Feasibility study on Nepal's participation in international assessment

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Fesibility study of Nepal's participation in international assessment

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Table of contents

Acknowledgements ii
Table of Contents iii
List of Tables and Figures v
Acronyms and Abbreviations vii
Executive Summary viii

Chapter 1

Introduction 1
Background 1
Objectives 3
Methodology 3

Chapter 2

An overview of National and International Assessment of Student Achievement 5
National Assessment of Student Assessment 5
National assessment in Nepal: Process, Methods and Characteristics 7
Characteristics of NASA 9
Previous National Assessments in Nepal 11
International Assessments 13

Chapter 3

Comparison of PISA, TIMSS and PIRLS with National Curriculum Framework (Nepal) 20
Mathematics: TIMSS, PISA and National Curriculum 20
Science: TIMSS, PISA and National Curriculum 35
English: PISA and PIRLS and National Curriculum 55
Nepali: PISA, PIRLS and National Curriculum 68

Chapter 4

Feasibility for Participating in International Assessments 81
Requirement for Undertaking TIMSS, PISA and PIRLS and National Capacity.... 81
Requirements and Preparedness for Participating in nternational asAsessment..... 84
Financial Implications 85

Chapter 5

Summary, Conclusion and Recommendations 88
NASA Experience and Future Prospect 88
Options for International Testing 88
National Curriculum and International Testing 90
Benefits and Challenges for Participating in International Assessments 92
Conclusion 94
Recommendations 95

List of Tables and Figures

Table No.	Titles
1	Differences between National Assessments and Public Examinations
2	Comparison Table: PISA – TIMSS – PIRLS
3	Comparison framework between international assessments and national curriculum
4	Content domain of mathematics between TIMSS and NCF
5	Analytical comparison of mathematics between TIMSS and NCF
6	Comparison of content domain between TIMSS and NCF
7	Analytical comparison of mathematics (Grade VIII) between TIMSS and NCF
8	Comparison of content domain of mathematics between PISA and NCF
9	Analytical comparison of mathematics between PISA and NCF
10	Comparison of content area/domain of science between NCF and TIMSS
11	Provision of Cognitive Domain at National Curriculum Framework and TIMSS
12	Provision of Specification Grid for 5th Graders at NCF
13	Framework of the Topics/Areas in NCF and TIMSS
14	Practical activities and specification grid provisioned in NCF
15	Content are/domain between TIMSS and NCF
16	Specification Grid in NCF for Eight Graders
17	Provision of Specification Grid for Eight Graders at TIMSS
18	Content domain for eighth graders at TIMSS
19	Framework of Content in National Curriculum Framework and TIMSS
20	Comparison of content domain between NCF and TIMSS
21	NCF Content framework of science, Grade 10
22	Distribution of Items for Knowledge at PISA
23	Framework of scientific literacy assessment in PISA
24	Content areas and weightage of science in NCF and PISA

25	Competency areas and weightage, PISA science
26	Scientific literacy assessment developed by PISA
27	Content domain of biology (Grade X) in NCF
28	Student assessment of practical work in NCF, Grade 10
29	Overall approach to assessment in NCF and TIMSS
30	Analytical comparison of science between NCF and PISA
31	Analytical comparison between PISA and NCF (English)
32	Analytical comparison between PIRLS and NCF (English)
33	Analytical comparison between PISA and NCF (Nepali)
34	Analytical comparison between PIRLS and NCF (Nepali)
35	ERO's human resource for carrying out large-scale assessment
36	NASA tasks shared by ERO and consultant firms
37	Payment installment for TIMSS 2019
38	International assessment costs (in US$)
39	Nepal's projected cost for international assessment
40	Summary of major international assessments
Figure No.	Title
1	Administrative cycle of NASA
2	Phases of the student assessment process
3	Distribution of cost for major international assessments

Acronyms

CDC	Curriculum Development Center
DFID	Department for International Development
DGS	Dynamic Geometry Software
ERO	Education Review Office
GPS	Global Positioning System
HA	Higher Abilities
HCF	Highest Common Factor
IEA	International Association for the Evaluation of Educational Achievement
LCM	Lowest Common Multiple
LLECE	Laboratorio Latinoamericano de Evaluatión de la Calidad de la Educatión
MOE	Ministry of Education
NASA	National Assessment for Student Achievement
NCF	National Curriculum Framework
OECD	Organization for Economic Cooperation and Development
PASAC	Programme d'Analyse des Systèmes Éducatifs de la CONFEMEN
PIRLS	Progress in International Reading Literacy Study
PISA	Program for International Student Assessment
SACMEQ	Southern and Eastern Africa Consortium of Monitoring Educational Quality
TIMSS	Trends in International Mathematics and Science Study
UK	United Kingdom

Executive Summary

Aims and methodology of the study

The aim of this study is to assess the readiness and feasibility of Nepal's participation in international assessment, particularly based on existing capacity on conducting large-scale assessment of student achievement. The goal is also to undertake a comparative analysis of the contents and domains to be tested in PISA, TIMSS and PIRLS with the Nepali curriculum. In addition, this study aims to assess both advantages and challenges of Nepal's participation in international testing. This study has additional purpose to compare the cost of NASA and the cost for participating in an international assessment and assess the appropriateness of participating in an international assessment based on the possible implications in budget.

This is a multi-method study, which employs a wide range of techniques including document and data review, financial analysis, interviews, web-based research, and policy study. Based on the review and assessment, this study provides Education Review Office (ERO) with recommendations about the feasibility for participating some international assessments or suggesting appropriate alternatives of international testing.

NASA and international assessments

With the establishment of ERO in 2010, Nepal laid foundation for conducting national assessment and applying the assessment result for the diagnosis of systematic problems of schooling and thereby taking necessary remedial actions. Along with the system development for national assessment, ERO successfully complemented NASA 2011, NASA 2012, NASA 2013 and NASA 2015. The assessment and analysis framework used in NASA assessments are designed and verified by national and international experts. Example of computer-based IRT modeling used in test analysis suggests that national assessment has been technically sound, authentic and reliable. Alongside, a number of lessons are being learnt to standardize national assessment on a par with the international assessment standard.

Along with the regular cycle of national assessment, there has also been a growing opportunity for Nepal to participate in standardized international assessments like Program for International Student Assessment (PISA), Trends in International Mathematics and Science Study (TIMSS) and Progress in International Reading and Language Study (PIRLS). PISA is run by Organization for Economic Cooperation and Development (OECD) which was first conducted in 2000 and repeated in every three years. This survey assesses learners aged 15 who are nearing the end of secondary education. It assesses performance in reading, mathematics, science and problem solving. The last of round of PISA test was undertaken in 2015 and its result will be published in December 2016. Managed by the International Association for the Evaluation of Educational Achievement (IEA), TIMSS was first conducted by IEA in 1995 and now repeated every 4 years and tests learners of 4th and 8th graders (10 and 14 years old). In 2001, the IEA offered another international survey, which

was called PIRLS. This is repeated every five years and it focuses on 10 year old learners' abilities in reading and literacy. The last round of this survey is conducted in 2011.

PISA for Development and pre-PIRLS are new testing opportunity designed particularly for the developing countries. PISA for Development is a new initiative of OCEC to 'increase developing countries' use of PISA assessments. This is done by developing contextual questionnaires and data-collection instruments that better capture diverse situations in emerging and developing countries, adjusting the PISA test instruments so that they are sensitive to a wider range of performance levels, and establishing methods and approaches to include out-of-school students in the PISA assessment. prePIRLS is another preparatory option for the developing countries designed by IEA to participate in PIRLS which reflects the same conception of reading as PIRLS, except it is less difficult. Depending upon a country's educational development, prePIRLS can be given at the fourth, fifth, or sixth grade.

International assessments and national curriculum

There is a significant overlap of content and domain of learning between the framework of international assessment and national curriculum. However, a lot more to be done to make contents and domain of learning congruent. Two of such tasks are - adaptation and alinement of the content of national curriculum in international testing context and redesigning existing examination system of schools to prepare students for internationally designed testing. The summary of content-specific comparative analysis is following:

Mathematics Grade V and VIII, TIMSS and NCF

Both TIMSS and NCF (Grade V and VIII) have similar contents in the areas of number system, geometry and measures and data display. There is around 90% overlap of contents in all areas of mathematics. Therefore there might be some small adjustment needed regarding the gap or content mismatch while adopting TIMSS test items for Nepalese students' assessment at the end of grade V. However, the Nepalese curriculum practices, including instruction and assessment, need to be reviewed and revised to meet the testing requirement of international testing. The areas of adaptation are: context/problem generation, mathematization of the context/problem, calculation, and verification with the context to adopt TIMSS level assessment.

Mathematics Grade X, PISA

Both PISA and NCF have aimed to develop knowledge and skills in the content areas such as change and relationships, space and shape, quantity, and uncertainty and data. There is approximately 90% similar content in PISA and NCF. Therefore, the content mismatch between PISA and NCF is not so big. Since the PISA assessment is based on context, process, and content, the Nepalese curriculum practices, including instruction and assessment, need to be adapted and revised in relation to context/problem generation, mathematization of the context/problem, calculation, and verification with the context while adopting PISA assessment items.

Science Grade V, TIMSS and NCF

There is high overlapping in the content between TIMSS and NCF Grade V Science. Regarding the content weightage, living beings, matter, energy and environment and Earth and universe has 35%, 32% and 17% weightage in NCF however, the equivalent is 45% (life science), 35% (physical science) and 20% (Earth Science) in TIMSS. The additional content in Grade V in NCF is information technology (8%) and simple technologies (8%). The content breakdown overlaps 70 to 80%. Regarding the area and domain of learning, knowledge, understanding and higher abilities carry 20%, 30% and 50% weightage respectively in NCF however the content breakdown in TIMMS is 40% (knowing), 40% (applying) and 20% (reasoning) .

Science Grade VIII, TIMSS and NCF

The overlapping of content of grade 8 in both TIMSS and NCF is found high. Physics, chemistry, biology and earth science have 25%, 20%, 35% and 20% contents respectively in TIMSS although the same areas have 25%, 15%, 15%, 20% respectively. The NCF has additional 25% weightage allocated for practical activities. The content breakdown overlaps approximately 70 to 80%. In terms of learning areas or domain, knowledge, understanding, and higher abilities have 20%, 30% and 50% weightage respectively where the corresponding domain covers 35% for knowing, 35% for applying and 30% for reasoning. The NCF has additional emphasis on 'higher abilities' domain.

Science PISA Grade X

While PISA is not a curriculum-based test, a significant overlap of the content and domain of learning has been observed between PISA and NCF. Secondary school science curriculum of Grade 10 consists of 30% physics, 15% chemistry, 22.5% biology and 7.5% astronomy and geology portion, PISA has 36%, 36% and 28% weightage allocated for physical, living and earth and space sectors. PISA has less emphasis on chemistry. While the NCF has subject-based focus on knowledge, understanding, application, and higher abilities of science learning, the PISA has a focus on three competency areas 1) explain phenomenon scientifically, 2) evaluate and design scientific enquiry, and interpret data and evidence scientifically. This will require Nepal's students preparing for higher order competency in explaining, evaluating, designing and interpreting the scientific phenomena and design.

PISA Reading

PISA reading is focused on understanding, using, reflecting and engaging with written texts in order to develop students' knowledge and potential and participate in society. While reading is core part of the PISA, the Grade 10 language curriculum (both English and Nepali) focuses on all four language skills – listening, speaking, reading and writing. The PISA literary assessments select items from different situation (e.g. personal 30%, educational 25%, occupational 15% and public 30%, the the Grade 10 language curriculum (both English and Nepali) focuses more on selected educational contents, and few on personal and public situation. There has been no

focus on occupational situation. While most of the reading exercises in Grade 10 language curriculum are based on continuous texts formed by sentence organization into paragraphs, PISA reading assessment has 60% items from continuous text, 30% from non-continuous (list, tables, graphs, diagrams, advertisements, schedules, catalogues, indexes and forms), mixed (5%) and multiple (5%) text format. Text in PISA includes description, narration, exposition, argumentation and instruction while Grade 10 language curriculum includes description and narration largely. Rather, Grade 10 curriculum focuses reading exercises on different genres such as poetry, prose, drama, letter-writing, fiction, autobiography and story. While the main mode of delivery for the previous PISA assessment was paper-and-pencil, PISA 2015 has also an option for computer-based delivery. This option does not exist in NCF Grade 10 language curriculum.

PIRLS Reading

Reading literacy, according to PIRLS 2016, is the ability to understand and use those written language forms required by society and/or valued by the individual. While reading to learn is key learning domain of PIRLS, Grade V curriculum (both English and Nepali) aims to develop all four skills of languages – listening, speaking, reading and writing. In PIRLS reading has two particular purposes – literary experience (50%) and acquire and use information (50%). Similarly, reading comprehension has focused on retrieving explicitly stated information (20%), make straightforward inferences (30%), interpret and integrate ideas and information (30%) and evaluate and critique. Whereas, NCF curriculum (Nepali and English) focuses more on functional use of reading, read different kinds of texts (stories and facts) both for enjoyment and to extract specific information, interpret charts, tables, diagrams, develop reading skills (skimming and more detailed reading). The curriculum for the development of reading skills is associated with the grammar skills and includes exercise such as completing, matching, ordering, choosing, and composing sentences. The reading skills will be develop in tandem with the writing, reading and other learning activities.

Feasibility for participating in international testing

Establishment of ERO first as an ad-hoc unit and now as a permanent legal entity of the government through 8th amendment of the Education Act and successful experience of NASA 2011, 2012, 2013 and 2015 have contributed to laying foundation for taking part in international assessment. However, there is still lack of both technical and human resource capacity to undertake large-scale assessment as a par with the requirement and standard of international assessment. The technical requirement includes adequate ICT infrastructure and other technological preparedness required for administration of test and analyzing the test results. Conducting international assessments also requires a number of technical human resources such as psychometrician, statistician, data manager, translators/translation reviewers, educationist, test administrators, national quality control monitor and scorers trained for doing their tasks as a par with the criteria and standard set by international assessment agencies. Existing human resource capacity at ERO is far below of this requirement.

In addition, there are context-related challenges which are associated with the unique cultural, linguistic, economic and political situation of the country. The international assessments may not necessarily reflect such uniqueness as they are designed in the educational and country context of the developed economies.

Financial requirements

Conducting international assessments also require significant financial investment on the part of the participating country. For example, the international overhead costs for new participants in PISA 2018 is EUR 182 000 payable over four years at EUR 45,500 per year from 2016 to 2018 (OECD, 2016). The total amount is equivalent to NRs 2,18,40,000.00 (1 EUR = NRs 120). In addition, the costs for the national implementation of the program should be borne entirely by the participating countries. This includes both the staff cost and operating cost of the assessment. There will be additional cost for attending the regular meetings to be held periodically.

Similarly, the basic fee per grade for participating in IEA paper TIMSS or IEA eTIMSS in 2019 is 225,000 ICU (IEA's International currency unit) = US$ 112,500 plus EURO 112,500 (IEA, 2016). This is equivalent to NRs 2,56,50,000 for one grade and NRs 5,13,00,000 for two grades (1 US$ = NRs 108 and 1 EUR = NRs 120).

Projecting the total participation cost using different international indicators and study data, Nepal has to allocate the budget in the figures mentioned below if opted for participating in the following international assessments:

International Assessment	International fees (in NRs)	Total estimated cost for Nepal (in NRs)
PISA 2018	2,18,40,000.00	8,73,60,000.00
TIMSS 2019 (Grade 4 & 8)	5,13,00,000.00	20,52,00,000.00
PIRLS 2016	2,68,00,000.00	10,72,00,000.00

The above figures suggest that there will be an obvious question regarding the value of public money if Nepal decides to participate in international testing.

Benefits and challenges

Participating in international assessments invites both benefits and challenges. The possible benefits include:

- For Nepal, participation in international studies enables policy makers and educators to compare the performance of Nepalese students with international students.
- Not only studies of student outcomes are important but, equally, studies of teacher training, teaching techniques and background information of students and schools are important in identifying factors which help students learn and achieve their potential.

- International studies provide schools and students with an opportunity to experience cutting-edge assessments that are designed by international experts.
- Participating in international assessment also helps to develop technical and human resource capacity to undertake state-of-the-art methods and techniques of assessing student achievement which in turns contribute to building better and reliable system of national assessment.

