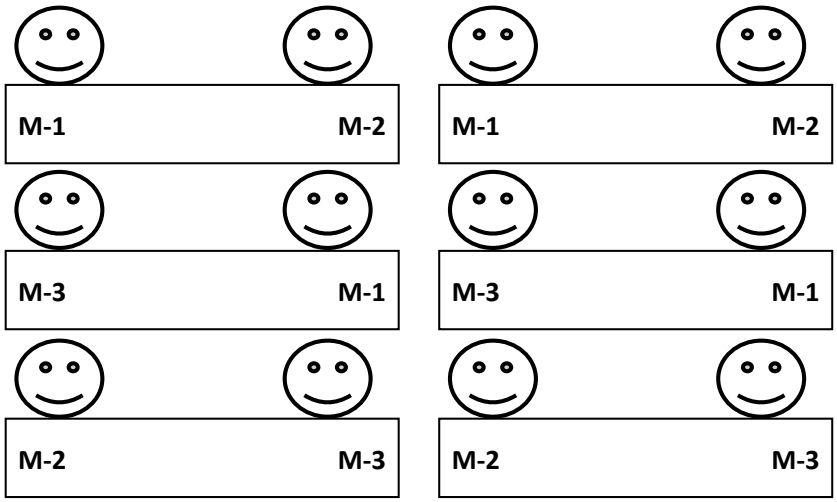
गरी उत्तर लेख्ने व्यवस्था मिलाउनु पर्नेछ ।

९. प्रश्नको उत्तर लेख्नको लागि प्रश्नावलीमा नै खाली ठाउँ दिइएको छ । सामान्यतया विद्यार्थीलाई थप खेस्रा उत्तरपुस्तिका आवश्यक पर्दैन । तर कुनै विद्यार्थीले थप उत्तरपुस्तिका खेस्राका लागि मागेमा विद्यालयले नै उपलब्ध गराउनु पर्नेछ ।

१०. एउटा बेञ्चमा बढीमा २ जना मात्र विद्यार्थी बस्ने गरी बसाइ व्यवस्था मिलाउनु पर्नेछ ।

११. प्रत्येक विषयमा ३ किसिमका प्रश्नपत्रका सेटहरू (Versions) उपलब्ध गराइएको छ । गणितमा प्रश्नका किसिमलाई M1, M2 र M3; नेपालीमा N1, N2 र N3 तथा विज्ञानमा S1, S2 र S3 सङ्केत गरिएको छ ।

१२. प्रश्नावली वितरण गर्दा ३ ओटै किसिमका सेटहरू क्रमशः पर्ने गरी वितरण गर्नु पर्नेछ । (तलको चित्रमा गणित विषयमा प्रश्नावली वितरणको एउटा नमूना दिइएको छ ।)



१३. विद्यार्थीले उत्तर लेखिसकेपछि निरीक्षकले प्रत्येक विद्यार्थीका भरिएको प्रश्नावली र उत्तरपुस्तिका दुवैलाई सँगै स्टिच गर्नु पर्नेछ ।

१४. प्रश्नावलीमा कुनै त्रुटी भेटिएमा प्र.अ./निरीक्षकले आफ्नो प्रतिवेदनमा सुझाव संलग्न गरी पठाउनु पर्नेछ तर प्रश्नहरू सच्याउने वा तत्काल कुनै निकायमा सोधखोज वा खबर गर्नु आवश्यक छैन ।

१५. परीक्षण समाप्त भएपछि उत्तरपुस्तिका तत्काल खामबन्दी गरी छिटो र सुरक्षित माध्यमबाट जिल्ला शिक्षा कार्यालयमा बुझाउनु पर्नेछ । उत्तरपुस्तिकाहरू बन्द गरिएको खामको बाहिर प्राप्त भएका, प्रयोग भएका र प्रयोग नभई फिर्ता भएका प्रश्नपत्रको सङ्ख्या तथा विद्यालयको कोड उल्लेख गर्नु पर्नेछ ।

१६. उत्तरपुस्तिका सँगै प्रधानाध्यापक र शिक्षकद्वारा भरिएका प्रश्नावलीहरू पनि जिल्ला शिक्षा कार्यालयमा बुझाउनु पर्नेछ ।

परीक्षण सम्बन्धमा थप जानकारी आवश्यक भएमा सम्पर्क:

- शैक्षिक गुणस्तर परीक्षण केन्द्र, सानोठिमी (०१६६३९५५६, ०१६६३९५५७), email id: eronasa@gmail.com

Annex 3: Scoring Guidelines

Selected response (SR items)

- Transfer students' response in each item in OMR sheets.
- If there are multiple responses of a student for a multiple chioce item, do not trasfer such responses in OMR sheet.

Constructed response items (CR items)

- Participate actively to the orientation programme organised for scorers.
- Study marking schemes or rubric.
- Participate in the discussion session with the marking coordinators and experts at the marking centre.
- Judge twice the answers against the schemes and provide appropriate point.
- Consult marking coordinators and experts at the marking centre afler making of with two answer sheets for their suggestion and confirmation.
- Provide whole number only (do not give scores in fraction or decimal.
- Transfer the score obtained by each student in OMR sheet after verification of score in each item.

Annex 4: Background Variables Based on Students' Responses in Mathematics, Nepali and Science

Variable	Categories	Maths		Nepali		Science	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Student gender	Boys	7406	47.8	7081	46.2	7248	47
	Girls	7983	51.6	8047	52.5	8042	52.2
	missing	93	0.6	199	1.3	125	0.8
	Total	15482	100	15327	100	15415	100
Language	Nepali	10094	65.2	10162	66.3	10240	66.4
	Other	5042	32.6	4659	30.4	4506	29.2
	missing	346	2.2	506	3.3	669	4.3
	Total	15482	100.0	15327	100	15415	100
Ethnicity	Brahmin/ chhetri	5472	35.3	5364	35	5579	36.2
	Janjati	5947	38.4	5886	38.4	5832	37.8
	Dalit	1858	12	2054	13.4	1939	12.6
	Other	1952	12.6	1717	11.2	1835	11.9
	missing	253	1.6	322	2.1	230	1.5
	Total	15482	100	15327	100	15415	100
Geography	Himali	890	5.7	843	5.5	848	5.5
	Hilly	9502	61.4	9503	62	9550	62
	Madhesi	4015	25.9	3724	24.3	3906	25.3
	Other	792	5.1	904	5.9	862	5.6
	missing	283	1.8	337	2.2	249	1.6
	Total	15482	100	15327	100	15415	100
Time spent on TV, Internet, Mobile, Compute	I Don't give time	3948	25.5	4046	26.4	3641	23.6
	less than 1 hour	8246	53.3	8108	52.9	8589	55.7
	1 to 2 hours	2065	13.3	1839	12	1989	12.9
	2 to 4 hour	220	1.4	184	1.2	226	1.5
	more than 4 hours	98	0.6	92	0.6	95	0.6
	missing	905	5.8	1073	7	875	5.7
	Total	15482	100	15327	100	15415	100