And, on the challenge part, the followings are pertinent:

- Nepal's educational investment and policy focus should be centered on access, quality and management. A significant number of school-age children are still outside the school. So before taking part in internationally comparable testing, Nepal should fulfil basic requirements for quality schooling.
- All international assessments are produced by developed countries in order to compare the achievement of students among themselves. The decision on test requirements and test objects has been made based largely on the country context of these countries. So, this testing may not be reflective to our country context.
- Taking consideration of contextual factors of schooling, it is argued that international assessment has laid its emphasis merely on learning outcomes of students no matter how the context, input and process variables are different. Considering unequal societies in our country, Nepal may require an equity-based assessment.
- International assessments are largely based on the state-of-the-art technology for administrating and analyzing the test. The latest version of these assessments requires students to take computer-based tests. Jumping into decision for the international assessment without such prerequisites would be problematic.

Recommendations

1. *Strengthening national assessment system*

   The analysis of existing national capacity for undertaking technology-based large-scale international assessments, curricular compatibility, existing data on access and achievement of students and the value for money suggests policy makers not to rush for participation in international testing. Rather, this study makes a strong recommendation for strengthening the national assessment system and developing a strong technological and human resource foundation for accomplishing the cutting-edge international assessments that are standardized and valid. For this purpose, the following recommendations are made:

   - ERO needs to be organized and developed as an autonomous and independent organization, keeping it free from the direct influence and regulation of the Ministry of Education.
   - Equip ERO with more sophisticated infrastructure and information technology.

- ERO should have adequate permanent positions to recruit staff qualified and trained in different aspects of testing. It is also recommended for considering that the relevant representatives of ERO should be provided opportunities to attend the various capacity building sessions offered by international testing organizations and contractors.
- The result of the periodic national assessment should be disseminated to the school level, and schools should be encouraged to develop learning improvement plan and take action for increasing achievement level of students.
- While strengthening national assessment system some comparison with international assessment could be done by calibrating some relevant items from international items and equating the scores using IRT modelling. Although such practices have already begun in previous NASA projects, this should be made more rigorous and comprehensive in future assessments.

2. *Curricular reform*
   Although a greater overlap has been observed between the framework of national curriculum and international testing, a further alinement of curricular contents and learning domains is necessary if Nepal aims to participate in international assessments. While the national curriculum of Nepal should have a focus on cultural, linguistic and ethnic diversity of its population, standardizing curricular contents with a greater global-local linkage is an additional necessity.
3. *Instruction and mode of delivery*
   In view of the fact that international assessments require more analytical, critical and judgmental capacity of the students to respond to the different high-ability questions, the domination of teacher-centered mode of delivery in Nepal should be replaced by more participatory, interactive and technology-assisted instruction whereby students take part in construction of knowledge and critical analysis of it.
4. *Use of ICT in learning and teaching*
   Both TIMSS and PISA are now developed as computer-based tests, though there is a paper-based option available for underdeveloped countries. This suggests that if Nepal aims to participate in PISA or TIMSS, the paper-based option may not be available in the next assessment cycle. Nepal therefore requires its schools to equip with technological infrastructure including electricity, computers, projectors, printers and required learning software and prepare teacher for ICT-supported instruction and assessment.
5. *Considering PISA for Development and prePIRLS options first*:
   With the fulfilment of the requirement – both technical and human resource – for participating in international testing, Nepal should first choose to participate in PISA for Development and prePIRLS as both are designed to suit the need of developing countries.

Chapter 1

Introduction

Background

National assessment is designed to describe the achievement of students' in a curriculum area aggregated to provide an estimate of the achievement level in the education system as a whole at a particular age or grade level (Greaney and Kellaghan, 2008, p. 7). It usually involves planning and administration of achievement tests to a sample group of students, representing the schools and students across the country. Background information, usually in questionnaire, are also collected, which provide information about how achievement is related to factors such as household and school characteristics. While most developed countries have a long tradition of national assessment, this has been a relatively new practice in developing countries (DFID, 2010). It is particularly a development of Education for All (1990 – 2015) movement. The Article 4 of the Jomtien Declaration underlines that the goal of basic education is to acquire actual learning acquisition and outcome, rather than exclusively upon enrolment, continued participation in organized programs and completion of certification requirement (UNESCO, 1990). This was reconfirmed in the Dakar Framework for Action (UNESCO, 2000) stating its goal to achieve by 2015 to improve all aspects of the quality of education so that recognized and measurable outcomes are achieved by all, especially in literacy, numeracy and essential life skills. This requires that the member countries to set up a reliable mechanism to measure students learning and provide reliable data on learning outcomes of students. As a result, most of the developing countries, including Nepal, have now developed a relatively permanent mechanism to measure and report students' learning in a national basis.

The Government of Nepal established Education Review Office (ERO) in 2010 with the aim of assessing 'student achievement regularly, carry out the performance audit of educational institutions and schools, and publicize the assessment and audit reports' (ERO, 2015b). The goal is also to inform regularly to educational stakeholders, including the government, teachers, parents, schools, students and civil society about the effectiveness, efficiency, equity and quality of education so that equity and quality can be improved regularly' (ERO, 2015b). Since its establishment, ERO has been conducting nation-wide assessment of student achievement for grades 8, 5 and 3 in different school subjects. In 2011, ERO conducted national assessment of grade 8 students in their 3 school subjects – Mathematics, Nepali language and Social Studies. This test was conducted in 25 sample districts that are representative of all eco-belts and development regions. Another round of national assessment was undertaken in 2012 in 28 districts. This assessment was conducted in Nepali and Mathematics for grade 3 and in Nepali, Mathematics and English in grade 5. The

second cycle of national assessment of 8th graders was conducted in 28 districts in 2013 in Mathematics, Nepali language and Science. A similar assessment was conducted for 3rd graders in Nepali and Mathematics and for 5th graders in Nepali, mathematics and English in 2015. Next rounds of NASA in Nepal will be conducted in grades 5, 8 and 10, which will be based on defined criteria and standards, generally 1 to 6 standards in hierarchical order of the complexity and depth of knowledge, skills and competencies.

Along with the regular cycle of national assessment, there has also been a growing opportunity for Nepal to participate in standardized international assessments like Program for International Student Assessment (PISA), Trends in International Mathematics and Science Study (TIMSS) and Progress in International Reading and Language Study (PIRLS). TIMSS was first conducted in 1995 and now repeated every 4 years and tests learners of 4th and 8th graders (10 and 14 years old). The last cycle of TIMSS was conducted in 2015 and its result will be published in September 2016. It is managed by the International Association for the Evaluation of Educational Achievement (IEA). PISA is run by Organization for Economic Cooperation and Development (OECD) which was first conducted in 2000 and repeated in every three years. This survey assesses learners aged 15 who are nearing the end of secondary education. It assesses performance in reading, mathematics, science and problem solving. The last round of PISA test was undertaken in 2015 and its result will be published in December 2016. In 2001, the IEA offered another international survey, which was called PIRLS. This is repeated every five years and it focuses on 10 year old learners' abilities in reading and literacy. The last round of this survey is conducted in 2011. The overall aim of these assessments and surveys is to offer information about international performance for the use of others in order to drive up education standards everywhere. It is also to facilitate dissemination of ideas on which features of education systems lead to the best performances (Cambridge, 2015).

There are further opportunities for developing countries to participate in such international assessments. For instance, PISA for Development is a new program to increase developing countries use of PISA assessments for monitoring progress towards nationally-set targets for improvement and for the analysis of factors associated with student learning outcomes. A number of developing countries, including Senegal, Zambia, Guatemala and Cambodia, have already participated in this program. In view of such new avenues of opportunity, there is a debate over whether or not participation in such international assessments is feasible for Nepal, both financially and technically. This indicates a need for undertaking a study to assess relevance and feasibility participating in international assessment and provide appropriate recommendations to the ERO and other relevant government agencies. In this context, this study is designed with the particular aim of providing ERO with recommendations about the feasibility of or some alternatives to participating in some international assessments based on both policy review and empirical analysis.

Objectives

The objectives of this study are as follows:

- To review national assessment process, methods and practices.
- To provide overview of international assessment practices, particularly of PISA, TIMSS and PIRLS.
- To compare the contents and domains to be tested in PISA, TIMSS and PIRLS with the relevant Nepali curriculum.
- To assess feasibility of methods and process used in international assessment in the context of Nepal, particularly based on existing capacity on conducting students' assessment.
- To compare the cost of NASA and the cost for participating in an international assessment and assess with the appropriateness of participating in an international assessment based on the possible implication in budget.
- To assess benefits and challenges of Nepal's participation in international assessments.
- To provide ERO with recommendations about the feasibility of or some alternatives to participating in some international assessments

Methodology

This study employs a multi-method approach, using a wide range of techniques including document and data review, financial analysis, interviews, web-based research, and policy study. Based on the review and assessment, this study provides ERO with recommendations about the feasibility for participating some international assessments or suggesting appropriate alternatives of international testing. Basically, this study entails the following four components:

Review study: A review study has been undertaken based on the available policies, secondary data, published report and other relevant literature. This study has first reviewed international assessment practices, looking into the frameworks, programs and practices of the international tests such as PISA (Program for International Student Assessment) and TIMSS (Trends in International Mathematics and Science Study) and Progress in International Reading Literacy Study (PIRLS). In addition, the review study has also looked into the national assessment policies and programs, focusing particularly on various assessments carried out by ERO in the past.

Subject-wise comparative study: A deskwork has been undertaken by subject experts to compare the contents and domains to be tested in PIRLS, TIMSS with the Nepali curriculum of grades 5 and 8 in Mathematics, Language (Nepali and English) and Science. Similarly, comparison have been made on the contents and domains to be tested in PISA with the Nepali curriculum of grade 10 in Mathematics, Language (Nepali and English) and Science. The subject experts have thoroughly looked into the curriculum and contents and specified the contents that are overlapped and

compatible and the contents that are unique and different, not compatible for international testing.

Feasibility study: A detailed study has been undertaken to assess the feasibility of the methods and process used in international assessment in the context of Nepal, particularly based on existing capacity on conducting students' assessment. This is done first by reviewing the test requirements for different international studies and then assessing institutional and human resource capabilities of ERO and other relevant national institutions to carry out international tests in Nepali context. For this purpose, a survey-cum-interview study have been done to assess institutional capacity of ERO and other relevant institutions in Nepal.

Cost-analysis: A financial study has been undertaken comparing the cost of NASA and the cost for participating in an international assessment and assessing with the appropriateness of participating in an international assessment based on the possible implication in budget. For this purpose, financial estimation will be made to participate separately in different international testing (e.g. PISA, TIMSS) by analyzing the financial policy and requirements of the individual assessment. In addition, financial enquiry has been undertaken via telephone and email communication and web-based resources were used intensively. For the budgetary requirements and funding options for using international testing in Nepal, financial records and audit reports of the previous NASA study have been reviewed along with interviews with the concerned authority and staff at ERO.

Personal communication and interview: Personal communication has been undertaken with international assessment agencies to receive assessment material and information about procedures that are not publicly available (for example, budget and other internal policy documents). Open ended interview has been undertaken with three professional expert of testing and measurement – two from Tribhuvan University and one from Kathmandu University. These interviews have been undertaken in order solicit opinion about the relevance and feasibility of Nepal's participation for international assessment, and its pros and cons.

Chapter 2

An overview of National and International Assessment of Student Achievement

National Assessment of Student Assessment

Assessment is a tool for determining the quality of educational outcomes. The objectives of student assessment are threefold (Poudel, 2016, p. 1): to provide feedback for classroom teaching and improve student learning, to certify the grade and qualification of students, and to monitor and evaluate the quality of education system and improve it. Accordingly, assessment is broadly classified into three types – classroom-based assessment, public examination and national assessment. Classroom assessment focuses more on formative aspect of learning of students in a particular school or classroom. The fundamental goal of this assessment is to assess learning and provide feedback to teachers and students for improving students' learning. Public examination, on the other hand, is administered usually by external authority (such as National Examination Board) to certify the grade and qualification of students. Both classroom assessment and national examination are considered mandatory for students, requiring all to take part in these tests.

National assessment is administered over a fixed period of time (e.g. every two or three years) in order to determine the status of educational achievement of students in identified curriculum areas (e.g. reading or literacy, mathematics, science). Assessed mostly among a sample of students, this kind of assessment plays a critical role in determining the performance of the education in the country and value for money in the education sector. National assessment provide answers to the key questions such as:

- How well are students learning in the education system (with reference to general expectations, aims of the curriculum, preparation for further learning, or preparation for life)?
- Does evidence indicate particular strengths and weaknesses in students' knowledge and skills?
- Do particular subgroups in the population perform poorly? Do disparities exist, for example, between the achievements of (a) boys and girls, (b) students in urban and rural locations, (c) students from different language or ethnic groups, or (d) students in different regions of the country?
- What factors are associated with student achievement? To what extent does achievement vary with characteristics of the learning environment (for example, school resources, teacher preparation and competence, and type of school) or with students' home and community circumstances?

- Are government standards being met in the provision of resources (for example, textbooks, teacher qualifications, and other quality inputs)?
- Do the achievements of students change over time?

(Greaney and Kellaghan, 2008)

In a national assessment, a) achievement is assessed using standardized instruments, administration and scoring procedures; b) assessment instruments are administered to an agreed upon population of students or, more commonly, to a probability sample of students who are selected to be representative of the population; c) individual student achievements are aggregated to the system level. Reliable data may also be obtained for subpopulations if samples are sufficiently large (e.g., students categorized by the state/province in which they attend school; students attending private schools and students attending public schools); d) background information, provided by participating students, teachers, and sometimes parents, is usually collected in questionnaires to provide insights into relationships between achievement and a variety of factors (e.g., school and classroom resources and practices, student characteristics, family characteristics) (DFID, 2010).

As mentioned earlier, national assessment differs from the kind of assessment that is found in regular program of school and colleges. These assessments are on the level of knowledge, skill or understanding of individual students in the classroom as a form of formative or summative decision about the students' learning in a particular curricular domain. Classroom assessment does not meet the following characteristics of national assessment (DFID, 2010): a) standardized instruments and procedures; b) administration to an entire student population or representative sample thereof; c) system or sub-system level aggregation of results; and d) systematic relation of performance data to background characteristics of students. A national assessment is also different than public examinations in that sense that the latter play a crucial role in certifying student achievement, in selecting students for further study and in standardizing what is taught and learned in schools (Greaney and Kellaghan, 2008). This is a kind of 'high stake' testing which has a high consequence for students' future career. The following table summarizes between national assessment and public examinations.

Table 1. Differences between National Assessments and Public Examinations

	National Assessments	Public examinations
Purpose	To provide feedback to policy makers.	To certify and select students.
Frequency	For individual subjects offered on a regular basis (such as every four years).	Annually and more often where the system allows for repeats.
Duration	One or two days.	Can extend over a few weeks.
Who is tested?	Usually a sample of students at a particular grade or age level.	All students who wish to take this examination at the examination grade level.

Format	Usually multiple choice and short answer.	Usually essay and multiple choice.
Stakes: importance for students, teachers, and others	Low importance	Great importance
Coverage of curriculum	Generally confined to one or two subjects	Covers main subject areas
Effect on teaching	Very little direct effect	Major effect: teacher tendency to teach what is expected on the examination.
Additional tuition sought for students	Very unlikely	Frequently
Do students get results?	Seldom	Yes
Is additional information collected from students?	Frequently, in student questionnaires	Seldom
Scoring	Usually involves statistically sophisticated techniques.	Usually a simple process that is based on a predetermined marking scheme
Effect on level of student attainment	Unlikely to have an effect	Poor results or the prospect of failure, which can lead to early dropout
Usefulness for monitoring trends in achievement levels over time	Appropriate if tests are designed with monitoring in mind	Not appropriate because examination questions and candidate populations change from year to year.

Source: (Greaney and Kellaghan, 2008)

National Assessment in Nepal: Process, Methods and Characteristics

Nepal's educational reform has been geared particularly since 2000 by various national and international policy vehicles such as Education for All (EFA) declarations, EFA Plan of Action (2004 – 2009) and School Sector Reform Plan (SSRP) 2009 – 2015. These policy tools focus to raise access, quality, accountability and relevance of school education in general and of basic and primary education in particular. As a part of this reform initiative, the SSRP envisioned national assessment as a tool to set norms and standards for quality education and planned to conduct it periodically for students enrolled in grades 3, 5 and 8. As planned in the SSRP, Education Review Office (ERO), a line organization of the Ministry of Education, was established in 2010 with the goal of carrying out large school system level assessment in a regular basis and provide "information for the feedback to the overall system of education so that the quality of and equity in education system can be improved" (Poudel, 2016). To serve these purposes, ERO completed two cycles of national assessment of 8th grade students in 2011 and 2013 (see ERO, 2013 and 2015) and two cycles of national assessment of 3rd and 5th graders in 2012 and 2015 (see ERO, 2015b, 2016). ERO, however, still operated with ad hoc policy arrangements of the Ministry of Education and yet to get its functional autonomy. The Ministry formed

a Steering Committee to regulate the functioning of ERO and provide policy inputs required. Similarly, the Ministry has also formed a Technical Committee to provide technical inputs and supports to ERO.