Time spent on playing and chating with friends	I Don't give time	2052	13.3	2161	14.1	2082	13.5
	less than 1 hour	9356	60.4	9181	59.9	9465	61.4
	1 to 2 hours	2616	16.9	2560	16.7	2561	16.6
	2 to 4 hour	393	2.5	291	1.9	327	2.1
	more than 4 hours	145	0.9	123	0.8	129	0.8
	missing	920	5.9	1012	6.6	851	5.5
	Total	15482	100	15327	100	15415	100
Time spent on playing games	I don't give time	2498	16.1	2468	16.1	2569	16.7
	less than 1 hour	7905	51.1	7817	51	7844	50.9
	1 to 2 hours	3224	20.8	3188	20.8	3278	21.3
	2 to 4 hour	563	3.6	567	3.7	514	3.3
	more than 4 hours	154	1	123	0.8	149	1
	missing	1138	7.4	1180	7.7	1061	6.9
	Total	15482	100	15327	100	15415	100
Time spent on household chores	I don't give time	1527	9.9	1410	9.2	1323	8.6
	less than 1 hour	4967	32.1	4751	31	4974	32.3
	1 to 2 hours	4892	31.6	4951	32.3	5097	33.1
	2 to 4 hour	1929	12.5	1977	12.9	1953	12.7
	more than 4 hours	837	5.4	782	5.1	802	5.2
	missing	1330	8.6	1471	9.6	1266	8.2
	Total	15482	100	15327	100	15415	100
Time spent on working for wages	I Don't give time	9580	61.9	9395	61.3	9756	63.3
	less than 1 hour	1665	10.8	1563	10.2	1598	10.4
	1 to 2 hours	1026	6.6	1027	6.7	932	6
	2 to 4 hour	574	3.7	552	3.6	539	3.5
	more than 4 hours	638	4.1	644	4.2	669	4.3
	missing	1999	12.9	2146	14	1921	12.5
	Total	15482	100	15327	100	15415	100
Time spent on reading a book for pleasure	I don't give time	1682	10.9	1425	9.3	1517	9.8
	less than 1 hour	6760	43.7	6606	43.1	6740	43.7
	1 to 2 hours	3758	24.3	3862	25.2	3855	25
	2 to 4 hour	1350	8.7	1349	8.8	1357	8.8

	more than 4 hours	632	4.1	659	4.3	651	4.2
	missing	1300	8.4	1410	9.2	1295	8.4
	Total	15482	100	15327	100	15415	100
Time spent on studying/ doing homework	I don't give time	604	3.9	521	3.4	421	2.7
	less than 1 hour	1689	10.9	1717	11.2	1631	10.6
	1 to 2 hours	4337	28	4046	26.4	4261	27.6
	2 to 4 hour	4631	29.9	4629	30.2	4771	31
	more than 4 hours	3308	21.4	3464	22.6	3425	22.2
	missing	913	5.9	950	6.2	906	5.9
	Total	15482	100	15327	100	15415	100
Student age	12 years or belw	783	5.1	796	5.193449	755	4.9
	13 years	3762	24.3	784	5.115156	3635	23.6
	14 years	5266	34.0	3614	23.5793	5119	33.2
	15 years	3283	21.2	4860	31.70875	3429	22.2
	16 years	1770	11.4	3412	22.26137	1833	11.9
	missing	618	4.0	1861	12.14197	644	4.2
	total	15482	100.0	15327	100	15415	100
Support for study beyond school time	father	1636	10.6	1717	11.2	1567	10.2
	mother	633	4.1	736	4.8	666	4.3
	brother/sister	6399	41.3	6606	43.1	6458	41.9
	tuition	3796	24.5	3188	20.8	3608	23.4
	friends	2052	13.3	2084	13.6	2159	14
	none	503	3.2	414	2.7	520	3.4
	missing	463	3	582	3.8	437	2.8
	Total	15482	100	15327	100	15415	100
Availability of textbook	yes	14700	94.9	14346	93.6	14435	93.6
	no	492	3.2	521	3.4	626	4.1
	missing	290	1.9	460	3	354	2.3
	Total	15482	100	15327	100	15415	100
Homework provided by teacher	every day	13175	85.1	11526	75.2	10770	69.9
	some times	1972	12.7	3372	22	4236	27.5
	never	77	0.5	77	0.5	105	0.7
	missing	258	1.7	353	2.3	304	2
	Total	15482	100	15327	100	15415	100

Feedback provided in homework	every day	11904	76.9	11250	73.4	10988	71.3
	some times	3152	20.4	3556	23.2	3895	25.3
	never	102	0.7	92	0.6	127	0.8
	missing	324	2.1	429	2.8	405	2.6
	Total	15482	100	15327	100	15415	100
Studnets' future aim	teacher	3389	21.9	3648	23.8	3290	21.3
	government employee	2805	18.1	2835	18.5	2718	17.6
	engineer	2477	16	2284	14.9	2427	15.7
	doctor	3658	23.6	3632	23.7	3765	24.4
	business man	788	5.1	736	4.8	815	5.3
	foreign employement	490	3.2	475	3.1	537	3.5
	farmer	409	2.6	368	2.4	410	2.7
	other	1155	7.5	966	6.3	1116	7.2
	missing	311	2	399	2.6	337	2.2
	Total	15482	100	15327	100	15415	100
Attitude towards subject: helps me in the daily life	fully agree	12360	79.8	11909	77.7	11719	76
	some how agree	2490	16.1	2744	17.9	3078	20
	some how disagree	190	1.2	169	1.1	206	1.3
	fully disagree	153	1	123	0.8	140	0.9
	missing	289	1.9	383	2.5	272	1.8
	Total	15482	100	15327	100	15415	100
Attitude towards subject: helps to learn other subjects too	fully agree	6426	41.5	10622	69.3	11719	76
	some how agree	3084	19.9	3510	22.9	3078	20
	some how disagree	359	2.3	506	3.3	206	1.3
	fully disagree	234	1.5	261	1.7	140	0.9
	missing	5379	34.7	429	2.8	272	1.8
	Total	15482	100	15327	100	15415	100
Attitude towards subject: Competency inthis subject helps to	fully agree	11637	75.2	9978	65.1	8775	56.9
	some how agree	2661	17.2	3678	24	5291	34.3
	some how disagree	474	3.1	828	5.4	651	4.2
	fully disagree	336	2.2	399	2.6	356	2.3

choose desirable subject in higher education	missing	374	2.4	444	2.9	342	2.2
	Total	15482	100	15327	100	15415	100
Attitude towards subject: Like to do activities related to the subject	fully agree	9628	62.2	9763	63.7	11649	75.6
	some how agree	4677	30.2	4123	26.9	2532	16.4
	some how disagree	569	3.7	644	4.2	539	3.5
	fully disagree	257	1.7	337	2.2	328	2.1
	missing	351	2.3	444	2.9	367	2.4
	Total	15482	100	15327	100	15415	100
Attitude towards ubjesct: Be competent in the subject to get a desirable job	fully agree	11711	75.6	9671	63.1	10349	67.1
	some how agree	2571	16.6	3862	25.2	3994	25.9
	some how disagree	509	3.3	843	5.5	441	2.9
	fully disagree	342	2.2	490	3.2	281	1.8
	missing	349	2.3	460	3	350	2.3
	Total	15482	100	15327	100	15415	100
Attitude towards the Learning of the subject: Often performed good in the subject	fully agree	8134	52.5	10576	69	11314	73.4
	some how agree	6281	40.6	3939	25.7	2699	17.5
	some how disagree	527	3.4	291	1.9	620	4
	fully disagree	187	1.2	123	0.8	397	2.6
	missing	353	2.3	414	2.7	385	2.5
	Total	15482	100	15327	100	15415	100
Attitude towards Learning of the subject: Want to learn the subject more at school	fully agree	12861	83.1	11557	75.4	8715	56.5
	some how agree	1825	11.8	2866	18.7	5824	37.8
	some how disagree	224	1.4	322	2.1	380	2.5
	fully disagree	211	1.4	153	1	157	1
	missing	361	2.3	429	2.8	339	2.2
	Total	15482	100	15327	100	15415	100
Attitude towards the Learning of the subject:	fully agree	11108	71.7	11817	77.1	12365	80.2
	some how agree	3254	21	2560	16.7	2226	14.4
	some how disagree	443	2.9	322	2.1	213	1.4