Reviewing three reports of NASA carried out by ERO (ERO, 2013; ERO 2015a, ERO 2015b), it has been learnt that NASA in Nepal takes about two years to complete its full cycle which includes several nested cycles.

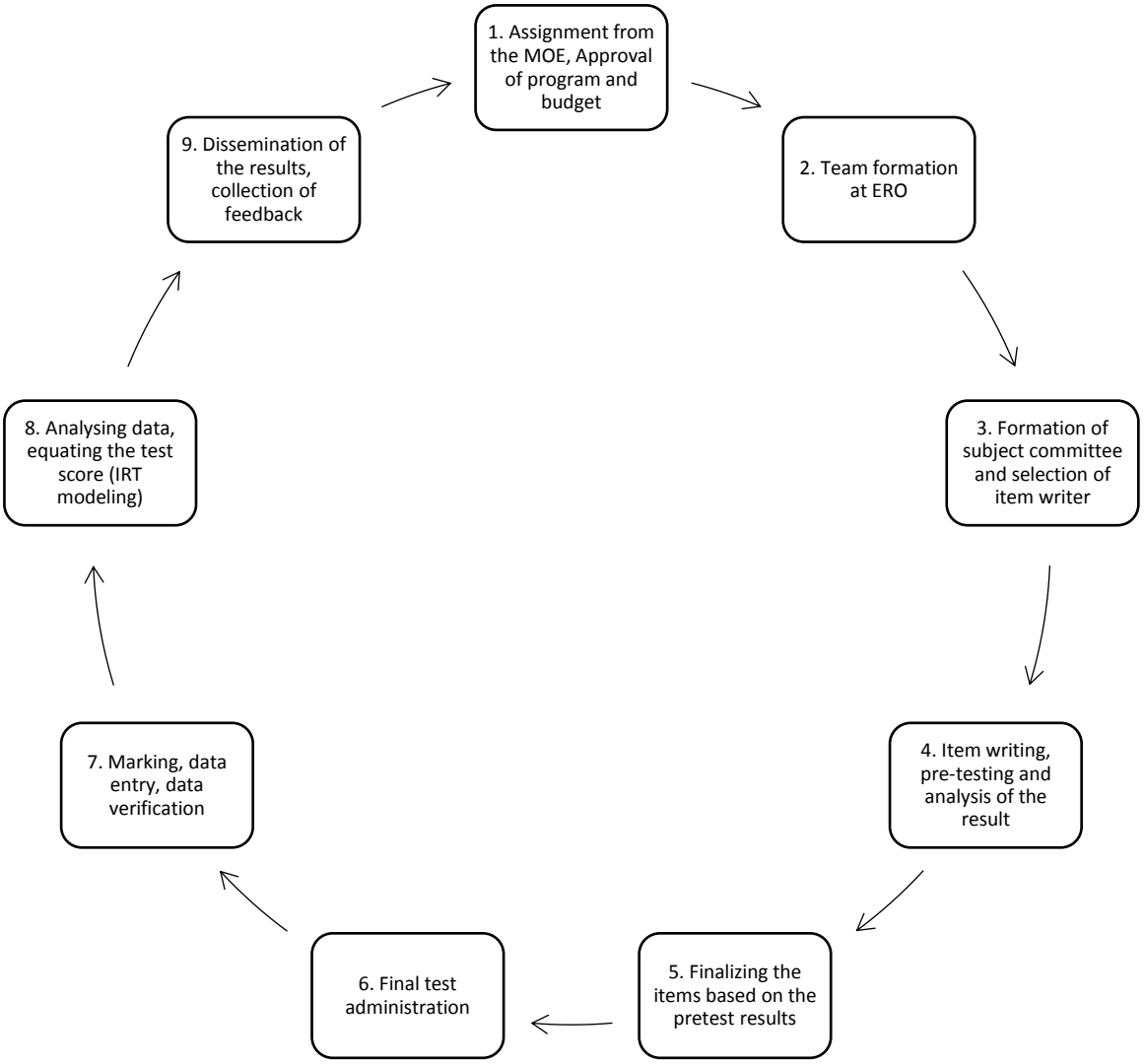


Figure 1. Administrative cycle of NASA (Source, ERO 2015a, 2015b)

As the above cycle suggests, the Ministry of Education approve the program and budget for the NASA assignments for particular year and grade(s). The Steering Committee formed under the Ministry takes this role. According to the approved program and budget, ERO forms a team to coordinate and execute the NASA activities and the NASA unit under ERO works as a team to coordinate NASA

activities. The subject committee formed under ERO takes a lead role in writing and finalize the test items. For this purpose, several teachers, teacher educators and subject experts are invited to contribute to item writing based on curriculum and specification grids of the concerned grade and subject. This group prepares a large number of test items with appropriate difficulty levels which will be pretested in two layers: in the first layer, pre-test will be carried out to ascertain the appropriateness of the language for the particular grade students, and in the second layer to assess the stable item parameters for the final tests. The test will be finalized incorporating the results and feedbacks collected from the pretesting. As mentioned in the NASA report 2013, the final versions of the test are prepared using the following six principles; 1) curriculum based, 2) content coverage, 3) proper structure of various levels of the cognitive domain (i.e. ecological validity) 4) high power of discrimination (i.e. reliability), 5) proper validity level, and 6) comparability of the results with the TIMSS and PIRLS. The final test then will be administered, generally by hiring an experienced consulting firm, in the sample schools with the support of the respective District Education Offices (DEOs). The consulting firm marks the answer paper and enter the data using appropriate data software. The ERO then undertakes the data management and analysis task including the equating of the test scores by using the Item Response Theory (IRT) modelling.

As clearly demonstrated in NASA report 2013, the assessment process goes through the following eight phases (Fig. 2): 1) writing, pre-testing, revising and finalizing the test items, 2) preparing and printing background questionnaire, printing and packing test, 3) administering and scoring the test, computer entry of score data using appropriate statistical software, 4) Checking and analyzing the data, item analysis, 5) writing the final reports, 6) editing and publishing the report, disseminating, 7) reporting to the schools, feedback from the schools and 8) updating item bank.

Characteristics of NASA

Reviewing NASA reports (ERO, 2013, 2015a, and 2015b) suggest following general characteristics of NASA:

1. **Large scale assessment**: All four national assessments were accomplished by ERO with representative sample schools and students from more than 25 districts, covering rural and urban schools, community and institutional schools, three ecological belts (Hill, Mountain and Terai) and five developmental regions (Eastern, Central, Western, Mid-Western, and Far-Western).
2. **Use of shared and participatory approach:** The national assessments were undertaken as a shared and participatory approach among national consultancy firms, school teachers and the ERO. In other words, NASA survey is a joint enterprise between in-house and out-source expertise at the national level.

3. **Use of Item Response Theory:** All national assessment followed modern testing theory and Item Response Theory (IRT) modelling was used to analyze test items and test construction. This made the assessment results comparable to earlier assessments in terms of various difficulty level.
4. **Validity and reliability assured:** In all national assessments, three parallel versions of items of the same difficulty level were used for each subject, equating them by IRT modelling. The reliability ensured through statistically is high and validity ensured by linking testing items with the respective curriculum.

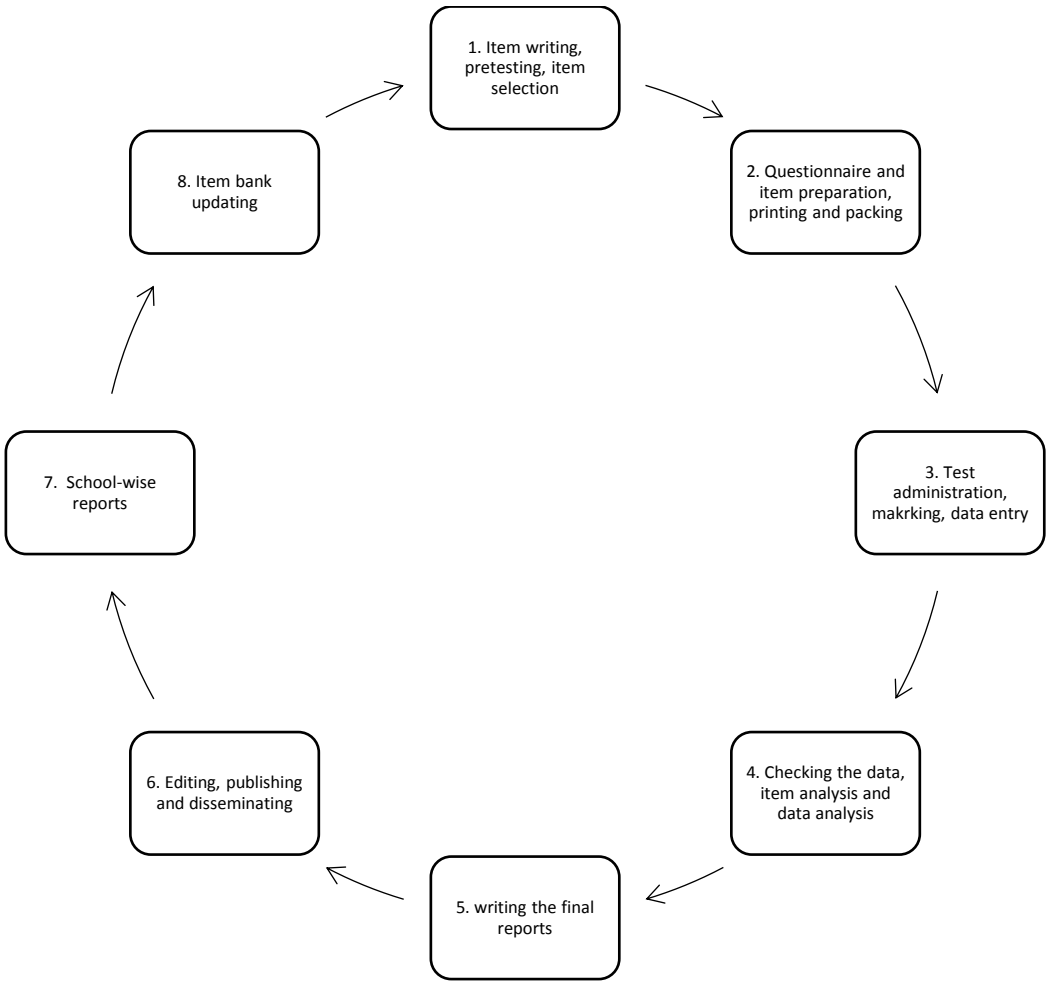


Figure 1. Phases of the student assessment process (Source: ERO (2015b)

5. **Capacity development:** The NASA 2011 was led by international consultant and during this assessment internal staff of ERO were trained to handle test analysis using IRT modelling. The subsequent exercise of NASA assessment provided opportunity for developing capacity of various agencies and teachers in test item construction, scoring answer books, score entry, and data analysis using IRT modeling. With this process, ERO personnel were trained to equate test items with internationally accepted standards.

6. **International comparison:** All national assessments followed the test standardization procedures and methodology and some items for Mathematics, Science and Reading linked with TIMSS, PISA and PIRLS.
7. **Preparation of item bank and analysis of every item:** A major characteristics feature of previous NASA was that item bank for each subject has been established and updated periodically. Each item was finalized after pre-testing are added every year. In addition, items were also drawn from international testing like TIMSS and PISA

Previous national assessments in Nepal

NASA 2011

As mentioned earlier, Nepal started adopting national assessment in 2011. The first assessment surveyed the learning status of grade 8 students in three subjects: Mathematics, Nepali and Social Studies. Altogether, 48,682 students, 1156 subject teachers and 1158 head teachers from 1201 schools from 25 districts took part in the assessment. The districts and schools represented all three ecological belts (Mountain, Hill and Terai) as well as the Development regions (Eastern, Central, Western, Mid-Western, Far-Western and Kathmandu Valley), along with both rural and urban schools as well as community and institutional schools. According to the NASA 2011 report, three versions of the final tests in each subjects were administered with the final scores equated by IRT modeling. The reliability and validity of the test was ensured by using standardized statistical analysis as well as using the specification grids of the local curriculum as prepared by the Curriculum Development Centre. The results are reported in the percentage of maximum marks where 100% represents all tasks solved and 0% none. The NASA 2011 report revealed that 1) there are great difference in achievement between students, schools, districts and developmental regions, 2) the students in institutional schools perform better than those in community schools, 3) students are apt in tasks related to memorization and recall, but are not effective in skills requiring application or ability at a higher cognitive level; 4) the low educational and social background is directly and strictly related to low results; 5) achievement level still depends on caste/ethnicity as well as on the home language of the student, 6) there are no remarkable differences between boys and girls, rural and urban schools, and across ecological zones; 7) In Nepali, achievement in reading and writing is low in absolute terms – an average student of grade 8 cannot read and write sufficiently well to manage higher studies for example. Achievement in Mathematics is not distributed normally, and in Geometry and Sets it is remarkably low when compared with the other content areas. In Social Studies, the achievement levels in Politics, History, and Civics is lower than the other content areas; 8) the results in mathematics have slightly declined from those of 2008 while the results in Nepali have increased. Reading skills are lower than at the international level.

NASA 2012

Another round of NASA assessment was initiated in 2012 with the aim of determining the learning level of grade 3 and grade 5 students in English, Mathematics, and Nepali subjects. Altogether 80,232 students (38,753 in grade 3 and 41,479 in grade 5 from randomly stratified 1690 sampled schools) participated in the assessment. The students are represented from 28 districts covering five developmental regions, three ecological zones and Kathmandu valley. According to the NASA report 2012, the key findings included 1) there is a clearly divided student population into distinct groups high-performing and low-performing, 2) there are certain contents of curricula are learnt less effectively than others, 3) students are performing well in recognizing the correct answer and in recalling the learnt facts, than in productive type of items, 4) there is a wider disparity in achievement between districts and development regions, 5) a remarkable variation exists in the performance of students between institutional and community schools, 6) there is a moderate but growing differences between the ecological belts and rural/urban schools, 7) a wider inequality exists in performance level between the different language groups, 8) socio-economic status (SES) and its components are found to have been strongly associated with the learning achievement, 9) prolonged hours of involvement in work impedes children's learning, 10) there is a greater association of over aged schooling with lower achievement, 11) the achievement level of students lacking textbook at a minimum is significantly lower than those who have access to the textbook, 12) there is a negative effect of bullying and unfair treatment from teachers on student achievement, 13) no remarkable difference exists in students' achievement because of gender and ethnicity, 14) there is low level performance of Nepalese student in comparison to international average.

NASA 2013

ERO conducted second cycle of large-scale assessment of student achievement in Mathematics, Nepali language and Science subjects in 2013. This assessment was conducted in 28 sample districts among 44, 067 students, including 48% boys and 52% girls from the randomly selected 1199 schools. The schools were selected from all ecological and developmental regions as well as from both 'community' and 'institutional' categories. As with other previous NASAs, three versions of test items in each subject were administered and reliability and validity ensured using appropriate statistical analysis, following specification grids and national curriculum and comparing the study results with the international assessment results. The test was administered throughout the sample districts and schools in the same day. The answer sheets were marked and scores recorded in computer using Optical Mark Reading (OMR) machine, and the assessment results, similar to the pervious national assessments, were presented in percentage of mean score.

According to NASA report 2013 (ERO, 2015b), the summary of the key results drawn from the analysis of the datasets of this assessment are as follows: 1) there is a wide difference in student achievement among development regions, ecological zones, districts, schools and students, 2) a remarkable gap exists in achievement score between institutional schools (57%) and community schools (26%), 3) students' performance is found better in lower levels of cognitive skills, but poor in higher cognitive skills, 4) there is caste/ethnicity and home language based variations in student achievement despite having no definite trend in achievement based on home language, 5) a remarkable rural urban difference exist in student achievement exists across all subjects, 6) achievement scores are going down over the years instead of improvement (49% in Nepali in 2011, 48% in 2013; 43% in Mathematics in 2011, 35% in 2013), 7) the unavailability of textbooks is associated with the lower level of achievement, 8) school bullying is impeding the learning potential of students (students who did not experience bullying scored 35% in Mathematics, 50% in Nepali and 42% in Science whereas students experienced extreme types of bullying have scored only 26 in Mathematics, 29% in Nepali and Science subjects each), and 9) reluctance to assign and check homework preventing students' progress (students who are assigned homework and provided appropriate feedback scored 36% in Mathematics, 50% in Nepali, and 42% in Science whereas the students who were assigned homework scored 27%, 34%, and 30% in these subjects respectively).