Enjoy learning the subject	fully disagree	230	1.5	169	1.1	264	1.7
	missing	447	2.9	460	3	347	2.3
	Total	15482	100	15327	100	15415	100
Attitude towards the Learning of the subject: Can learned the subject quickly	fully agree	5290	34.2	7863	51.3	11242	72.9
	some how agree	7981	51.6	5717	37.3	3099	20.1
	some how disagree	1266	8.2	828	5.4	375	2.4
	fully disagree	407	2.6	307	2	252	1.6
	missing	538	3.5	598	3.9	447	2.9
	Total	15482	100	15327	100	15415	100
Attitude towards the Learning of the subject: the subject is difficult for me	fully agree	2666	17.2	1962	12.8	5042	32.7
	some how agree	6221	40.2	4751	31	7968	51.7
	some how disagree	3257	21	3372	22	1368	8.9
	fully disagree	2698	17.4	4506	29.4	459	3
	missing	640	4.1	736	4.8	578	3.7
	Total	15482	100	15327	100	15415	100
Attitude towards the Learning of the subjec: I am not good in the subject	fully agree	2070	13.4	1763	11.5	2097	13.6
	some how agree	5034	32.5	3479	22.7	6209	40.3
	some how disagree	3486	22.5	3173	20.7	3503	22.7
	fully disagree	4174	27	6253	40.8	2904	18.8
	missing	718	4.6	659	4.3	702	4.6
	Total	15482	100	15327	100	15415	100
Attitude towards the learning of the subject: The subject is realy difficult	fully agree	2299	14.8	2222	14.5	1749	11.3
	some how agree	3333	21.5	2161	14.1	4762	30.9
	some how disagree	2490	16.1	2222	14.5	3576	23.2
	fully disagree	6770	43.7	8047	52.5	4576	29.7
	missing	590	3.8	659	4.3	752	4.9
	Total	15482	100	15327	100	15415	100
Classroom activities in the subject: Give attention	in all lessons	12152	78.5	12461	81.3	2120	13.8
	in half of the lessons	2085	13.5	1686	11	2942	19.1
	in some lessons	781	5	628	4.1	2626	17
	I never do	75	0.5	77	0.5	7082	45.9

to teacher presentation and exercise accordingly	missing	389	2.5	475	3.1	645	4.2
	Total	15482	100	15327	100	15415	100
Classroom activities in in the subject: Work in small group	in all lessons	5872	37.9	5288	34.5	11999	77.8
	in half of the lessons	4536	29.3	4767	31.1	2030	13.2
	in some lessons	3820	24.7	4000	26.1	876	5.7
	I never do	686	4.4	582	3.8	87	0.6
	missing	568	3.7	705	4.6	423	2.7
	Total	15482	100	15327	100	15415	100
Classroom activities in the subject: Describe our answer ourselves	in all lessons	5105	33	5978	39	5424	35.2
	in half of the lessons	4696	30.3	4399	28.7	4841	31.4
	in some lessons	4347	28.1	3648	23.8	3821	24.8
	I never do	736	4.8	444	2.9	777	5
	missing	598	3.9	858	5.6	552	3.6
	total	15482	100	15327	100	15415	100
Classroom activities in the subject: Engage in learning by manipulating instruments/ creative writing	in all lessons	4570	29.5	6621	43.2	5326	34.6
	in half of the lessons	4650	30	3755	24.5	4521	29.3
	in some lessons	4506	29.1	3617	23.6	4120	26.7
	I never do	1123	7.3	444	2.9	676	4.4
	missing	633	4.1	904	5.9	772	5
	Total	15482	100	15327	100	15415	100
Classroom activities in the subject: Practice cerative reading	in all lessons	4766	30.8	4246	27.7	5906	38.3
	in half of the lessons	4588	29.6	4016	26.2	3984	25.8
	in some lessons	4509	29.1	5441	35.5	3924	25.5
	I never do	898	5.8	705	4.6	783	5.1
	missing	721	4.7	920	6	818	5.3
	Total	15482	100	15327	100	15415	100
Classroom activities in the subject: Define a	in all lessons	3790	24.5	4659	30.4	3919	25.4
	in half of the lessons	2577	16.6	4767	31.1	4047	26.3
	in some lessons	3782	24.4	4307	28.1	4895	31.8

procedures/ methods to solve difficult problem ourselve	I never do	4607	29.8	751	4.9	1674	10.9
	missing	726	4.7	843	5.5	880	5.7
	Total	15482	100	15327	100	15415	100
Classroom activities in the subject: Solve problem ourselves	in all lessons	7340	47.4	5640	36.8	4305	27.9
	in half of the lessons	3961	25.6	4338	28.3	4467	29
	in some lessons	2928	18.9	3770	24.6	4774	31
	I never do	555	3.6	736	4.8	1119	7.3
	missing	698	4.5	843	5.5	750	4.9
	Total	15482	100	15327	100	15415	100
Classroom activities in the subject: Start homework at the classroom	in all lessons	4652	30	3801	24.8	5164	33.5
	in half of the lessons	4848	31.3	2498	16.3	4463	29
	in some lessons	4407	28.5	3372	22	4182	27.1
	I never do	860	5.6	4644	30.3	879	5.7
	missing	715	4.6	1012	6.6	727	4.7
	Total	15482	100	15327	100	15415	100
Classroom activities in the subject: Review our homework ourselves	in all lessons	5585	36.1	7326	47.8	3822	24.8
	in half of the lessons	4367	28.2	3265	21.3	2505	16.3
	in some lessons	3970	25.6	2636	17.2	3695	24
	I never do	722	4.7	1012	6.6	4413	28.6
	missing	838	5.4	1088	7.1	980	6.4
	Total	15482	100	15327	100	15415	100
Classroom activities in the subject: Self assessement of our task	in all lessons	5718	36.9	7771	50.7	7103	46.1
	in half of the lessons	4033	26	2483	16.2	3427	22.2
	in some lessons	4043	26.1	2483	16.2	2772	18
	I never do	947	6.1	1563	10.2	1091	7.1
	missing	741	4.8	1012	6.6	1022	6.6
	Total	15482	100	15327	100	15415	100