NASA 2015

NASA 2015 is the second round large-scale assessment accomplished in 2015 which assesses learning outcomes of 3rd Graders in Mathematics and Nepali and of 5th Graders in Mathematics, Nepali and English. As with the earlier assessments, altogether 74,078 students (33,863 in Grade 3 and 40,015 in Grade 5) from randomly stratified 1543 sampled schools participated in the assessment. Both rural and urban as well public and private schools were included from a randomly selected 23 Districts covering all five Development regions. The test items were standardized after pretesting six sets of test papers in 7724 students 153 schools from 11 Districts representing different strata. All the items were analyzed and equated using IRT modelling. In the test, the average achievement has remained at 42 to 52 varying by subjects and Grades. In Nepali, the 3rd Graders have achieved 52 percent which is 46 percent for 5th Graders. Similarly, in Mathematics, the higher Graders have achieved (48) lower Graders (45). Other major findings include: 1) distinctly divided school and student population into various groups in terms of achievement; 2) disproportionately distributed achievement level among Ecological, Development regions and Districts; 3) wider inequality in learning achievements among students by location and types of school; 4) an unbalance learning across all curricula contents; 5) lower level of cognitive ability for the tasks requiring higher ability; 6) influence of caste/ethnicity and home language backgrounds in achievement; 7) association of low socio-economic status with remarkably lower learning achievement; 8) effect of

homework and support for study in higher achievement; 9) effect of availability of textbook in students' achievement; 10) effects of attending schooling at proper ages; 11) effect of utilizing beyond school hour in achievement; and 12) stagnant learning achievement over the years (ERO, 2016, pp. 2 – 15).

International assessments

The term 'international large-scale assessment', according to Lockheed (2008), refers to assessments having three characteristics: (1) they involve multiple countries; (2) they utilize tests that are uniform and standardized across countries in terms of content, administration process, timing and scoring; and (3) they involve large samples of test-takers scientifically selected from comparable populations across countries.

International assessments provide opportunities for countries worldwide to take part in comparative survey of students' achievement in particular subject or area of knowledge that provides information about an education system in relation to one or more other systems (DFID, 2010). Such assessments are conducted periodically (in every three or four years, for example) and adheres to high technical standards of assessment design, instrumentation, sampling, administration, analysis and reporting. There is also a high degree of transparency in dissemination of the results. Ongoing participation in the international assessments enables a country to monitor student achievement over time and to examine the country's standing relative to many other countries. While the varying cultural and curriculum settings of participating countries and students need to be taken into account when interpreting the outcomes, international assessments provide an opportunity to compare the performance of students not only in countries that are similar in language, culture and economic standards of the country concerned but also in countries that are not similar. International studies also provide information on the strengths and weaknesses of the individual country in particular subject domains such as reading, mathematics and science and such information is extremely valuable in identifying areas that require further attention in school curriculum or classrooms. International studies also provide schools and students with an opportunity to experience cutting-edge assessments that are designed by international experts, applicable to all participating countries and that meet a high technical standard that is rigorously applied and monitored.

International assessments of student achievement fall into one of two categories: global assessments or regional assessments. International assessments that are carried out in countries throughout the world may be considered global. Three major global assessments are: Program for International Student Assessment (PISA), Trends in International Mathematics and Science Study (TIMSS) and Progress in International Reading Literacy Study (PIRLS). The regional assessments are undertaken in particular region to address the issue of the inappropriateness of global assessments for many countries by confining participation to countries in the same region that are

similar in their culture and economic development. Some noteworthy regional assessments are: Southern and Eastern Africa Consortium of Monitoring Educational Quality (SACMEQ), Program d'Analyse des Systèmes Éducatifs de la CONFEMEN (PASAC*),* Laboratorio Latinoamericano de Evaluatión de la Calidad de la Educatión (LLECE). The concern of this study is global assessment. Therefore, a brief introduction of PISA, TIMSS and PIRLS is provided below:

PISA: PISA is a project of Organization for Economic Cooperation and Development (OECD) that assess learners of age 15 who are nearing the end of secondary education. Started in 2001 and repeated in every three years, this survey assesses performance in reading, mathematics, science and problem solving. Special focus is placed on one of these areas in each year of assessment. Rather than focusing on particular curriculum of particular grade, PISA assesses how far students near the end of secondary schooling have acquired some of the knowledge and skills essential for full participation in society.

PISA for Development is a new initiative of OCEC to 'increase developing countries' use of PISA assessments for monitoring progress towards nationally-set targets for improvement, for the analysis of factors associated with student learning outcomes, particularly for poor and marginalized populations, for institutional capacity-building and for tracking international educational targets in the post-2015 framework being developed within the UN's thematic consultants' (OECD, 2016). This project is already working to enhance the PISA instruments and will undertake field trails in seven developing countries (Cambodia, Ecuador, Honduras, Guatemala, Paraguay, Senegal and Zambia) during 2016. The final results for PISA for Development, which are expected in 2018, will provide local policy makers with new evidence to diagnose shortcomings in their education systems and inform new policies. In the meantime, the PISA for Development countries will benefit from peer-to-peer exchanges with other members of the PISA global community. The enhanced PISA instruments will be made available to all countries for the 2021 cycle of the assessment.

According to OECD (2013), PISA for Development addresses the need of developing countries by:

- Developing contextual questionnaires and data-collection instruments that better capture diverse situations in emerging and developing countries. This will allow for a deeper understanding of how certain factors – such as the socio-economic background of students or the learning environment in classrooms – are associated with learning outcomes in different contexts.
- Adjusting the PISA test instruments so that they are sensitive to a wider range of performance levels. While there are undoubtedly high performers in all countries, a number of 15-year-old students in developing countries can be expected to perform at lower levels of proficiency. Enhanced test instruments will better capture performance differences among these students, while

maintaining the comparability of a country's results on the international PISA scales.

- Establishing methods and approaches to include out-of-school students in the PISA assessment. Though much progress has been made in increasing access to education around the world, over 60 million children of primary-school age and over 70 million children of lower-secondary-school age remain out of school. Conducting PISA only among enrolled students would provide unrepresentative results and could encourage countries to exclude potential low performers from schools.

TIMSS: Managed by the International Association for the Evaluation of Educational Achievement (IEA), TIMSS assesses achievement on mathematics and science at fourth and eighth grades in every four years. TIMSS 2015, the last one, comprises the sixth assessment in a series begun in 1995. TIMSS Advanced is a new variant that is administered to students in the final year of secondary school (usually 12th grade) to assess students' knowledge in advanced mathematics and physics. Having been administered in 1995 and most recently in 2015, TIMSS Advanced is meant for students who have engaged in studies to further prepare for the rigors of tertiary education. (TIMSS & PIRLS International Study Center, 2012).

PIRLS: This test is also organized and coordinated by the IEA. PIRLS measures trends in 10 year old learners' abilities in reading and national policy and practices related to literacy. First undertaken in 2001, this assessment is repeated every 5 years. The last of the series was administered in 2011 and next one is going to be run in 2016. A new variant of PIRLS is prePIRLS which is designed for countries in which most students at grade 4 are earlier in the process of learning to read than grade 4 children from those countries that participated in PIRLS.

Pre-PIRLS (now PIRLS Literacy) was introduced in 2011 as a less difficult version of PIRLS to make it easier for developing countries to assess the ability levels of their students at the end of the primary school cycle. Pre-PIRLS is oriented towards more basic elements of reading and is more likely to be administered at a grade higher than 4th. Pre-PIRLS was administered to only three countries in 2011. It is assumed that in some countries, students are more likely to have developed the reading comprehension competencies necessary for success on PIRLS by the fifth or sixth grade. For these countries, participation in PIRLS at the fifth or sixth grade will provide detailed information about students' strengths and weakness in an international context, whereas participation at the fourth grade will provide only the information that students lack reading comprehension skills.

As a new extension to PIRLS in 2016, ePIRLS is an innovative assessment of online reading, making it possible for countries to assess how successful they are in

preparing fourth grade students to read, comprehend, and interpret online information. ePIRLS uses an engaging, simulated internet environment with authentic school-like assignments about science and social studies topics to measure achievement in reading for informational purposes.

Table 2. Comparison Table: PISA – TIMSS – PIRLS

	PISA	TIMSS	PIRLS
Full Name	Program for International Student Assessment	Trends in International Mathematics & Science Study	Progress in International Reading Literacy Study
Assesses	Reading, mathematics, science, problem solving	Mathematics and science	Reading
Age	15	10 and 14	10
Grade	Grade 9 (UK Year 10)	Grade 4 and Grade 8 (UK Year 5 and 9)	Grade 4 (UK Year 5)
Last assessment	2015	2015	2011
Next assessment	2018	2018	2016
When	Autumn	March-June	March-June
Purpose	Evaluates education systems by assessing to what extent students at the end of compulsory education can apply their knowledge to real-life situations and be equipped for society	Measures trends in maths and science achievement Describes educational context, including home support, students' attitudes, curriculum, teachers' training, classroom activities	Measures trends in reading comprehension Investigates the experiences young children have at home and school in learning to read
Focus	Skills-based	Curriculum-based	Curriculum-based
Type pf test	Criterion-referenced	Criterion-referenced	Criterion-referenced
Achievement levels reported	Reading 1a-5, Mathematics 1 -6, Science 1-6	Low, intermediate, high, advanced	Low, intermediate, high, advanced
Supplementary information	Background information obtained from learners in a questionnaire. Focuses on characteristics of learners, attitudes to	Background information obtained from learners in a questionnaire. Information also collected about	Background information obtained from learners in a questionnaire. Information also collected about

	subjects, motivation and learning strategies	teachers, activities of schools and teachers' classroom behaviour	teachers, activities of schools and teachers' classroom behaviour
Organization	Organisation for Economic Cooperation and Development (OECD)	International Association for the Evaluation of Educational Achievement (IEA)	International Association for the Evaluation of Educational Achievement (IEA)
Countries	79 countries and economies in 2015	59 countries in 2015	55 countries and 7 sub-national entities in 2011
Test length	120 minutes, plus 15 minute background questionnaire	72 minutes at Grade 4 90 minutes at grade 8 plus 15 minute background questionnaire	80 minutes, plus 15 minute background questionnaire
No. Learners assessed	More than 5,000 learners in each country/Jurisdiction	At least 4,000 learners in each country/jurisdiction	About 3,500-4000 learners in each country/jurisdiction
Development process	Developed by international experts and PISA Consortium test developers. Test items reviewed by country representatives for cultural bias and relevance to PISA's goals	TIMSS Science & Math Item Review Committee and National Research Coordinators from participating countries develop frameworks through iterative process	PIRLS Reading Development Group and National Research Coordinators from participating countries update frameworks for each PIRLS administration and reviews test items for cultural bias
Variants	A new PISA-based test for schools was developed for 2014. It provided results for schools but not aggregated at national level - OECD ran a new survey of adult skills (age 16-65); results released in 2013.	TIMSS Advanced in maths and physics for age 18 – Grade 12 (UK Year 13) or 1st year of university	Depending on country's educational development, can be taken later than age 10 Pre-PIRLS version: less difficult

	PISA for Development is another initiative of the OECD that aims to identify how PISA can be support evidence-based policy making in emerging and developing economies.		e-PIRLS based on computer-based literacy

Source: http://www.oecd.org/pisa/home/ ; http://timss.bc.edu/index.html

Chapter 3

Comparison of PISA, TIMSS and PIRLS with National Curriculum Framework (Nepal)

This section makes a comparative analysis of PISA, TIMSS and PIRLS contents with those of the National curriculum in Nepal. It aims particularly to assess congruency and difference, if any, between the domain of international assessment and national curricula. The comparison are made based on the analysis of assessment framework of international testing and National Curriculum Framework (NCF). The comparative analysis has been made based on the framework provided in the following table (Table 3).

Table 3. Comparison framework between international assessments and national curriculum

S.N.	Subject area	International Assessment	National Curriculum
1.	Math	TIMSS grade 4 and 8 math	Mathematics Grades 5 and 8
		PISA math, Year 15	Mathematics Grade 10
2.	Science	TIMSS Science Grade 4 and 8	Science Grades 5 and 8
		PISA Science, Year 15	Mathematics Grade 10
3.	English	PISA and PIRLS Reading Framework	English Grade 10 and Grade 5
4.	Nepali	PISA and PIRLS Reading Framework	Nepali Grade 10 and Grade 5

Mathematics: TIMSS, PISA and National Curriculum

TIMSS and NCF: Grade V

TIMSS 2015 was organized in two dimensions: *content dimension*, specifying the subject matter to be assessed; and *cognitive dimension*, specifying the thinking processes to be assessed. The target percentage of testing elements devoted to each content and cognitive domain for the TIMSS 2015 and NCF of fourth grade are as follows (CDC, 2069BS; ERO, 2015a; CDC, 2007; Mullis & Martin, 2013).

Table 4. Content domain of mathematics between TIMSS and NCF

TIMSS		NCF		
Percentage	Content Domain	Content Domain	Percentage	
40%	Number	Number System	18%	50%
		Number Operations	14%	
		Fraction, Decimal, Percentage, Unliterary Method, Simple Interest	18%	
35%	Geometry and Measures	Geometry	9%	30%
		Time, Money and Measurements	16%	
		Bill and Budget	5%	
15%	Data Display	Statistics	5%	5%
10%	Algebra	Algebra	10%	15%
		Sets	5%	

Each content domain consists of topic areas, and each topic area in turn includes several topics, described as below.

Number

The number content domain in fourth grade consists of understandings and skills related to number and its operation in three topic areas. In TIMSS, these area are divided as whole numbers (25%); fractions and decimals (15%); and expressions, simple equations, and relationships (10%) (Mullis & Martin, 2013). In NCF, the areas of content domain are Number System (18%), Number Operations (14%),and Fraction, Decimal, Percentage, Unliterary Method, Simple Interest (18%) (CDC, 2065BS).

In the TIMSS and NCF, the content under whole numbers aims that students of grade V will be able to demonstrate knowledge of place value, including recognizing and writing numbers in expanded form; and represent whole numbers using words, diagrams, or symbols, compare, order, and round whole numbers, compute (+, −, ×, ÷) with whole numbers, solve problems set in contexts, including those involving measurements, money, and simple proportions, identify odd and even numbers; identify multiples and factors of numbers (CDC, 2065BS; Mullis & Martin, 2013).

In the TIMSS and NCF, the content under fractions and decimals aim that students of grade be able to recognize fractions as parts of wholes, parts of a collection, or locations on number lines, and represent fractions using words, numbers, or models, identify equivalent simple fractions; compare and order simple fractions; add and subtract simple fractions, including those set in problem situations, demonstrate knowledge of decimal place value including representing decimals using words, numbers, or models; compare, order, and round decimals; add and subtract decimals, including those set in problem situations (CDC, 2065BS; Mullis & Martin, 2013).

In the TIMSS, the content under expressions, simple equations, and relationships aims that students of grade be able to find the missing number or operation in a number

sentence identify or write expressions or number sentences to represent problem situations involving unknowns, identify and use relationships in a well-defined pattern (e.g., describe the relationship between adjacent terms and generate pairs of whole numbers given a rule), however Algebra and sets are focused in NCF (CDC, 2065BS; Mullis & Martin, 2013).

Geometric Shapes and Measures

TIMSS assessment consists of two content categories under geometric shapes and measures sense and application. These are: points, lines, and angles; and two- and three-dimensional shapes. In NCF, there are three content categories under geometry sense and application. These are: geometry; time money and mensuration and bill and budget (CDC, 2065BS; Mullis & Martin, 2013).

In the TIMSS and NCF, the content under points, lines, and angles aims that students of grade be able to measure and estimate lengths, identify and draw parallel and perpendicular lines, identify, compare, and draw different types of angles (e.g., a right angle, and angles larger or smaller than a right angle), Use informal coordinate systems to locate points in a plane (CDC, 2065BS; Mullis & Martin, 2013).

In the TIMSS, the content under two- and three-dimensional shapes aims that students of grade be able to use elementary properties to describe and compare common two- and three-dimensional geometric shapes, including line and rotational symmetry, Relate three-dimensional shapes with their two-dimensional representations, Calculate perimeters of polygons; calculate areas of squares and rectangles; and estimate areas and volumes of geometric figures by covering with a given shape or by filling with cubes. In NCF, three dimensional part are missing (CDC, 2065BS; Mullis & Martin, 2013).