Classroom activities in the subject: Use of the subject in daily life	in all lessons	3429	22.1	8951	58.4	7707	50
	in half of the lessons	3570	23.1	3280	21.4	2834	18.4
	in some lessons	4851	31.3	2115	13.8	2589	16.8
	I never do	2959	19.1	322	2.1	1427	9.3
	missing	673	4.3	659	4.3	858	5.6
	Total	15482	100	15327	100	15415	100
Mother's education	illitrate	4806	31	5027	32.8	4759	30.9
	literate only	6013	38.8	6146	40.1	6239	40.5
	grade 10	2756	17.8	2498	16.3	2609	16.9
	grade 12	849	5.5	705	4.6	905	5.9
	bachelors	415	2.7	291	1.9	371	2.4
	masters level or higher	145	0.9	138	0.9	138	0.9
	missing	498	3.2	506	3.3	394	2.6
	Total	15482	100	15327	100	15415	100
Father's education	illitrate	2227	14.4	2207	14.4	2106	13.7
	literate only	5487	35.4	5732	37.4	5462	35.4
	grade 10	4444	28.7	4338	28.3	4471	29
	grade 12	1748	11.3	1456	9.5	1771	11.5
	bachelors	770	5	659	4.3	690	4.5
	masters level or higher	389	2.5	399	2.6	475	3.1
	missing	417	2.7	521	3.4	440	2.9
	Total	15482	100	15327	100	15415	100
Mother's occupation	agriculture and household work	9149	59.1	9518	62.1	9014	58.5
	household work only	3203	20.7	2897	18.9	3243	21
	work in other's house	164	1.1	123	0.8	137	0.9
	labor	161	1	153	1	186	1.2
	foreign country	278	1.8	230	1.5	300	1.9
	teaching	317	2	307	2	325	2.1
	business	1125	7.3	1012	6.6	1203	7.8
	government job	274	1.8	245	1.6	296	1.9

	other	313	2	812	5.3	711	4.6
	missing	498	3.2				
	Total	15482	100	15327	100	15415	100
Father's occupation	agriculture and household work	4690	30.3	4981	32.5	4585	29.7
	household work only	409	2.6	383	2.5	328	2.1
	work in other's house	309	2	276	1.8	261	1.7
	labor	1041	6.7	1073	7	1039	6.7
	foreign country	3672	23.7	3587	23.4	3779	24.5
	teaching	483	3.1	460	3	494	3.2
	business	2202	14.2	1977	12.9	2282	14.8
	government job	1146	7.4	1012	6.6	1180	7.7
	other	1000	6.5	1579	10.3	1467	9.5
	missing	530	3.4				
	Total	15482	100	15327	100	15415	100
Home possession: Table	No	4527	29.2	4475	29.2	3876	25.1
	Yes	10955	70.8	10852	70.8	11539	74.9
	Total	15482	100	15327	100	15415	100
Home possession: Study Room	No	6226	40.2	5794	37.8	5517	35.8
	Yes	9256	59.8	9533	62.2	9898	64.2
	Total	15482	100	15327	100	15415	100
Home possession: Separate place to read	No	5274	34.1	4859	31.7	4607	29.9
	Yes	10208	65.9	10468	68.3	10808	70.1
	Total	15482	100	15327	100	15415	100
Home possession: Computer	No	11587	74.8	11894	77.6	11417	74.1
	Yes	3895	25.2	3433	22.4	3998	25.9
	Total	15482	100	15327	100	15415	100
Home possession: Software for learning	No	13038	84.2	13166	85.9	12974	84.2
	Yes	2444	15.8	2161	14.1	2441	15.8
	Total	15482	100	15327	100	15415	100
Home possession: Internet	No	12057	77.9	12308	80.3	11930	77.4
	Yes	3425	22.1	3019	19.7	3485	22.6
	Total	15482	100	15327	100	15415	100

Home possession: Magazine	No	11380	73.5	11204	73.1	11089	71.9
	Yes	4102	26.5	4123	26.9	4326	28.1
	Total	15482	100	15327	100	15415	100
Home possession: Former literature	No	11766	76	11618	75.8	11432	74.2
	Yes	3716	24	3709	24.2	3983	25.8
	Total	15482	100	15327	100	15415	100
Home possession: Books (story, poem)	No	7253	46.8	6775	44.2	6701	43.5
	Yes	8229	53.2	8552	55.8	8714	56.5
	Total	15482	100	15327	100	15415	100
Home possession: Artistic materials	No	9683	62.5	9457	61.7	9367	60.8
	Yes	5799	37.5	5870	38.3	6048	39.2
	Total	15482	100	15327	100	15415	100
Home possession: Reference book	No	7347	47.5	7403	48.3	6976	45.3
	Yes	8135	52.5	7924	51.7	8439	54.7
	Total	15482	100	15327	100	15415	100
Home possession: Dictionary	No	9151	59.1	9748	63.6	8888	57.7
	Yes	6331	40.9	5579	36.4	6527	42.3
	Total	15482	100	15327	100	15415	100
Home accessories: Mobile Phone	None	1197	7.7	1778	11.6	1599	10.4
	one	2771	17.9	2897	18.9	2898	18.8
	two	5100	32.9	4981	32.5	5041	32.7
	three or more	5790	37.4	5671	37	5877	38.1
	missing	624	4				
	Total	15482	100	15327	100	15415	100
Home accessories: Television	None	4804	31	6882	44.9	6432	41.7
	one	7521	48.6	7158	46.7	7456	48.4
	two	1220	7.9	1119	7.3	1324	8.6
	three or more	199	1.3	169	1.1	203	1.3
	missing	1738	11.2				
	Total	15482	100	15327	100	15415	100
Home accessories: Computer	None	9160	59.2	12200	79.6	11971	77.7
	one	3023	19.5	2682	17.5	2944	19.1
	two	372	2.4	353	2.3	387	2.5

	three or more	115	0.7	92	0.6	113	0.7
	missing	2812	18.2				
	Total	15482	100	15327	100	15415	100
Home accessories: Motorcycle	None	8971	57.9	11924	77.8	11907	77.2
	one	3088	19.9	2881	18.8	2935	19
	two	464	3	414	2.7	456	3
	three or more	133	0.9	107	0.7	117	0.8
	missing	2826	18.3				
	Total	15482	100	15327	100	15415	100
Home accessories: Car	None	11419	73.8	14714	96	14769	95.8
	one	533	3.4	506	3.3	531	3.4
	two	76	0.5	61	0.4	78	0.5
	three or more	54	0.3	46	0.3	37	0.2
	missing	3400	22				
	Total	15482	100	15327	100	15415	100
Home accessories: Pakki house	None	6431	41.5	8859	57.8	8632	56
	one	6084	39.3	5671	37	5928	38.5
	two	677	4.4	598	3.9	630	4.1
	three or more	244	1.6	199	1.3	225	1.5
	missing	2046	13.2				
	Total	15482	100	15327	100	15415	100
Activities in leisure time at school	class work or home work	7662	49.5	7847	51.2	8029	52.1
	group work	2431	15.7	2253	14.7	2194	14.2
	play	1357	8.8	1257	8.2	1309	8.5
	mostly classes are regular	3263	21.1	3464	22.6	3518	22.8
	missing	769	5	506	3.3	365	2.4
	Total	15482	100	15327	100	15415	100
Frequency of extra activities at school	happens regularly	5679	36.7	5579	36.4	3755	24.4
	happens sometimes	9256	59.8	9120	59.5	6215	40.3
	never happens	162	1	138	0.9	110	0.7
	missing	385	2.5	490	3.2	5335	34.6
	Total	15482	100	15327	100	15415	100

Frequency of participation in extra activities	1 regularly	4377	28.3	4230	27.6	4480	29.1
	2 some times	9827	63.5	9871	64.4	9669	62.7
	3 never	919	5.9	766	5	890	5.8
	missing	359	2.3	475	3.1	376	2.4
	Total	15482	100	15327	100	15415	100
Attitudes towards teacher: Teachers are	fully agree	11579	74.8	11679	76.2	11350	73.6
	some how agree	3081	19.9	2835	18.5	3289	21.3
	some how disagree	271	1.8	261	1.7	262	1.7
friendly with studnets	fully disagree	156	1	123	0.8	154	1
	missing	395	2.6	429	2.8	360	2.3
	Total	15482	100	15327	100	15415	100
Attitudes towards teacher: Teachers wish for students' welfare	fully agree	13077	84.5	12905	84.2	12940	83.9
	some how agree	1593	10.3	1609	10.5	1669	10.8
	some how disagree	256	1.7	230	1.5	267	1.7
	fully disagree	140	0.9	153	1	159	1
	missing	416	2.7	444	2.9	380	2.5
	Total	15482	100	15327	100	15415	100
Attitudes towards teacher: Most of the teachers listen me	fully agree	8592	55.5	8690	56.7	8364	54.3
	some how agree	5423	35	5165	33.7	5527	35.9
	some how disagree	674	4.4	674	4.4	708	4.6
	fully disagree	238	1.5	230	1.5	280	1.8
	missing	555	3.6	552	3.6	536	3.5
	Total	15482	100	15327	100	15415	100
Attitudes towards teacher: Teacchers help students' if needed	fully agree	11543	74.6	12001	78.3	11636	75.5
	some how agree	2833	18.3	2406	15.7	2728	17.7
	some how disagree	344	2.2	261	1.7	318	2.1
	fully disagree	190	1.2	138	0.9	180	1.2
	missing	572	3.7	521	3.4	553	3.6
	Total	15482	100	15327	100	15415	100

Attitudes towards teacher: Teachers treat students' fairly	fully agree	8294	53.6	8215	53.6	7977	51.7
	some how agree	3457	22.3	3219	21	3511	22.8
	some how disagree	1071	6.9	1073	7	1258	8.2
	fully disagree	1791	11.6	2038	13.3	1865	12.1
	missing	869	5.6	766	5	804	5.2
	Total	15482	100	15327	100	15415	100
Attitudes towards teacher: Physical punishment is not	fully agree	5556	35.9	5410	35.3	5057	32.8
	some how agree	5078	32.8	4920	32.1	5211	33.8
	some how disagree	1995	12.9	1870	12.2	2159	14
	fully disagree	1995	12.9	2360	15.4	2211	14.3
practiced	missing	858	5.5	766	5	777	5
	Total	15482	100	15327	100	15415	100
Attitudes towards teacher: Teachers stay full time in classroom	fully agree	9648	62.3	9871	64.4	9520	61.8
	some how agree	3748	24.2	3418	22.3	3805	24.7
	some how disagree	846	5.5	828	5.4	852	5.5
	fully disagree	456	2.9	460	3	472	3.1
	missing	784	5.1	751	4.9	766	5
	Total	15482	100	15327	100	15415	100
Attitudes towards teacher: Scolding is not practiced by teachers	fully agree	5028	32.5	5257	34.3	4802	31.2
	some how agree	5427	35.1	4981	32.5	5148	33.4
	some how disagree	2104	13.6	2038	13.3	2360	15.3
	fully disagree	2212	14.3	2406	15.7	2448	15.9
	missing	711	4.6	644	4.2	657	4.3
	Total	15482	100	15327	100	15415	100
Attitudes towards school: Happy to come to school	fully agree	13704	88.5	13702	89.4	4802	31.2
	some how agree	994	6.4	843	5.5	5148	33.4
	some how disagree	159	1	153	1	2360	15.3
	fully disagree	222	1.4	215	1.4	2448	15.9
	missing	403	2.6	429	2.8	657	4.3
	Total	15482	100	15327	100	15415	100

Attitudes towards school: Friends are ready to support	fully agree	11073	71.5	11219	73.2	13529	87.8
	some how agree	3444	22.2	3203	20.9	1136	7.4
	some how disagree	307	2	291	1.9	151	1
	fully disagree	178	1.1	138	0.9	232	1.5
	missing	480	3.1	475	3.1	367	2.4
	Total	15482	100	15327	100	15415	100
Attitudes towards school: Teachers are ready to support student	fully agree	12795	82.6	12875	84	10478	68
	some how agree	1831	11.8	1625	10.6	4004	26
	some how disagree	234	1.5	245	1.6	354	2.3
	fully disagree	132	0.9	123	0.8	139	0.9
	missing	490	3.2	444	2.9	440	2.9
	Total	15482	100	15327	100	15415	100
Attitudes towards school: Teachers wish to student do better	fully agree	13910	89.8	13810	90.1	13754	89.2
	some how agree	757	4.9	720	4.7	868	5.6
	some how disagree	158	1	138	0.9	149	1
	fully disagree	199	1.3	199	1.3	204	1.3
	missing	458	3	475	3.1	440	2.9
	Total	15482	100	15327	100	15415	100
Bullying at school: Something of mine was stolen	happened	3009	19.4	3004	19.6	7802	50.6
	not happened	11924	77	11771	76.8	2147	13.9
	missing	549	3.5	552	3.6	5466	35.5
	Total	15482	100	15327	100	15415	100
Bullying at school: Others students hit or hurt me	happened	2213	14.3	2192	14.3	8365	54.3
	not happened	12683	81.9	12553	81.9	1513	9.8
	missing	586	3.8	598	3.9	5537	35.9
	Total	15482	100	15327	100	15415	100
Bullying at school: Other students forced me to do, what I don't like	happened	1810	11.7	1732	11.3	12937	83.9
	not happened	13007	84	12997	84.8	1805	11.7
	missing	665	4.3	613	4	673	4.4
	Total	15482	100	15327	100	15415	100

Bullying at school: Others students teased, harrased me	happened	2823	18.2	2835	18.5	11771	76.4
	not happened	11955	77.2	11786	76.9	2924	19
	missing	704	4.5	705	4.6	720	4.7
	Total	15482	100	15327	100	15415	100
Bullying at school: Other students excluded me from various activities	happened	1539	9.9	1456	9.5	13067	84.8
	not happened	13281	85.8	13227	86.3	1607	10.4
	missing	662	4.3	659	4.3	741	4.8
	Total	15482	100	15327	100	15415	100
Bullying at school: Others students called me by nickname	happened	3395	21.9	3326	21.7	9867	64
	not happened	11484	74.2	11419	74.5	2383	15.5
	missing	603	3.9	598	3.9	3165	20.5
	Total	15482	100	15327	100	15415	100

Annex 5: Selected Tables of NASA Results 2017 for grade 8 in Mathematics, Nepali and Science