Data Display

In the TIMSS and NCF, the content of assessment consists of reading, interpreting, and representing under data display category. Further, these aims that students of grade be able to read, compare, and represent data from tables, pictographs, bar graphs, line graphs and pie charts, Use information from data displays to answer questions that go beyond directly reading the data displayed (e.g., solve problems and perform computations using the data, combine data from two or more sources, make inferences, and draw conclusions based on the data) (CDC, 2065BS; Mullis & Martin, 2013).

Table 5. Analytical comparison of mathematics between TIMSS and NCF

Content Domain	TIMSS contents of areas of knowledge	National curriculum contents of areas of knowledge	What is more in TIMSS	What is more in National curriculum	Discrepancy/gap analysis
Number	Whole numbers (25%)	Number System (18%)	More emphasis on number pre-algebraic concepts also are included Represent whole numbers using diagrams, or symbols.	Identify Square, Square root, Cube, cube root, and prime factor of numbers	There is no big differences between the content domain of TIMSS and NCF. However, one of the four big idea, equation and relationships are emphasized in TIMSS. In the meantime, Number structure are emphasized in NCF
		Number Operations (14%)		Four basic opertions with number	This part is almost missing in TIMSS
	Expressions, simple equations, and relationships (10%)	Algebra and sets (15%)	Concept of equation, Problem of number sentence represent problem situations involving unknowns.	Algebraic Expressions and operations. And sets	National cucciculum covers more than TIMSS, particularly algebraic expressions and sets
	Fractions and decimals (15%)	Fraction, Decimal, Percentage, Unliterary method, Simple Interest (18%)	Set fraction in problem situations	Multiplication of fraction Conversion of fraction and percentage Simple verbal problems on percentage Calculation of simple interest with the help of unitary method	Both test have set competencies on recognize fractions/decimals, represent fractions/decimals using words, numbers, or models, identify equivalent simple fractions; compare and order simple fractions/decimals; add and subtract simple fractions/decimals, including those set in problem situations. Also both test have set their competencies on round decimals.
Geometry And Measures	Geometry And Measures 35%	Geometry 9%	Three-dimensional Shapes	Classification of triangles on the basis of angles and arms	Both test have set competencies on basic two dimensional geometrical study consisting point, line, and plane figures of triangle and
		Time, Money and		e problems on Currency,	

		Measurements 16%		rement on e, Area, ter, Capacity, e, and Weight cified.	quadrilateral. IN TIMSS three dimensional geometric objects are also introduced. IN NCF, the problems on Time, Currency is introduced.
		Bill and Budget 5%		Basic understanding of bill and budget.	
Data Display	Data Display 15%	Statistics 5%	Make inferences, and draw conclusions based on the data		Reading, Interpreting, and Representing data are included in both test whereas solving the problems and perform computations using the data are included only in TIMSS

Relevance for taking TIMSS test by Nepalese Students

Both TIMSS and NCF has identified to demonstrate knowledge of number system, geometry and measures, and data display. There is around 90% similar content. Therefore, it would not be a large gap and content mismatch while adopting TIMSS test items for Nepalese students' assessment at the end of grade V. However, the Nepalese curriculum practices need to aware from context/problem generation, mathematization of the context/problem, calculation, and verification with the context to adopt TIMSS level assessment.

TIMSS and NCF: Grade VIII

TIMSS assessment of eighth grade content domains and the target percentages of testing time devoted are given in the table below. In the same table below, the right alignments are allocated for content domains and the target percentages specification for NCF. Each content domain consists of topic areas, and each topic area in turn includes several topics (CDC, 2069BS; Mullis & Martin, 2013)

Table 6. Comparison of content domain between TIMSS and NCF

TIMSS		NCF		
Percentage	Content Domain	Content Domain	Percentage	
30%	Number	Arithmetic	28	32%
		Mensuration	4	
30%	Algebra	Algebra	23	29%
		Sets	6	
20%	Geomerty	Geometry	24	33%
		Coordinate Geometry	3	
		Transformation Geometry	6	
20%	Data and Chance	Statistics	6	6%

Number

The TIMSS assessment consists of three content categories under number sense and application. These are: whole numbers, fractions, decimals, and integers, and ratio,

proportion, and percent. In NCF, the content categories are whole number, natural number, rational number, real number, fraction and decimal, ratio and proportion, profit and loss, unitary method, simple interest, and mensuration (CDC, 2069BS; Mullis & Martin, 2013).

In the TIMSS, the content under whole numbers aims that students of grade be able to demonstrate understanding of whole numbers and operations, compute with whole numbers in problem situations, find and use multiples or factors of numbers, identify prime numbers, and evaluate powers of numbers and square roots of perfect squares. The content under fractions, decimals, and integers aims that students be able to identify, compare, or order rational numbers (fractions, decimals, and integers), compute with rational numbers (fractions, decimals, and integers) including those set in problem situations. Similarly the contents under ratio, proportion, and percent aims that students be able to identify and find equivalent ratios; and model a given situation by using a ratio and divide a quantity in a given ratio, convert among percent, proportions, and fractions, and solve problems involving percent or proportions (Mullis & Martin, 2013). In the NCF, the contents under authentic aims to develop understanding and application of number system and conversion (base 2, base 5 and base 10), whole numbers and operations, scientific notations, ratio and proportion, percentage, profit and loss, vat, tax, unitary method, simple interest, and basic problems of mensuration (CDC, 2069BS).

Algebra

TIMSS assessment consists of three content categories under Algebra sense and application. These are: expressions and operations; equations and inequalities; and relationships and functions. In NCF, there are three content categories under Algebra sense and application. These are: expressions and operations; equations and inequalities, and indices (CDC, 2069BS; Mullis & Martin, 2013).

In the TIMSS, the content under expressions and operations aims that students of grade VIII be able to find the value of an expression given values of the variables, simplify algebraic expressions involving sums, products, and powers of expressions; and compare expressions to determine if they are equivalent, and use expressions to represent problem situations. In NCF, the content under expressions and operations aims that students of grade VIII be able to factorize and simplify algebraic expressions involving sums, products, and powers of expressions; find HCF, LCM and compare expressions, and use expressions to represent problem situations (CDC, 2069BS; Mullis & Martin, 2013).

In TIMSS, the content under equations and inequalities aims that students of grade VIII be able to write equations or inequalities to represent situations, solve linear equations, linear inequalities, and simultaneous linear equations in two variables. In NCF, the content under equations and inequalities aims that students of grade VIII be able to write equations or inequalities one and two variable to represent situations,

solve linear equations, linear inequalities, quadratic equation, and simultaneous linear equations in two variables with mathematical and graphical methods (CDC, 2069BS; Mullis & Martin, 2013).

In TIMSS, the content under relationships and functions aims that students of grade be able to generalize pattern relationships in a sequence, or between adjacent terms, or between the sequence number of the term and the term, using numbers, words, or algebraic expressions, interpret, relate, and generate representations of functions in tables, graphs, or words, and identify functions as linear or non-linear; contrast properties of functions from tables, graphs, or equations; and interpret the meanings of slope and y-intercept in linear functions. In NCF the focus is given in indices and its simplification. In addition, NCF has introduced set operations aiming that students of grade VIII be able to identify and work on set operations using Venn-diagrams (CDC, 2069BS; Mullis & Martin, 2013).

Geometry

TIMSS contents for the assessment of grade VIII students aims to extend the understandings of shapes and measures assessed at the fourth grade. The content areas for TIMSS in geometry block are divided into three topic areas. These topic areas in geometry are geometric shapes; geometric measurement; and location and movement. In NCF, contents for the assessment of grade VIII students are divided into three topic areas. These topic areas in geometry are line and angle measurements, triangle, quadrilateral and polygons, congruence and similar, circle, and solids, coordinate geometry and transformation geometry. Basically, these NCF contents are also related with geometric shapes, geometric measurement and geometric location and movement (CDC, 2069BS; Mullis & Martin, 2013).

The TIMSS contents under geometric shapes and the NCF contents such as triangle, quadrilateral and polygons, congruence and similar, circle, and solids aim that students of grade VIII be able to identify different types of angles and use the relationships between angles on lines and in geometric figures, identify geometric properties of two- and three-dimensional shapes, including line and rotational symmetry, identify congruent triangles and quadrilaterals and their corresponding measures; and identify similar triangles and use their properties. Both contents aim to enable students to relate three-dimensional shapes with their two-dimensional representations (e.g., nets, two-dimensional views of three-dimensional objects) and use geometric properties, including the Pythagorean Theorem, to solve problems (CDC, 2069BS; Mullis & Martin, 2013).

In TIMSS, the content under geometric measurement and the contents line and angle measurements under NCF aims that students of grade VIII be able to draw and estimate the size of given angles, line segments, and perimeters; and estimate areas and volumes, select and use appropriate measurement formulas for perimeters,

circumferences, areas, surface areas, and volumes; and find measures of compound areas (CDC, 2069BS; Mullis & Martin, 2013).

In TIMSS, the contents under location and movement and the content of coordinate geometry and transformation geometry under NCF aims that students of grade VIII be able to locate points and solve problems involving points in the cartesian plane, recognize and use geometric transformations (translation, reflection, and rotation) of two-dimensional shapes (CDC, 2069BS; Mullis & Martin, 2013).

Data and Chance

TIMSS contents for the assessment of grade VIII students in data and chance block are divided into three topic areas. These three topic areas are: characteristics of data sets; data interpretation; and chance. In NCF, the contents for the assessment of grade VIII students under statistics block are divided into mean, median, mode, range line graph and pie chart (CDC, 2069BS; Mullis & Martin, 2013).

In TIMSS and NCF both, the contents aim that students of grade eight be able to identify and compare characteristics of data sets including mean, median, mode, range, and shape of distributions (in general terms), calculate, use, or interpret mean, median, mode, or range to solve problems (CDC, 2069BS; Mullis & Martin, 2013).

In TIMSS and NCF, the content further aims that students of grade be able to read data from a variety of visual data displays, use and interpret data sets to solve problems (e.g., make inferences, draw conclusions, and estimate values between and beyond given data points), identify and describe approaches to organizing and displaying data that could lead to misinterpretation (CDC, 2069BS; Mullis & Martin, 2013).

In TIMSS, the content under chance aims that students of grade be able to judge chances of outcomes as certain, more likely, equally likely, less likely, or impossible in general terms, use data, including experimental data, to estimate the chances of future outcomes, given a process designed to be random, determine the chances of possible outcomes (CDC, 2069BS; Mullis & Martin, 2013).

Table 7. Analytical comparison of mathematics (Grade VIII) between TIMSS and NCF

TIMSS Contents/Areas of Knowledge	National curriculum contents/Areas of knowledge	What is more in TIMSS	What is more in National curriculum	Discrepancy/gap analysis
Number 30%	Arithmetic (28%)	Multiples or factors of numbers, identify prime numbers, and evaluate powers of numbers and square roots of perfect squares	Number system and conversion (base 2, base 5 and base 10), scientific notations, profit and loss, vat, tax, unitary method, simple interest	There is almost similar contents in both test. The TIMSS assessment consists whole numbers, Fractions, decimals, and integers, and Ratio, proportion, whereas the contents categories in NCF are whole number, natural number, rational number, real number, fraction and decimal, ratio and proportion, profit and loss, unitary method, simple interest, and mensuration. Some of the day to day home arithmetic and mensuration are added in NCF.
			Basic problems of mensuration	
Algebra 30%	Algebra (23%)	Find the value of an expression given values of the variables, Relationships and functions	Factorize, find HCF, LCM, equation solve by graphical methods, Indices	The contents of TIMSS are divided into three content categories under Algebra sense and application. These are: Expressions and operations; Equations and inequalities; and Relationships and functions, whereas the contents of NCF are divided into Expressions and operations; Equations and inequalities, and Indices. So the almost contents are similar in nature. NCF has also included the contents from Set.
	Sets (6%)		Set operations and venn-diagrams	
Geometry 20%	Geometry (28%)	Identify different types of angles, geometric properties of two- and three-dimensional shapes, congruent triangles and quadrilaterals and their corresponding measures; and similar triangles Calculate and estimate angles, line segments, and perimeters; and estimate areas and volumes, select and use appropriate measurement formulas for perimeters, circumferences, areas, surface areas, and volumes; and locate points in the Cartesian plane, recognize and use geometric transformations (translation,		Both test TIMSS and NCF's contents for the assessment of grade VIII students are similar. The content areas for TIMSS in geometry block are divided into three topic areas: Geometric shapes; Geometric measurement; and Location and movement whereas the content categories under NCF are divided into line and angle measurements,
	Coordinate Geometry (3%)			
	Transformation Geometry (6%)			

		reflection, and rotation) of two-dimensional shapes.		Triangle, quadrilateral and polygons, congruence and similar, circle, and solids, coordinate geometry and transformation geometry.
Data and Chance 20%	Statistics (6%)	More emphasis on interpretation of data and the fundamentals of probability (called "chance")	More emphasis on calculation	In TIMSS and NCF, the contents for the assessment of grade VIII students in data and chance block are divided into Characteristics of data sets; Data interpretation comprising mean, median, mode, range line graph and pie chart. There is almost similar contents for assessment

Relevance for taking TIMSS test by Nepalese students

Both TIMSS and NCF has identified to demonstrate knowledge of Number, Algebra, Geometry, data. There is around 90% similar content. Therefore it would not be large gap and content mismatch while adopting TIMSS test items by Nepalese students' assessment at the end of grade VIII. However, the Nepalese curriculum practices of grade VIII need to aware from context/problem generation, mathematization of the context/problem, calculation, and verification with the context while adopting TIMSS assessment items.

PISA: Grade X

PISA assessment of Tenth Grade content domains and the target percentages of testing devoted are given in the table below. The trend items selected for PISA 2015 are distributed across the four content categories. In the same table below, the right alignments are allocated for content domains and the target percentages specification for NCF. Each content domain consists of topic areas, and each topic area in turn includes several topics (CDC, 2071BS; OECD, 2016).

Table 8. Comparison of content domain of Mathematics between PISA and NCF

PISA		NCF		
Percentage	Content Domain	Content Domain	Percentage	
25%	Change and Relationships	Algebra	20	25%
		Sets	5	
25%	Space and Shape	Geometry	26	40%
		Mensuration	14	
25%	Quantity	Arithmetic	12	20%
		Trigonometry	8	
25%		Statistics	10	15%

	Uncertainty and Data	Probability	5	

Table 8(a) Contxt and Process category

Context Category		Process Category	
Personal	25%	Formulating situations mathematically	25%
Occupational	25%	Employing mathematical concepts, facts, procedures and reasoning	50%
Societal	25%	Interpreting, applying and evaluating mathematical outcomes	25%
Scientific	25%		

Change and relationships

PISA contents for the assessment of grade X students in change and relationships block are concerned with functions and algebra, including algebraic expressions, equations and inequalities, tabular and graphical representations, are central in describing, modelling and interpreting change phenomena, representations of data and relationships, defining and interpreting change and relationships. These contents in PISA accessed the students' performance in three context category personal, occupational, societal and scientific, and in three process category; formulating situations mathematically, employing mathematical concepts, facts, procedures and reasoning, interpreting, applying and evaluating mathematical outcomes. In NCF the content category are divided into algebra and sets. The contents in NCF are categorized in Bloom's taxonomy for assessment (CDC, 2071BS; OECD, 2016).

PISA assessment contents for Grade X under change and relationships category are divided into three sub units. These are functions, algebraic expressions, and equations and inequalities. These contents in PISA aims that students will be able to understands and apply the concept of function, emphasizing but not limited to linear functions, their properties, and a variety of descriptions and representations of them, verbal, symbolic, tabular and graphical representation, whereas NCF includes the contents from factorization, HCF, LCM, radical surds, Venn diagram and set operations. In addition both PISA and NCF constitutes the contents on verbal interpretation of and manipulation with algebraic expressions, powers and simple roots, linear and related equations and inequalities, simple second-degree equations, and analytic and non-analytic solution methods (CDC, 2071BS; OECD, 2016).

Space and shape

PISA contents for the assessment of grade X students in Space and shape block are concerned with visual and physical world: patterns, properties of objects, positions and orientations, representations of objects, decoding and encoding of visual information, navigation and dynamic interaction with real shapes as well as with

representations. Geometry under space and shape category extends beyond traditional geometry in content, meaning and method, drawing on elements of other mathematical areas such as spatial visualization, measurement and algebra. Dynamic Geometry Software (DGS), Global Positioning System (GPS) software are included in this content category. These contents in PISA accessed the students' performance in three context category personal, occupational, societal and scientific, and in three process category; Formulating situations mathematically, Employing mathematical concepts, facts, procedures and reasoning, Interpreting, applying and evaluating mathematical outcomes. In NCF the content category are divided into quadrilateral and circle, the experimental verification, deductive derivation, and construction of related theorems and concepts. The contents in NCF are categorized in Bloom's taxonomy for assessment (CDC, 2071BS; OECD, 2016).