Mathematics

Mean score by province in Math					
	Mean	**SE**	**n_stu**	**Upper**	**Lower**
National	499.48	1.567	15482	502.547	496.404
Prov 1	485.68	3.606	2308	492.748	478.613
Prov 2	500.94	4.118	2006	509.013	492.870
Prov 3	519.62	3.639	3276	526.748	512.483
Prov 4	514.35	3.677	1809	521.557	507.142
Prov 5	501.35	3.445	3229	508.104	494.601
Prov 6	467.19	3.625	1432	474.297	460.087
Prov 7	479.52	3.579	1422	486.532	472.503
Mean score by gender in math					
Gender	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Boy	504.92	1.683	7406	508.214	501.616
Girl	494.73	1.594	7983	497.857	491.608
Missing			93	490.164	458.665
Mean score by ethnicity in math					
Ethnicity	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Brahman/Chhetri	508.25	2.230	5472	512.622	503.880
Janjati	497.58	1.756	5947	501.022	494.140
Dalit	482.35	1.975	1858	486.225	478.481
Others	500.40	3.073	1952	506.422	494.376
Missing			253		
Mean score by geographical identity in Math					
Geography	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Himali	497.66	3.171	890	503.875	491.445
Hilly	501.88	1.848	9502	505.496	498.254
Madhesi	497.83	2.487	4015	502.707	492.957
Others	484.54	3.383	792	491.173	477.911
Missing			283		
Mean score by age group in Math					
Age	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
12 years or belw	504.24	2.566	783	509.267	499.209
13 years	505.97	1.930	3762	509.754	502.186
14 years	505.90	1.878	5266	509.579	502.218

15 years	493.36	1.673	3283	496.640	490.080
16 years	480.35	1.725	1770	483.728	476.965
Missing			618		
Mean score by mother's education in Math					
Mother's education	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Illitrate	486.28	1.492	4806	489.205	483.356
Literate	497.27	1.477	6013	500.161	494.371
Grade 10	515.46	2.257	2756	519.882	511.033
Grade 12	528.51	3.211	849	534.806	522.218
Bachelor's	544.21	5.070	415	554.148	534.273
Master's or above	539.44	7.809	145	554.742	524.129
Missing			498		
Mean score by fathers education in Math					
Father's education	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Illitrate	477.90	1.640	2227	481.115	474.685
Literate	492.58	1.458	5487	495.440	489.724
Grade 10	503.85	1.791	4444	507.361	500.341
Grade 12	517.98	2.525	1748	522.928	513.031
Bachelor's	539.22	3.469	770	546.020	532.420
Master's or above	546.49	4.561	389	555.432	537.551
Missing	471.12	3.625	417	478.222	464.013
Mean score by mother's occupation in Math					
Mother's occupation	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Agriculture and household work	490.99	1.419	9149.000	493.775	488.213
Household work only	514.10	2.285	3203.000	518.582	509.624
Work in other's house	497.50	5.015	164.000	507.332	487.674
Labour	497.58	4.383	161.000	506.167	488.985
Foreign country	508.29	3.510	278.000	515.164	501.406
Teaching	528.78	4.398	317.000	537.398	520.160
Business	520.43	2.559	1125.000	525.444	515.412
Government job	520.21	4.710	274.000	529.438	510.976
Other	529.48	4.239	313.000	537.790	521.172
Missing			498.000		
Mean score by father's occupation in Math					
Father's occupation	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Agriculture and household work	484.44	1.496	4690	487.368	481.502
Household work only	479.48	3.030	409	485.422	473.544

Work in other's house	479.78	3.029	309	485.720	473.848
labour	495.61	2.252	1041	500.019	491.193
Foreign country	501.76	1.877	3672	505.442	498.082
Teaching	519.66	3.372	483	526.272	513.052
Business	518.27	2.541	2202	523.248	513.288
Government job	517.13	2.780	1146	522.577	511.679
Other	523.96	2.931	1000	529.702	518.212
Missing	477.64	3.209	530	483.925	471.347
Mean score by time spend household chores in Mathematics					
Time spent in household chores	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Missing			1330		
Don't give time	503.86	2.8194	1527	509.391	498.339
Less than 1 hour	508.51	1.9728	4967	512.372	504.639
One to two hours	501.84	1.7069	4892	505.185	498.494
Two to four hours	492.04	1.7070	1929	495.382	488.690
More than four hours	479.09	2.0466	837	483.103	475.080
Mean score by support to the students in Mathematics					
Support to the students	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Father	497.11	2.4541	1636	501.922	492.302
Mother	491.81	3.1411	633	497.969	485.656
Brother/Sister	497.98	1.6827	6399	501.277	494.681
Tuition	507.14	1.8273	3796	510.723	503.561
Friends	496.77	2.2370	2052	501.151	492.382
None	501.92	4.0137	503	509.792	494.058
Missing			463		
SE of percentages in proficiency levels in Mathematics					
Proficiency level	**Stu_percent**	**SE**	**n_stu**	**Upper**	**Lower**
1 (Pre-basic)	2.13	0.33	327	below 395	
2 (Basic)	12.86	0.79	2020	448	395
3 (Proficient 1)	31.26	0.9	4785	501	448
4 (Proficient 2)	38.81	1.01	5902	553	501
5 (Proficient 3)	14.10	0.72	2155	606	553
6 (Advanced)	0.84	0.13	121	above 606	
	100.0		15310		
Mean score by language in Mathematics					
Language	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Nepali	503.45	1.883414	10094	507.139	499.756
Other	492.54	1.949318	5042	496.362	488.721

Missing			346		
Mean score by influence of bullying in Mathematics					
Influence of bullying	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
No any one	499.52	1.592	7978	502.636	496.396
low bullying	502.65	1.835	5008	506.243	499.049
Medium bullying	499.15	2.488	1740	504.028	494.274
High bullying	482.93	3.589	405	489.963	475.893
Missing			351		
Mean score by use of leisure time in Mathematics					
Use of leisure time	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Classwork/homework	498.90	1.661	7662	502.154	495.643
Group work	504.39	2.331	2431	508.963	499.824
Playing	485.60	2.439	1357	490.380	480.821
No leisure class	509.79	2.344	3263	514.382	505.194
Missing			769		
Mean score by availability of text book in Mathematics					
Availability of text book	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Yes	501.14	1.571	14700	504.216	498.058
No	469.65	2.986	492	475.506	463.800
Missing			290		
Mean score in Mathematics by TV watching time					
Support to the students	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Not given time	489.50	1.752	3948	492.930	486.064
Less than an hours	503.29	1.749	8246	506.713	499.857
One-two hours	515.91	2.734	2065	521.274	510.556
Two-four hours	504.71	5.267	220	515.032	494.384
More than four hours	489.43	5.734	98	500.666	478.187
Missing			905		
Mean score in Mathematics by school type					
Type of school	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Community	485.32	1.376	11831	488.020	482.626
Institutional	547.47	2.435	3651	552.240	542.696
Mean score in Mathematics by homework given					
Type of school	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Every day	501.74	1.619	13175	504.919	498.571
Sometimes	487.84	2.332	1972	492.412	483.273
Never	490.63	8.034	77	506.378	474.884
Missing			258		

Mean score in Mathematics by feedback given.					
Type of school	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Every day	499.61	1.560	11904	502.667	496.552
Sometimes	501.68	2.370	3152	506.330	497.039
Never	497.90	8.415	102	514.391	481.402
Missing			324		

Nepali

Mean score by province in Nepali					
	Mean	**SE**	**n-stu**	**Upper**	**Lower**
National	500.00	1.118	15327	502.191	497.809
Prov 1	491.54	3.076	2278	497.566	485.508
Prov 2	477.88	3.207	1948	484.167	471.595
Prov 3	517.86	2.349	2829	522.461	513.255
Prov 4	510.84	2.595	1819	515.923	505.749
Prov 5	500.54	2.326	3183	505.094	495.978
Prov 6	492.33	3.351	1413	498.894	485.760
Prov 7	496.26	2.316	1857	500.798	491.718
Mean score by gender in Nepali					
Gender	**Mean**	**SE**	**n_st**	**Upper**	**Lower**
Boy	499.83	1.179	7082	502.136	497.516
Girl	500.93	1.240	8061	503.358	498.498
Missing			184		
Mean score by ethnicity in Nepali					
Ethnicity	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Bhraman/Chettri	514.23	1.338	5252	516.852	511.606
Janjati	497.58	1.338	5944	500.205	494.961
Dalit	490.54	1.712	2034	493.897	487.187
Other	482.69	2.156	1784	486.921	478.467
Missing			313		
Mean score by geographical identity in Nepali					
Gegraphy	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Himali	504.40	2.664	772	509.623	499.181
Hilly	509.54	1.142	9138	511.779	507.303
Madhesi	480.11	2.025	4088	484.078	476.140
Other	493.43	2.800	993	498.915	487.941
Missing			336		

Mean score by age group in Nepali					
Age	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Missing	472.30	3.7554	796	479.6576	464.9364
12 & below	501.85	2.4318	784	506.6174	497.0846
13	510.25	1.2870	3614	512.7695	507.7245
14	507.03	1.2826	4860	509.5419	504.5141
15	495.33	1.3084	3412	497.8894	492.7606
16 & above	481.51	1.7667	1861	484.9758	478.05018
Mean score by mothers education in Nepali					
Mothers education	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Illiterate	488.538	1.3829	5009	491.2486	485.8274
Literate Only	506.079	1.0339	6100	508.1054	504.0526
Grade 10	510.108	1.4979	2539	513.0438	507.1722
Grade 12	518.798	2.3559	725	523.4155	514.1805
Bachelor	526.059	3.3525	309	532.6299	519.4881
Master's & above	514.79	6.0899	145	526.7262	502.8538
Missing			500		
Mean score by father's education in Nepali					
Father's education	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Illiterate	482.023	1.617689	2206	485.1937	478.85233
Literate Only	502.696	1.061859	5657	504.7772	500.61476
Grade 10	502.649	1.255331	4379	505.1094	500.18855
Grade 12	509.966	1.8014	1489	513.4967	506.43526
Bachelor	527.504	2.438441	671	532.2833	522.72466
Master&above	524.702	3.189808	412	530.954	518.44998
Missing			513		
Mean score by mothers occupation in Nepali					
Mothers occupation	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Agriculture & household	497.401	1.10518	9364	499.5672	495.23485
Household only	505.651	1.701167	3007	508.9853	502.31671
Work in other's home	491.925	5.486386	136	502.6783	481.17168
Labor	517.488	4.741604	156	526.7815	508.19446
Foreign country	509.166	3.443657	246	515.9156	502.41643
Teaching	521.064	3.414777	315	527.757	514.37104
Business	515.362	1.803586	1045	518.897	511.82697
Government job	518.237	3.585364	247	525.2643	511.20969
Other/Missing	473.047	4.51694	811	481.9002	464.1938

Mean score by father's occupation in Nepali					
Father's occupation	**Mean**	**SE**	**n_nstu**	**Upper**	**Lower**
Agriculture & household	490.43	1.329	4836	493.031	487.821
Household only	478.57	3.493	389	485.418	471.726
Work in other's home	485.94	3.311	285	492.426	479.448
Labor	504.84	1.942	1068	508.643	501.031
Foreign country	504.58	1.183	3661	506.903	502.265
Teaching	516.92	2.880	452	522.568	511.278
Business	510.27	1.572	2026	513.353	507.189
Government job	516.39	2.069	1012	520.440	512.330
Other/Missing	496.05	3.025	1598	501.976	490.120
Mean score by time spent on household chores in Nepali					
Time spend in household chores	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Missing			1030		
Don't give time	497.95	1.420	3951	500.731	495.165
Less than 1 hour	503.32	1.183	8217	505.639	501.001
one to two hours	507.02	1.890	1855	510.724	503.316
two to four hours	494.15	4.690	186	503.346	484.960
More than four hours	469.08	6.546	88	481.908	456.246
Mean score by support to the students in Nepali					
Support to the students	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Father	494.36	1.953	1708	498.185	490.531
Mother	494.52	2.714	737	499.838	489.200
Brother/Sister	503.64	1.198	6549	505.990	501.296
Tuition	503.52	1.474	3244	506.405	500.629
Friends	498.54	1.438	2101	501.361	495.723
None	506.00	3.292	406	512.452	499.548
Missing			582		
SE of percentages in proficiency levels in Nepali					
Proficiency level	**Stu_percent**	**SE**	**n_stu**	**Upper**	**Lower**
1 (Pre-basic)	0.5	0.126922	75	below 383	
2 (Basic)	4.7	0.315963	717	438	383
3 (Proficient 1)	26.1	0.733396	3996	494	438
4 (Proficient 2)	58.4	0.759241	8878	549	494
5 (Proficient 3)	10.1	0.530654	1537	605	549
6 (Advanced)	0.2	0.038736	20	above 605	
	100.0		15223		

Mean score by language in Nepali					
Language	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Nepali	510.37	1.104	10036	512.535	508.207
Other	481.61	1.787	4798	485.112	478.108
Missing			493		
Mean score by influence of bullying in Nepali					
Influence of bullying	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
No any one	503.40	1.108	7885	505.568	501.224
Low bullying	505.17	1.306	4949	507.726	502.608
Medium bullying	490.07	2.093	1712	494.170	485.968
High bullying	471.73	4.366	384	480.285	463.173
Missing			397		
Mean score by use of leisure time in Nepali					
Use of leisure time	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Classwork/homework	499.53	1.138	7901	501.757	497.295
Group work	507.07	1.821	2216	510.634	503.496
Playing	485.89	2.347	1274	490.490	481.288
No leisure class	509.54	1.384	3452	512.255	506.829
Missing			484		
Mean score by availability of textbook in Nepali					
Availability of textbook	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Yes	502.26	1.062	14370	504.339	500.177
No	479.11	3.310	524	485.595	472.619
Missing			433		
Mean score in Nepali by TV watching time					
Support to the students	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
not given time	497.95	1.420	3951	500.731	495.165
less than an hour	503.32	1.183	8217	505.639	501.001
one-two hours	507.02	1.890	1855	510.724	503.316
two-four hours	494.15	4.690	186	503.345	484.961
more than four hours	469.08	6.546	88	481.907	456.247
Missing			1030		
Mean score in Nepali by school type					
Type of school	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Community	495.00	1.164	12128	497.277	492.715
Institutional	519.90	2.168	3199	524.148	515.650

Mean score in Nepali by homework given.					
Type of school	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Everyday	501.52	1.149	11428	503.771	499.269
Sometimes	500.18	1.626	3476	503.366	496.992
Never	477.21	7.513	80	491.930	462.480
Missing			343		
Mean score in Nepali by feedback given					
Type of school	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
everyday	502.25	1.091	11208	504.387	500.111
sometimes	500.18	1.576	3615	503.265	497.089
Never	465.03	9.296	91	483.250	446.810
Missing			413		