PISA assessment contents under space and shape category are divided into three sub units. These are co-ordinate systems, relationships within and among geometrical objects in two and three dimensions, and measurement. These contents in PISA aims that students will be able to understand and apply representation and description of data, position and relationships, relationships within and among geometrical objects in two and three dimensions: static relationships such as algebraic connections among elements of figures, relative position, similarity and congruence, and dynamic relationships involving transformation and motion of objects. NCF and PISA both constitutes the contents from correspondences between two- and three-dimensional objects, quantification of features of and among shapes and objects, such as angle measures, distance, length, perimeter, circumference, area and volume (CDC, 2071BS; OECD, 2016).

Quantity

PISA contents for the assessment of grade X students in quantity block are concerned with understanding measurements, counts, magnitudes, units, indicators, relative size, and numerical trends and patterns. Aspects of quantitative reasoning – such as number sense, multiple representations of numbers, elegance in computation, mental calculation, estimation and assessment of reasonableness of results – are the essence of mathematical literacy relative to quantity. Thus mathematical literacy in the area of quantity applies knowledge of number and number operations in a wide variety of settings. These contents in PISA accessed the students' performance in three context category : personal, occupational, societal and scientific; and in three process category: formulating situations mathematically, employing mathematical concepts, facts, procedures and reasoning, interpreting, applying and evaluating mathematical outcomes. In NCF the content category are divided into tax, vat, money, bill and budget, simple and compound interest, population growth and depreciation. In addition, NCF has included contents from trigonometric relation and calculations. The contents in NCF are categorized in Bloom's taxonomy for assessment (CDC, 2071BS; OECD, 2016).

PISA contents for the assessment of grade X students in uncertainty and data block are concerned with numbers and units, arithmetic operations, percent, ratios and proportions, counting principles and estimation. These contents in PISA aim that students will be able to understand and apply concepts, representations of numbers and number systems, including properties of integer and rational numbers, relevant aspects of irrational numbers, as well as quantities and units referring to phenomena such as time, money, weight, temperature, distance, area and volume, and derived quantities and their numerical description, the nature and properties of these operations and related notational conventions, numerical description of relative magnitude and the application of proportions and proportional reasoning to solve problems, simple combinations and permutations, purpose-driven approximation of quantities and numerical expressions, including significant digits and rounding(CDC, 2071BS; OECD, 2016).

Uncertainty and data

PISA contents for the assessment of grade X students in uncertainty and data block are concerned with recognizing the place of variation in processes, having a sense of the quantification of that variation, acknowledging uncertainty and error in measurement, and knowing about chance. Furthermore,It includes forming, interpreting and evaluating conclusions drawn in situations where uncertainty is central. The presentation and interpretation of data are key concepts in this category.

There is uncertainty in scientific predictions, poll results, weather forecasts and economic models. The focus on the interpretation and presentation of data is an important aspect of the uncertainty and data category. These contents in PISA accessed the students' performance in three context category personal, occupational, societal and scientific, and in three process category:formulating situations mathematically, employing mathematical concepts, facts, procedures and reasoning, Interpreting, applying and evaluating mathematical outcomes. In NCF the content category are divided into statistics and probability. The contents in NCF are categorized in Bloom's taxonomy for assessment. (CDC, 2071BS; OECD, 2016).

PISA assessment contents under uncertainty and data category are divided into four sub units: data collection, representation and interpretation, data variability and its description, samples and sampling, and chance and probability. The contents in PISA and NCF both aim that students will be able to understands and apply nature, genesis and collection of various types of data, and the different ways to represent and interpret them, concepts such as variability, distribution and central tendency of data sets, and ways to describe and interpret these in quantitative terms, notion of random events, random variation and its representation, chance and frequency of events, and basic aspects of the concept of probability. However, PISA has included contents from concepts of sampling and sampling from data populations, including simple inferences based on properties of samples (CDC, 2071BS; OECD, 2016).

Table 9. Analytical comparison of mathematics between PISA and NCF

PISA Contents/Areas of Knowledge	National curriculum contents/Areas of knowledge	What is more in PISA	What is more in National curriculum	Discrepancy/gap analysis
Change and Relationships	Algebra Sets	concept of function and their representations	HCF, LCM, radical surds, Venn diagram and set operations	In PISA and NCF, the contents for the assessment of grade X are almost similar. There is no radical differences.
Space and Shape	Geometry Mensuration	Use of Dynamic software DGS, GPS	quadrilateral and circle, the experimental verification, deductive derivation, and construction of related theorems and concepts	In PISA and NCF, the contents for the assessment of grade X are almost similar for space and shape category. There is no large differences in the contents. However PISA have included and integrated technology in the curriculum.
Quantity	Arithmetic Trigonometry	application of proportions and proportional reasoning, Counting principles	Simple and compound interest, population growth and depreciation	In PISA and NCF, the contents for the assessment of grade X are almost similar for quantity category. There is no large differences in the contents. However PISA have focused on use of ratio and proportion and counting principal whereas NCF have focused on home arithmetic.
Uncertainty and Data	Statistics Probability	sampling and sampling from data populations, including simple inferences based on properties of samples		In PISA and NCF, the contents for the assessment of grade X are almost similar for uncertainty and data category. There is no large differences in the contents. However PISA have included sampling and inference.

Relevance for taking PISA test by Nepalese students

Both PISA and NCF have contents such as change and relationships, space and shape, quantity, and uncertainty and data. There is around 90% similar content. Therefore it would not be a large gap and content mismatch while adopting PISA test items by Nepalese students' assessment at the end of grade X. Since the PISA assessment are based on context, process, and content, the Nepalese curriculum practices of grade X need to aware from context/problem generation, mathematization of the

context/problem, calculation, and verification with the context while adopting PISA assessment items.

TIMSS and NCF: Grade V

Content Area/Domain

There are three major content domains in TIMSS Science grade IV assessment: life science, physical science, and earth science where as in NCF, the fifth grade contents include living beings, environment, matter and energy, earth and the universe, information technology and simple technologies. The comparison of the framework of content domain is shown in the following table.

Table 10. Comparison of content area/domain of science between NCF and TIMSS

NCF		**TIMSS**	
Content Domains	**Percentage**	**Content Domains**	**Percentages**
Living beings	35%	Life science	45%
Environment	14%	Physical science	35%
Matter and energy	18%	Earth science	20%
Earth and the universe	17%%	--	--
Information technology	8%	--	--
Simple technologies	8%	--	--
Total	**100**	**Total**	**100**

Each of these content domains includeone or more major topic areas, and each topic area and include several sub-topics. Each topic is further described by specific objectives that represent the learning that students should accomplish within each topic.

NCF is provisioned the six major content areas like living beings, environment, matter and energy, earth and the universe, information technology and simple and indigenous technology. It gives more priority on study of living beings (35%) in course . Physical part i.e., matter and energy (18%) covers very less i.e., nearly half as it is given in the TIMSS framework of study. Physics portion is allocated 35% in TIMSS and life science covers 45% priority. Earth science is given equal importance i.e., 17% and 18% respectively in both NCF and TIMSS framework respectively.

Similarly, in the framework of NCF, information technology, environmental studies and simple and indigenous technology are given priority with the percentage of 8%, 14% and 8% respectively which are not focused in TIMSS test of framework.

Across the fifth grade assessment, each objective receives approximately equal weight in terms of time allocated to assessing these objectives. The verbs used in the performance objectives are intended to represent typical performances expected of fifth graders, but are not intended to limit performances to a particular cognitive domain. Each performance objective can be assessed drawing on any of the three cognitive domains.

Table 11. Provision of cognitive domain at national curriculum framework and TIMSS

NCF		**TIMSS**	
Domain	**Percentage**	**Domain**	**Percentage**
Knowledge	20%	Knowing	40%
Understanding	30%	Applying	40%
Higher abilities	50%	Reasoning	20%

Higher abilities are not specified in NCF but in the TIMSS framework of study, higher abilities like reasoning is mentioned (20%). Analyzing, creating are missing in TIMSS framework but in NCF, it has given the space. Science is the practical based subject of psychomotor domain has very important role to develop science process skills among the fifth graders (Krapp, 2011). So, all the aspects and domains should be addressed by the curriculum.

Table 12. Provision of Specification Grid for 5th Graders at NCF

Areas	**K (30%)**	**U (40%)**	**A (20%)**	**HA (10%)**
Physics	7.5	10	5	2.5
Chemistry	4.5	6	3	1.5
Biology	4.5	6	3	1.5
Astronomy and geology	1.5	2	0	1.5
Environmental education	4.5	6	3	1.5
Total	**22.5**	**30**	**14**	**8.5**

A detailed **s**pecification grid is provided in the NCF and to develop questions in TIMSS, a grid is designed on the basis of major areas mentioned in the curriculum.

Table 13. Framework of the Topics/Areas in NCF and TIMSS

NCF		**TIMSS**	
Discipline/ Area	**Topics**	**Discipline/ Area**	**Topics**
Living beings	Vertebrate and invertebrate animals Oviparous and viviparous animals Land animals Aquatic animals Life processes of living beings	Life science	Characteristics and life processes of organism and life cycles Reproduction and heredity, organisms, environment and their interactions Ecosystems Human health
Environment	Natural disasters and their controlling measures Relationship between living and non-living beings	Physical science	Classification and properties of matter and changes in matter Forms of energy and energy transfer Forces and motion
Matter and energy	Matter and its states Energy (heat and light) Effects of heat in daily life Methods of conservation of energy	Earth science	Earth's structure, physical characteristics, and resources Earth's processes and history Earth in the solar system
Earth and the universe	Monsoon, climate change and its effects Atmosphere, lithosphere and hydrosphere Structure of the earth The solar system	--	--
Information technology	Sources of information Ways of communication (one way and two way communication). Importance of communication technology.	--	--
Simple technologies	Traditional water mill, indigenous technology, pump set and hand pump	--	--

The framework of content in NCF is divided into six major topics. Each of these content domains includes one or more major topic areas, and each topic area in turn includes several topics. Each topic is further described by specific objectives that represent the learning that students should accomplish within each topic. Across the fifth grade assessment, each objective receives approximately equal weight in terms of time allocated to assessing the objective. The action verbs used in the performance objectives are intended to represent typical performances expected of fifth graders, but are not intended to limit performances to a particular cognitive domain. Each performance objective can be assessed drawing on each of the three cognitive domains i.e., knowledge, understanding and higher abilities.

Provision of evaluation criteria for 5th graders at NCF and TIMSS

The NCF framework (Grade V) has offered different techniques to assess the students' performance. These are observation, project work, exercise discussion and hands on and minds on activities. But in the framework of TIMSS, each student is required to take a two-hour handwritten test. Part of the test is multiple-choice and part involves fuller answers. There are six and a half hours of assessment materials, but each student is not tested on all the parts. Following the cognitive test, participating students spend nearly one more hour answering a questionnaire on their background including learning habits, motivation, and family. School directors fill in a questionnaire describing school demographics, funding, etc.

Provision of Practical Domain at National Curriculum Framework and TIMSS

TIMSS incorporates practical works in science. These practices include skills from daily life and school studies that students use in a systematic way to conduct scientific inquiry and that are fundamental to all science disciplines. Increasing emphasis has been placed on science practices and science inquiry in many countries' current science curricula, standards, and frameworks. The TIMSS 2015 Science Framework takes the position that the understandings and skills required to undertake science practices cannot be assessed in isolation, but must be assessed in the context of one of the content domains, and draw upon the range of thinking processes specified in the cognitive domains (Nola, 2005). Therefore, some items in the TIMSS 2015 science assessment at both the fifth and eighth grades assess one or more of these important science practices as well as content specified in the content domains and thinking processes specified in the cognitive domains.

The provision of practical activities and specification grid provisioned in NCF is given below:

Table 14. Practical activities and specification grid provisioned in NCF

S. No.	**Activities**	**Marks**
1	Drawing, labeling and description	5
2	Recording	5
3	Material development and its use	5
4	Report writing	6
5	Interview/Interview	4
Total		**25**

The provision of practical activities in science is very important as it is practical based subject. Practical work follows the basic principle of learning by doing. Students get an opportunity to activity participate in the learning process. Practical work helps in acquiring of scientific knowledge and scientific outlook, the twin main objectives of teaching science. By doing experiments students learn how to handle and operate apparatus etc. Through practical work the students learn many good habits like resourcefulness, initiative, co-cooperation etc. (Acharya, 2010). Validity of the concepts learned by the students can be tested by experimentation. This satisfies basic human desire of knowledge of what, how and why of things. Lab work develops scientific attitude and scientific temper. By doing experiments, students are motivated to know more and more of science.

TIMSS and NCF: Grade VIII

Content Area/Domain

The framework of content areas at NCF has been divided into five major areas mentioned on the table below.

Table 15. Content are/domain between TIMSS and NCF

NCF		**TIMSS**	
Domain/Area	**Percentage**	**Domain/Area**	**Percentage**
Physics	25%	Biology	35%
Chemistry	15%	Chemistry	20%
Biology	15%	Physics	25%
Astronomy and geology	5%	Earth science	20%
Environmental education	15%	--	--
Practical activities	25%	--	--
Total	**75+ (25 practical)=100%**	**Total**	**100%**

TIMSS framework content domain does not cover the environmental aspect of learning. Practical portion is provisioned 25% is not decreased in the course domain of TIMSS. Astronomy portion has given more importance i.e., (20%) at TIMMS and it is only (15%) in the course of national curriculum framework, Nepal.

Table 16. Specification grid in NCF for eight graders

Areas	**K (30%)**	**U (40%)**	**A (20%)**	**HA (10%)**
Physics	7.5	10	5	2.5
Chemistry	4.5	6	3	1.5
Biology	4.5	6	3	1.5
Astronomy and geology	1.5	2	0	1.5
Environmental education	4.5	6	3	1.5
Total	**22.5**	**30**	**14**	**8.5**

The specification grid proposed by CDC is based on cognitive domain and not prefer on any affective and psychomotor abilities of students in science.

Table 17. Provision of Specification Grid for Eight Graders at TIMSS

Content Category	Number of Items	No. of Multiple-Choice Items	No. of Short-Answer Items	No. of Extended-Response Items
Science	5	2	1	2
Life science	28	20	5	3
Physical science	22	15	4	3
Environmental issues and the nature of science	6	3	1	2
Total	61	40	11	10

Performance Expectation	No. of Items	No. of Multiple-Choice Items	No. of Short-Answer Items	No. of Extended-Response Items
Understanding simple information	19	42	1	1
Understanding complex information	22	21	5	4
Theorizing, Analyzing and solving problems	13	3	6	5
Sciene Process	6	5	1	0
Investigating the natural world	1	1	0	0

Specification grid proposed by TIMSS contains content category and performance category in which science process skills along with cognitive domain abilities are mentioned. It is very important to study science.

Content Domains for Eight Graders at TIMSS

Five major content domains defined the science content for the TIMSS Science is biology, chemistry, physics, and earth science. It shows the target percentages for each of the five content domains in the TIMSS 2015 science assessment.

Table 18. Content domain for eighth graders at TIMSS

Eighth Grade Content Domains	**Percentages**
Biology	35%
Chemistry	20%
Physics	25%
Earth science	20%

These three cognitive domains are used at five grades; however the target percentages for each domain vary between fifth and eighth grade in accordance with the increased cognitive ability, instruction, experience, and breadth and depth of understanding of students at the higher grade level. The percentage of items that involve knowing is higher at the fifth grade while the percentage of items that ask students to engage in reasoning is higher at the eighth grade. While there is some hierarchy across the three domains (from knowing to applying to reasoning), each domain contains items representing a full range of difficulty. The above table shows the target percentages for each of the three cognitive domains at the eighth grade. For the eighth grades, each content domain includes items developed to address each of the three cognitive domains. For example, the life science content domain will include knowing, applying, and reasoning items, as will the other content domains. In this aspect (David, 2005) stressed that higher abilities along with critical thinking contents should be kept in the science curriculum. In the curriculum, there is no space for the development of critical thinking practices in science subject.

Items in this domain assess students' knowledge of facts, relationships, processes, concepts, and equipment. Accurate and broad-based factual knowledge enables students to successfully engage in the more complex cognitive activities essential to the scientific enterprise.