Science

Mean score by province in Science					
Province	**Mean**	**SE**	**n-stu**	**Upper**	**Lower**
National	500	1.389	15415	503.187	497.741
Prov 1	483.11	2.920	2240	488.837	477.392
Prov 2	487.61	3.506	1988	494.482	480.738
Prov 3	528.63	3.160	2847	534.820	522.434
Prov 4	518.06	3.336	1821	524.601	511.524
Prov 5	497.57	2.544	3182	502.556	492.582
Prov 6	484.30	4.261	1461	492.656	475.952
Prov 7	488.00	3.641	1876	495.140	480.868
Mean score by gender in Science					
Gender	**Mean**	**SE**	**n_st**	**Upper**	**Lower**
Girl	498.14	1.502	8042	501.080	495.193
Boy	503.36	1.443	7248	506.184	500.528
Missing			125		
Mean score by ethnicity in Science					
Ethnicity	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Bhraman/Chettri	510.59	1.870	5579	514.251	506.919
Janjati	498.26	1.654	5832	501.503	495.019
Dalit	487.62	2.044	1939	491.628	483.617
Other	492.77	2.907	1835	498.468	487.071
Missing			230		

Mean score by geographical identity in Science					
Gegraphy	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Himali	506.95	4.065	848	514.916	498.980
Hilly	506.37	1.579	9550	509.460	503.272
Madhesi	486.22	2.116	3906	490.368	482.075
Other	488.35	4.417	862	497.003	479.688
Missing			249		
Mean score by age group in Science					
Age	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Missing	486.220		644		
12 & below	502.910	2.672000	755	508.1471	497.67288
13	508.396	1.806000	3635	511.9358	504.85624
14	506.277	1.546000	5119	509.3072	503.24684
15	495.310	1.550000	3429	498.348	492.272
16 & above	481.674	1.928000	1833	485.4529	477.89512
Mean score by mother's education in Science					
Mother's education	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Illiterate	488.68	1.561	4758	491.741	485.622
Literate Only	501.07	1.418	6235	503.850	498.292
Grade 10	511.86	1.767	2608	515.327	508.398
Grade 12	521.80	3.217	905	528.109	515.498
Bachelor	536.63	3.931	371	544.336	528.927
Master's & above	519.99	8.154	138	535.972	504.009
Missing			400		
Table : Mean score by father's education in Science					
Father's education	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Illiterate	479.52	1.821	2106	483.091	475.953
Literate Only	496.90	1.470	5462	499.785	494.022
Grade 10	503.02	1.440	4471	505.846	500.199
Grade 12	515.63	2.116	1771	519.777	511.481
Bachelor's	531.61	3.598	690	538.664	524.558
Master & above	536.58	4.162	475	544.734	528.419
Missing			440		
Mean score by mothers occupation in Science					
Mother's occupation	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Agriculture & household	493.96	1.357	9014	496.623	491.304
Household only	510.68	2.076	3243	514.746	506.607
Work in other's home	492.82	5.167	137	502.946	482.692

Labor	498.11	4.660	186	507.248	488.980
Foreign country	509.28	3.129	300	515.413	503.147
Teaching	525.45	4.082	325	533.450	517.450
Business	514.35	2.293	1203	518.845	509.859
Government job	517.19	4.187	296	525.395	508.982
Other/Missing			711		
Mean score by father's occupation in Science					
Father's occupation	**Mean**	**SE**	**n_nstu**	**Upper**	**Lower**
Agriculture & household	488.22	1.620	4585	491.391	485.039
Household only	481.08	3.107	328	487.167	474.987
Work in other's home	477.91	3.568	261	484.901	470.914
Labor	499.05	2.367	1039	503.688	494.410
Foreign country	501.20	1.494	3779	504.128	498.273
Teaching	516.59	2.903	494	522.276	510.895
Business	514.85	2.015	2282	518.804	510.906
Government job	515.19	2.606	1180	520.294	510.078
Other/Missing	508.30	2.660	1467	513.509	503.083
Mean score by time spend household chores in Science					
Time spent in household chores	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Missing			1266		
Don't give time	502.92	2.421	1323	507.666	498.175
Less than 1 hour	507.84	1.725	4974	511.219	504.459
one to two hours	502.73	1.501	5097	505.673	499.788
two to four hours	494.52	1.842	1953	498.133	490.911
More than four hours	485.87	3.439	802	492.615	479.134
Mean score by support to the students in Science					
Support to the students	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Father	499.59	2.499	1567	504.486	494.690
Mother	494.31	2.807	666	499.807	488.803
Brother/Sister	500.80	1.560	6458	503.855	497.741
Tuition	506.48	1.736	3608	509.879	503.075
Friends	495.88	1.785	2159	499.380	492.381
None	501.66	3.532	520	508.584	494.737
Missing			437		

SE of percentages in proficiency levels in Science					
Proficiency level	**Stu_percent**	**SE**	**n_stu**	**Upper**	**Lower**
1 (Pre-basic)	1.83	0.159	286	below 390	
2 (Basic)	15.47	0.692	2390	436	390
3 (Proficient 1)	38.88	0.830	5976	482	436
4 (Proficient 2)	32.71	0.829	4958	529	482
5 (Proficient 3)	9.94	0.643	1496	575	529
6 (Advanced)	1.16	0.158	174	above 575	
	100.0		15280		
Mean score by language in Science					
Language	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Nepali	506.45	1.614	10240	509.616	503.289
Other	488.49	2.089	4506	492.583	484.392
Missing			669		
Mean score by influence of bullying in Science					
Influence of bullying	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
No any one	499.57	1.408	7972	502.328	496.810
low bullying	504.93	1.644	5161	508.146	501.704
Medium bullying	499.60	2.537	1658	504.577	494.631
High bullying	480.27	4.044	305	488.195	472.342
Missing			319		
Mean score by use of leisure time in Science					
Use of leisure time	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Classwork/homework	498.55	1.440	8029	501.368	495.725
Group work	507.24	2.093	2194	511.339	503.134
Playing	488.60	2.697	1309	493.889	483.316
No leisure class	507.86	1.965	3518	511.711	504.009
Missing			365		
Mean score by availability of textbook in Science					
Availability of textbook	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Yes	502.04	1.393	14435	504.766	499.304
No	479.22	2.946	626	484.998	473.451
Missing			354		
Mean score in Science by TV watching time					
Support to the students	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
not given time	494.63	1.893	3641	498.336	490.916
less than an hour	502.47	1.451	8589	505.313	499.626
one-two hours	514.86	2.352	1989	519.465	510.245

two-four hours	511.22	4.404	226	519.851	502.585
more than four hours	481.71	7.175	95	495.774	467.650
Missing			875		
Mean score in Science by school type					
Type of school	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Community	489.73	1.357	11858	492.392	487.071
Institutional	537.67	2.245	3557	542.069	533.269
Mean score in Science by homework given					
Type of school	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Everyday	500.70	1.496	10770	503.632	497.769
Sometimes	501.58	1.849	4236	505.208	497.960
Never	494.67	6.865	105	508.129	481.219
Missing			304		
Mean score in Science by feedback given.					
Type of school	**Mean**	**SE**	**n_stu**	**Upper**	**Lower**
Everyday	501.17	1.440	10988	503.992	498.348
Sometimes	501.28	2.008	3895	505.217	497.344
Never	492.25	6.265	127	504.527	479.968
Missing			405		

Sample districts of NASA 2017

Government of Nepal
Ministry of Education, Science & Technology
Education Review Office
Sanothimi, Bhaktapur

www.ero.gov.np eronasa@gmail.com