Table 19. Framework of content in national curriculum framework and TIMSS

NCF		**TIMSS**	
Domains	**Sub topics**	**Domains**	**Sub topics**
Physics	Measurement Speed and velocity Simple machine Pressure Work, energy and power Heat	Physics	Physical states and changes in matter; Energy transformation and transfer; Light and sound; Electricity and magnetism; and

	Light Sound Electricity and magnetism		Forces and motion.
Chemistry	Matter Mixture Metals and non-metals Acids, bases and salts Some useful gases	Chemistry	Composition of matter; Properties of matter; and Chemical change.
Biology	Animal kingdom Cells and tissues Life processes	Biology	Characteristics and life processes of organisms; Cells and their functions; Life cycles, reproduction, and heredity; Diversity, adaptation, and natural selection; Ecosystems; and Human health.
Astronomy and geology	Structure of the earth Monsoon and climate The earth and the universe	Earth science	Earth's structure and physical features; Earth's processes, cycles, and history; Earth's resources, their use and conservation; and Earth in the solar system and the universe.
Environmental education	Environmental and its balance Environmental pollution and its prevention Environment and sustainable development	--	--

Cognitive Domains for Eighth Grades at NCF and TIMSS

The cognitive dimension is divided into three domains which describes the thinking processes students are expected to use when encountering the science items developed for TIMSS 2015. The first domain includes the skills such as: knowing, addresses the student's ability to recall, recognize, and describe facts, concepts, and procedures whichare necessary for a solid foundation in science. The second domain, incorporates the sub skills such as: applying, focuses on using this knowledge to generate explanations and solve practical problems. The third domain covers the sub-skills, such as: reasoning, includes using evidence and science understanding to analyze, synthesize, and generalize, often in unfamiliar situations and complex contexts.

These three cognitive domains are used in both grades; however the target percentages for each domain vary between fifth and eighth grade in accordance with the increased cognitive ability, instruction, experience, and breadth and depth of understanding of students at the higher grade level. The percentage of items that involve knowing is higher at the fifth grade while the percentage of items that ask

students to engage in reasoning is higher at the eighth grade. While there is some hierarchy across the three domains (from knowing to applying to reasoning), each domain contains items representing a full range of difficulty. Following table shows the target percentages for each of the three cognitive domains at the fifth and eighth grades.

Table 20. Comparison of content domain between NCF and TIMSS

NCF			**TIMSS**	
Cognitive domain	**Percentage**		**Cognitive Domain**	**Percentage**
Knowledge	20%		Knowing	35%
Understanding	30%		Applying	35%
Higher abilities	50%		Reasoning	30%

Items in this domain assess students' knowledge of facts, relationships, processes, concepts, and equipment. Accurate and broad-based factual knowledge enables students to successfully engage in the more complex cognitive activities essential to the scientific enterprise. Items in this domain require students to engage in applying knowledge of facts, relationships, processes, concepts, equipment, and methods in contexts likely to be familiar in the teaching and learning of science. Items in this domain require students to engage in reasoning to analyze data and other information, draw conclusions, and extend their understandings to new situations. In contrast to the more direct applications of science facts and concepts exemplified in the applying domain, items in the reasoning domain involve unfamiliar or more complicated contexts. Answering such items can involve more than one approach or strategy. Scientific reasoning also encompasses developing hypotheses and designing scientific investigations.

Provision of Science Practices in National Curriculum Framework and TIMSS

Students of science must become proficient in science process skills to develop an understanding of how the scientific enterprise is conducted. These practices include skills from daily life and school studies that students use in a systematic way to conduct scientific inquiry. Five practices are fundamental to scientific inquiry are represented in TIMSS 2015 for grade eight students which are as follows:

i. Asking questions based on observations: Scientific inquiry includes observations of phenomena in the natural world with unfamiliar characteristics or properties. These observations lead to questions, which are used to formulate testable hypotheses to help answer those questions.

ii. Generating evidence: Testing hypotheses requires designing and executing systematic investigations and controlled experiments in order to generate evidence to support or refute the hypothesis. Scientists must relate their

understanding of a science concept to a property that can be observed or measured in order to determine the evidence to be gathered, the equipment and procedures needed to collect the evidence, and the measurements to be recorded.

iii. Working with data: Once the data are collected, scientists summarize it in various types of visual displays and describe or interpret patterns in the data and explore relationships between variables.

iv. Answering the research question: Scientists use evidence from observations and investigations to answer questions and support or refute hypotheses.

v. Making an argument from evidence: Scientists use evidence together with science knowledge to construct explanations, justify and support the reasonableness of their explanations and conclusions, and extend their conclusions to new situations.

These science practices cannot be assessed in isolation, but must be assessed in the context of one of the science content domains, and by drawing upon the range of thinking processes specified in the cognitive domains. Therefore, some items in the TIMSS 2015 science assessment at both the fifth and eighth grades will assess one or more of these important science practices as well as content specified in the content domains and thinking processes specified in the cognitive domains.

PISA and NCF: Grade X

The twenty-first century is characterized as the age of globalization, protection of human rights and child rights, demand for peace through scientific literacy. Under the vision of developing scientific literacy, science education to the community people is regarded as the fundamental right. It pointed out that sustainable development is dependent upon a scientific and technologically literate population and called on governments, public and private sector interests to review educational provision. Priority should be given to providing equal access for all boys, girls, men and women to science and technological literacy. The 1993 Declaration urged agencies, NGOs, INGOs and governments to work together to advance the capability of countries for designing, planning and implementing programs to enhance scientific and technological literacy for all (UNESCO, 2006). It recommended that UNESCO made provision during this decade for an international program of co-operation in the field of science and technology education to develop scientific literacy to the people (ibid).

The main aim of science subject at the school level in Nepal is to understand the nature of scientific and technological literacy in relation to local culture and values and national social and economic needs and aspirations. It helps to support for non-formal, informal and life-long learning strategies to develop scientific literacy among the Nepalese people. Scientific and technological literacy, in its broadest sense, means

much more than simply being able to read, understand and write about science and technology (Shrestha, 2009). It includes the ability to apply scientific and technological concepts and process skills to the life, work and culture of one's own society (ibid).

On the other hand, Program for International Students Achievement (PISA) is an ongoing program that will lead to the development of a body of information for monitoring trends in the knowledge and skills of students in various countries as well as in different demographic subgroups of each country. The major domain in 2015 in science is to develop scientific literacy. Through questionnaires distributed to students, parents, school principals and teachers, it gathers information about students' home background, their approaches to learning and their learning environments in science.

Feature of PISA related Science

- Policy orientation connects data on student learning outcomes with data on students' backgrounds and attitudes towards learning, and on key factors that shape their learning in and outside school, in order to highlight differences in performance patterns and identify the characteristics of schools and education systems that perform well.
- Innovative concept of literacyrefers to students' capacity to apply knowledge and skills in science subject, and to analyses reason effectively as they identify, interpret and solve problems in a variety of situations.
- Relevance to lifelong learning, as PISA asks students to report on their motivation to learn, their beliefs about themselves and their learning strategies.
- Regularityenables countries to monitor their progress in meeting key learning objectives.

Framework of Science Domain in National Curriculum Framework and PISA

The ability to engage with science-related issues, and with the ideas of science, as a reflective citizen. A scientifically literate person is willing to engage in reasoned discourse about science and technologyrequires the competencies to plain phenomena scientifically and evaluate explanations for a range of natural and technological phenomena (Lederman, 2006). It includes the skills such as: evaluate and design scientific enquiry ,appraise scientific investigations and propose ways of addressing questions scientifically, interpret data and evidence scientifically and evaluate data, claim and argument in a variety of representations and draw appropriate scientific conclusions.

PISA assesses students' performance in science through questions related to:

Contexts: Personal, local/national and global issues, both current and historical, which demand some understanding of science and technology.

Knowledge: An understanding of the major facts, concepts and explanatory theories that form the basis of scientific knowledge. Such knowledge includes knowledge of both the natural world and technological artifacts (content knowledge), knowledge of how such ideas are produced (procedural knowledge), and an understanding of the underlying rationale for these procedures and the justification for their use (epistemic knowledge).

Competencies: The ability to explain phenomena scientifically, evaluate and design scientific enquiry, and interpret data and evidence scientifically.

Attitudes: A set of attitudes towards science indicated by an interest in science and technology, valuing scientific approaches to enquiry, where appropriate, and a perception and awareness of environmental issues. The second, "support for scientific enquiry" in the previous cycles, was changed to a measure of "valuing scientific approaches to enquiry", which is essentially a change in terminology to better reflect what is measured.

Scientific literacy is defined as the ability to engage with science related issues, and with the ideas of science, as a reflective citizen. McGrath (1999) argues that a scientifically literate person is willing to engage in reasoned discourse about science and technology, which requires the competencies to explain phenomena scientifically, evaluate and design scientific enquiry, and interpret data and evidence scientifically.

Framework of Class 10 contents at National Curriculum Framework and PISA

School science curriculum consists of 10 general objectives, which throw light on the overall development of knowledge and competencies among the students. Secondary school science curriculum of class 10 constitutes 35% physics, 25% chemistry, 30% biology and 10% astronomy and geology portion. The details of the specification grid for class 10 science are shown in the following table.

Table 21. NCF Content framework of science, Grade 10

S. No.	Topics	Abilities			Total marks
		Knowledge (20%)	Understanding (30%)	Higher abilities (50%)	
1.	Force + energy	6	9	15	30
2.	Pressure				
3.	Heat + light				
4.	Current electricity and magnetism				
5.	Classification of elements + chemical reactions + hydrocarbons + gases	3	4.5	7.5	15

6.	Metals + materials used in daily life + acid, base and salt				
7.	Virus + stimulus and reactions + blood circulation	4.5	7	11	22.5
8.	Cell division + reproduction + ecosystem and genetics				
9.	Classification of plants and animals + ecosystem + genetics				
10.	History of earth + atmosphere + universe	1.5	2.5	3.5	7.5
Total		**15**	**23**	**37**	**75**

The PISA science assessment is not an assessment of contexts. Rather, it assesses competencies and knowledge in specific contexts. These contexts are chosen on the basis of the knowledge and understanding that students are likely to have acquired by the age of 15.

Table 22. Distribution of Items for Knowledge at PISA

	Systems			
Knowledge types	**Physical**	**Living**	**Earth and space**	**Total over system**
Content	20-24	20-24	14-18	54-66
Procedural	7-11	7-11	5-9	19-31
Epistemic	4-8	4-8	2-6	10-22
Total over knowledge type	**36**	**36**	**28**	**100**

The criteria are applied to knowledge from the major fields of physics, chemistry, biology, earth and space sciences, and require that the knowledge:

(i) has relevance to real-life situations
(ii) represents an important scientific concept or major explanatory theory that has enduring utility
(iii) is appropriate to the developmental level of 15-year-olds

It is assumed that students have some knowledge and understanding of the major explanatory ideas and theories of science, including an understanding of the history and scale of the universe, the particle model of matter, and the theory of evolution by natural selection. Knowledge is required for understanding the natural world and for making sense of experiences in personal, local/national and global contexts (Acharya, 2008). The framework uses the term "systems" instead of "sciences" in the descriptors of content knowledge. The intention is to convey the idea that citizens have to understand concepts from the physical and life sciences, and earth and space sciences, and how they apply in contexts where the elements of knowledge are

interdependent or interdisciplinary (Erikson, 2007). Things viewed as subsystems at one scale may be viewed as whole systems at a smaller scale. For example, the circulatory system can be seen as an entity in itself or as a subsystem of the human body; a molecule can be studied as a stable configuration of atoms but also as a subsystem of a cell or a gas. Thus, applying scientific knowledge and exhibiting scientific competencies is the major concern of the curriculum.

Epistemic knowledge refers to an understanding of the role of specific constructs and defining features essential to the process of knowledge building in science (Duschl, 2007). Those who have such knowledge can explain, with examples, the distinction between a scientific theory and a hypothesis or a scientific fact and an observation. They know that models, whether representational, abstract or mathematical, are a key feature of science, and that such models are like maps rather than accurate pictures of the material world. These students can recognize that any particle model of matter is an idealized representation of matter and can explain how the Bohr model is a limited model of what we know about the atom and its constituent parts. They recognize that the concept of a "theory" as used in science is not the same as the notion of a "theory" in everyday language, where it is used as a synonym for a "guess" or a "hunch". According to Johnson & Johnson (2000), procedural knowledge is required to explain what is meant by the control-of-variables strategy; epistemic knowledge is required to explain why the use of the control-of-variables strategy or the replication of measurements is central to establishing knowledge in science.

Table 23. Framework of scientific literacy assessment in PISA

Contexts	Personal, local/national and global issues, both current and historical, which demand some understanding of science and technology
Knowledge	An understanding of the major facts, concepts and explanatory theories that form the basis of scientific knowledge. Such knowledge includes knowledge of both the natural world and technological artifacts (content knowledge), knowledge of how such ideas are produced (procedural knowledge), and an understanding of the underlying rationale for these procedures and the justification for their use (epistemic knowledge)
Competencies	The ability to explain phenomena scientifically, evaluate and design scientific enquiry, and interpret data and evidence scientifically
Attitudes	A set of attitudes towards science indicated by an interest in science and technology, valuing scientific approaches to enquiry where appropriate, and a perception and awareness of environmental issues

Assessment items are not limited to school science contexts. In the PISA 2015, scientific literacy assessment, the items focus on situations relating to the self, family

and peer groups (personal), to the community (local and national), and to life across the world (global). Technology-based topics may be used as a common context. Some topics may be set in historical contexts, which are used to assess students' understanding of the processes and practices involved in advancing scientific knowledge. The contexts are chosen in light of their relevance to students' interests and lives. The areas of application are: health and disease, natural resources, environmental quality, hazards, and the frontiers of science and technology. They are the areas in which scientific literacy has particular value for individuals and communities in enhancing and sustaining quality of life, and in developing public policy (Soti, 2005).

The PISA science assessment is not an assessment of contexts. Rather, it assesses competencies and knowledge in specific contexts. These contexts are chosen on the basis of the knowledge and understanding that students are likely to have acquired by the age of 15.

Distribution of Items by Contents in National Curriculum Framework and PISA

Total distribution of the areas/contents in the national curriculum framework and the PISA is shown in the below table.

Table 24. Content areas and weightage of science in NCF and PISA

NCF		**PISA**	
Areas	**Weightage**	**Areas**	**Weightage**
Physics	30%	Physical	36%
Chemistry	15%	Living	36%
Biology	22.5%	Earth and space	28%
Astronomy and geology	7.5%	--	--
Total	**100%**	**Total**	**100%**

The table shows that the areas of science contents are spreading to all the branches of natural science in national curriculum framework. It has given importance of chemical science as well. But in PISA, content has not given any place for the chemistry to understand the chemical nature of the substances.

The criteria are applied to knowledge from the major fields of physics, chemistry, biology, earth and space sciences, and require that the knowledge: has relevance to real-life situations, represents an important scientific concept or major explanatory

theory that has enduring utility is appropriate to the developmental level of 15-year-olds.

According to White (2005), students have some knowledge and understanding of the major explanatory ideas and theories of science, including an understanding of the history and scale of the universe, the particle model of matter, and theory of evolution by natural selection. These examples of major explanatory ideas are provided for illustrative purpose there has been no attempt to list comprehensively all the ideas and theories that might be considered fundamental for scientifically literate individual.

Physical systems that require knowledge of:

- Structure of matter (e.g. particle model, bonds)
- Properties of matter (e.g. changes of state, thermal and electrical conductivity)
- Chemical changes of matter (e.g. chemical reactions, energy transfer, acids/bases)
- Motion and forces (e.g. velocity, friction) and action at a distance (e.g. magnetic, gravitational and electrostatic forces)
- Energy and its transformation (e.g. conservation, dissipation, chemical reactions)
- Interactions between energy and matter (e.g. light and radio waves, sound and seismic waves)

Living systems that require knowledge of:

- cells (structures and function, DNA, plant and animal)
- concept of an organism (unicellular and multicellular)
- humans (health, nutrition, subsystems such as digestion, respiration, circulation,
- excretion, reproduction and their relationship)
- Populations (species, evolution, biodiversity, genetic variation)
- ecosystems (food chains, matter and energy flow)
- biosphere (ecosystem services, sustainability)

The competency of evaluating and designing scientific enquiry to the students, PISA has divided the competency areas in three different aspects which is shown below.

Table 25. Competency areas and weightage, PISA science

Competency areas	**Percentage of total items**
Explain phenomenon scientifically	40-50
Evaluate and design scientific enquiry	20-30
Interpret data and evidence scientifically	30-40

National curriculum framework has not separated the percentage of items in competency areas in science subject but it has given importance to develop science process skills by doing hands on and minds on activities. It has given priority on development of scientific literacy and attitudes through the means of practical activities which is shown in curriculum and it allocated for 25% in the course.

Table 26. Scientific literacy assessment developed by PISA

Area	**Personal**	**Local/national**	**Global**
Health and diseases	Maintenance of health, accidents, nutrition	Control of disease, social transmission, food choices, community health	Epidemics, spread of infectious diseases
Natural resources	Personal consumption of materials and energy	Maintenance of human populations, quality of life, security, production and distribution of food, energy supply	Renewable and non-renewable natural systems, population growth, sustainable use of species
Environmental quality	Environmentally friendly actions, use and disposal of materials	Population distribution, disposal of waste, environmental impact	Biodiversity, ecological sustainability, control of pollution, production
Hazards	Risk assessments of lifestyle choices	Rapid changes (e.g. earthquakes, severe weather).	Climate change, impact of modern communication
Frontiers of science and technology	Scientific aspects of hobbies	New materials, devices and processes, genetic modifications	Extinction of species, exploration of space, origin and structure of the universe

Table 27. Content domain of biology (Grade X) in NCF

Area for scientific literacy assessment	**Sub-themes of the area**
Virus	Living and non-living characteristics, Viral diseases and prevention
Stimulus and reactions	Nervous system, endocrine and exocrine glands
Blood circulation	Blood circulation, human heart and its structure
Cell division	Mitosis, meiosis, stages and importance
Reproduction	Types of reproduction, vegetative reproduction
Ecosystem	Food chain, food web, ecological pyramid, bio-geological pyramid
Genetics	Heredity, Mendel's laws, DNA, RNA
Classification of plants and animals	Classification of animals and plants and characteristics

Assessment of Practical Activities at NCF

National Curriculum Framework has given the following scheme of practical activities at class ten students to develop the science process skills and develop the science process skills of the students. Twenty five marks for practical exam are allotted in class ten. 100 marks in science is divided into 75 marks and 25 marks for theory and practical papers respectively. Students have to secure pass marks both in theory paper as well as in practical examinations. PISA test has not given due importance such practical activities. The developments of science process skills are very much important to learn science but it is the weakness of PISA.

Table 28. Student assessment of practical work in NCF, Grade 10

S. No.	Item/type	Requirement points	Marks
1.	Spotting	Name, diagram and three characteristics with classification	5
2.	Write up/Field report writing	Title, materials, procedure and conclusion	5
3.	Simple material preparation or assembling	Objectives, materials, methods and uses	5
4.	Mini project/activity	Title, introduction, procedure and conclusion	6
5.	Oral/viva and note book record	Not exceeding five subject related questions	4
Total marks			**25**

Approaches of NCF and PISA Curriculum and Related Items

The comparative study glimpse of National Curriculum Framework and PISA is given on the following table.

Table 29. Overall approach to assessment in NCF and TIMSS

NCF	TIMSS
Treating all students alike and responding to the group as a whole and not treat as a different person with different skills.	Understanding and responding to individual student's interests, strengths, experiences, and needs.
Rigidly following curriculum without hands on activities.	Selecting and adapting curriculum according to present need.
Focusing on student acquisition of information and not on memorization.	Focusing on student understanding and use of scientific knowledge, ideas, and inquiry processes.
Presenting scientific knowledge through lecture, text, and demonstration.	Guiding students in active and extended scientific inquiry.
Asking for recitation of acquired knowledge.	Providing opportunities for scientific discussion and debate among students.
Testing students for factual information at the end of the unit or chapter.	Continuously assessing student understanding.
Maintaining responsibility and authority.	Sharing responsibility for learning with students.

Supporting competition among the peers.	Supporting a classroom community with cooperation, shared responsibility, and respect.
Individual effort to teach.	Working with other teachers to enhance the science program.

Table 30. Analytical comparison of science between NCF and PISA

PISA Contents/Areas of Knowledge	**National curriculum contents/Areas of knowledge**	**What is more in PISA**	**What is more in National curriculum Grade 10**	**Discrepancy/gap analysis**	**Relevance for taking PISA test by our students**
Areas of knowledge Content knowledge Procedural knowledge Epistemic knowledge	Areas of knowledge Content knowledge Science process skills	Epistemic knowledge	Science process skills (Priority in practical aspects in science)	Epistemic knowledge is not mentioned in NCF. Science process skills are very important in science but it is not mentioned in PISA	To compete with and to understand the international standard of education to develop scientific literacy.
Competencies for scientific literacy Explain phenomena scientifically Evaluate and design scientific enquiry Interpret data and evidence scientifically	Competencies for scientific literacy Develop scientific attitudes Scientific inquiry Skills of science	Data interpretation	Development of skills of science through practical activities	NCF has not mentioned the importance of scientific attitudes to develop scientific literacy among the Nepalese people.	To develop inquiry approach among the Nepalese students in the context of the world.
Domains Knowledge Competencies Attitudes	Domains Knowledge (20%) Understanding (30%) Higher abilities (50%)	Cognitive, affective and psychomotor domain are included in this test	Elaboration of cognitive domain up to higher abilities	Higher abilities like analyzing, synthesizing and creating is lacking in NCF. Affective and psychomotor domains are not mentioned in the curriculum as it is very important in science a practical based subject.	Development of practical skills through hands on activities. Develop the attitudes of scientific literacy.

Contents Physical (36%) Living (36%) Earth and space (28%)	Contents Physics (40%) Chemistry (15%) Biology (22.5%) Astronomy and geology (7.5%)	More priority is given for biology and earth and space	Chemistry portion is extra and required. Physical science is given more priority Major natural sciences are given important	Less priority is given on chemical concepts to our students. More emphasis is laid on physics which more than the physics course of PISA.	To understand the different aspects of biological sciences as it is preferred in PISA curriculum.
Issues addressed Young people's understanding of global issues Development of attitudes toward cultural diversity and tolerance through scientific literacy	Issues addressed Socio-cultural and educational aspects curriculum development process consistency and continuity of curriculum Norms and value based education Life skill based education Education for employment and self-employment ICT based education	Attempts to address the global issues Addressing cultural diversity through scientific literacy	Value based education Developing the life skills through the medium of scientific literacy Incorporating ICT in education Generating self-employment opportunities	Global issues are lacking in the NCF. Concept of cultural diversity is not mentioned in PISA. Critical thinking and creative thinking approaches are not addressed by the curriculum.	To understand the global issues and problems that help students to adopt in the glocal village
Life skills based education is not mentioned in PISA program	Life skill based education Vocational skills (skills considered very essential to promote economic activities) Life skills (skills considered very essential to cope with the problems and various risks that crop up in life)	No more contents in PISA	Research in science education is given importance in NCF and science process skills are given priority in NCF.	Practical based and life skills are lacking in the course framework of PISA.	It will enable the policy makers and educators to compare the performance of Nepalese students with students in other countries.

English: PISA and PIRLS Reading and National curriculum of Nepal (Grade 10 and 5)

Reading in PISA

PISA is a standardized test which focuses on science, mathematics and reading literacy. It is assessed as a minor domain, providing an opportunity to make comparisons in student performance over time. The mode of reading is based on the both paper and digital media. The framework does not, however, cover digital reading (also referred to as electronic reading in 2009). This is because the 2009 report provided separate scales for print reading and digital reading. Since reading is a minor domain in PISA 2015, and since digital reading was not assessed in all participating countries in 2009 or in 2012, there are no separate data on digital reading, nor was digital reading included as part of the overall concept of reading literacy (OEDC, 2016). The mode of communication was introduced in PISA reading assessment 2015. The computer is the primary mode of delivery for all domains, including reading literacy. However, paper based assessment instruments are provided in the situation that choose not to test their students by computer. The reading literacy component of both the computer-based and paper-based instruments is composed of the same clusters of reading trend items. The number of trend items in the minor domains are increased compared with previous PISA assessments, thereby increasing the construct coverage while reducing the number of students responding to each question. This design is intended to reduce potential bias while stabilizing and improving the measurement of trends.

The PISA situation variables were adapted from the Common European Framework of Reference (CEFR) developed for the Council of Europe (Council of Europe, 1996). The four situation variables – personal, public, educational and occupational

Reading literacy was the major domain assessed in 2000, for the first PISA cycle and in 2009, for the fourth PISA cycle. For the sixth PISA cycle (PISA 2015), reading is a minor domain and its framework has not changed from the PISA 2009 cycle. There were two major modifications to the PISA 2009 version of the reading framework: the incorporation of an assessment of digital reading and the elaboration of the constructs of reading engagement and metacognition. However, reading is a minor domain in PISA 2015. The reading of digital texts is not included and no data on engagement or metacognition in reading are collected.

Comparison between PISA and National Curriculum of Nepal

The following table highlights the major differences between the PISA reading assessment and the national curriculum of Nepal.

Table 31. Analytical comparison between PISA and NCF (English)

Domains	PISA Contents/Areas of Knowledge	National curriculum contents/Areas of knowledge	More in PISA	National curriculum Grade 10 (More)	Discrepancy/gap analysis	Relevance for taking PISA test by our students
Focus of the text/objectives	Three main domains are mainly focused in the readings text: • *Situation*, which refers to the range of broad contexts or purposes for which reading takes place. The four situation variables – personal, public, educational and Occupational – are described in the following paragraphs. Personal situation Public category Educational texts Occupational readings • *text*, which refers to the range of material that is read There were four main text classifications, because of the print and digital reading assessments proposed in these surveys: • Medium: print and digital	-The functional approach is the major focus in the national curriculum. -The simple and unseen text. -Use of different silent reading techniques in order to comprehend a variety of authentic texts. -Read short texts intensively for detailed understanding. -Read longer texts extensively for general understanding. -Show understanding of the underlying themes and ideas of texts. -Show understanding of an argument. -Retrieve specific information form texts to synthesize and analyses by means of	Reading text based on the situation, text and aspect. The test is based on the skills based. As a result, the functional aspects of language are based on the reading texts.	The integrated approach of functional use through readings is used -use of paraorthographic text of reading. The grammatical and language functions to be studied are clearly stated in the scope and sequence of the text.	The use of English for specific purpose is introduced in PISA however the national curriculum focuses on the use of general language functions based on the reading text and scanning and skimming skills. -Both the curriculum lay focus on the contextual use of reading text	The students can develop the reading texts based on the broader context and use English for academic and occupational purpose.

	• Environment: authored, message-based and mixed (only applicable to digital medium) • Text format: continuous, non-continuous, mixed and multiple • Text type: description, narration, exposition, argumentation, instruction and transaction • *Aspect*, which refers to the cognitive approach that determines how readers engage with a text. Five aspects guide the development of the reading literacy assessment tasks: • retrieving information • forming a broad understanding • developing an interpretation • reflecting on and evaluating the content of a text • reflecting on and evaluating the form of a text.	a variety of reading techniques, e.g. skimming and scanning. -Identify the structure and organization of paragraphs and longer texts through developing an awareness of cohesive devices (thus, that's why, in this way, etc.). -Anticipate the likely continuation of the interrupted text. -Appreciate literary text of an appropriate level. -Deduce the meaning of unfamiliar lexical items by means of contextual, syntactic and semantic clues. -Interpret information presented in diagrammatic forms (pie chart, graph chart, bar/column chart, table, etc.).				

Mode of delivery	Paper-based and computer-based	Paper-based	Computer based test	Speaking skills as a separate component	-	To make the readers more digitally aware with reading
Functional areas/approach	Cognitive based approach Interactive nature of text and comprehension based text)	Integrated approach Comprehension-based text.	Cognitive approach of reading	Functional use of language	Use of English for occupational purpose	Cognitive development through wider texts
Language functions focused	Description, narration, exposition, argumentation, instruction and transaction.	Commands Giving and withholding permission Reporting, giving and withholding permission Giving advice/ warnings Expressing conditions Asking for reasons Expressing unexpected results Describing Expressing preferences Talking about personal experience Talking about the past Talking about the past: comparing past and present Confirming and denying	Text based on the text types	No such classification of texts	Text and types relation	Wider variety of texts

		Agreeing and disagreeing Indicating time and motions Interpreting tables, graphs, charts, diagrams, etc.				
Aspects focused	• retrieving information • forming a broad understanding • developing an interpretation • reflecting on and evaluating the content of a text • reflecting on and evaluating the form of a text.	The grammatical concepts, functional use of language and creative thoughts.	Argumentative readings	General readings Short and long readings	Scanning readings texts in relation to narrative, and argumentative texts	Develop exposition and argumentation
Digital use	Digital reading practices	No use of digital text	Use of vocabulary in context.	High use of paper based text	Digital intervention on reading text	Make the learners cope with digital skills
Diversity in readings	Personal, educational, occupational and public	Personal and experiential	Seen and unseen text.	General use of language in learning specific language items	Context based on learning	

Based on these purposes, the secondary curriculum has been prepared in order to make the Grade 10 courses more applicable to society, both in Nepal and outside world (CDC, 2067). Language here is seen as a skill that allows one to get things done. The things done through language are described as functions such as expressing likes and dislikes, good wishes, etc. A single language function can usually be expressed through more than one grammatical structure or set of vocabulary items. The grammar is inbuilt with the structure of language functions. Therefore, students are expected to internalize grammar rules naturally and use correct and grammatical

language both in written and spoken expression. English and Nepali are introduced at the primary level is much simpler than these languages used at the secondary level. The functions remain the same at this advanced level but they are recycled with an increasing expansion of structure, vocabulary and register. The curriculum also includes instructional objectives and skills in content areas, and a scope and sequence chart specifying the number of periods for each unit. Further assessment procedures have also been established to assist the educational development of the students. The main objectives of reading in both subjects is to develop an ability to use simple reference materials, read, appreciate and enjoy literary texts and develop an awareness of contemporary social values and norms relevant to Nepal. The reading items selected in the text is based on the integrated approach of learning. The reading text items are based on the functional approach. The learners read the short and long text in which most of the text are related in the national context. However, the unseen text are based on developing the scanning skills of the learners.

However, the reading assessment in PISA is based on the different aspects such as: personal, educational, occupational and public aspects of language learning. The reading items are selected based on these four themes. The curriculum is more content and skills based. It focuses on the specific use of language vocabulary based on the different texts. The major strengths of reading assessment are based on the use of English for specific and occupational purpose. The digital intervention used in the PISA is a new trend used in the language assessment.

Assessment in NCF

There is continuous assessment, both formal and informal to test different four skills and aspects of the English language. Oral comprehension as speaking tests as well as dictation will also be used in addition to the usual exercises. The use of pictures will prove to be highly motivating and reliable for composition work (describing persons, places, things, objects and actions, etc.) both for discussion, dictation and finally for writing. For Grades Nine, there is terminal (summative) Examination covering 60% and the remaining 40% will be done through Continuous Assessment System. Serious attention should be given to differently-abled students with different ability in designing assessment tools to such students.

In grade nine, the first purpose of assessment is instructional improvement, conducted through formative assessment. The responsible agency for the assessment is the school. The weightage of English as a subject in the internal examination is 25%, however it is not included in the final test/ external examination. Similarly, the second purpose is promotion, which is conducted through summative assessment. The responsible agency for the assessment is the school. The weightage of English as a subject in the internal examination is 25%, which is focused on, test listening and speaking skills while, 75% in final test / external examination. The mode of the test examination for promotion is practical and theory based. The course has strong vertical

relationship with the grade 9 course.

Similarly, in grade ten, the first purpose of assessment is instructional improvement, conducted through formative assessment which includes unit test, classroom test, participation, attendance, home assignment, life skills and project work. The assessment is conducted by the RC or the group of schools. The weightage of English as a subject in the internal examination is 25% and 75% in the final test/ external examination. Similarly, the second purpose is qualifying exam /sent-up examination which is conducted through summative assessment. The responsible agency for the assessment is the RC or the group of schools. The weightage of English as a subject in the final test / external examination is 75%, however it is not included in the internal examination. The third purpose is level wise promotion /final examination (SLC) conducted through *Summative assessment at regional level.* The assessment is conducted by the OCE. The weightage of English as a subject in the internal examination is 25% which is focused on test listening and speaking skills and 75% in the final test/ external examination. The mode of the test examination for level wise promotion /final examination (SLC) is based on test listening and speaking skills.

English: PIRLS and National Curriculum

The PIRLS framework for assessing reading achievement was initially developed for the first assessment in 2001, using IEA's 1991 Reading Literacy Study as the basis for the PIRLS definition of reading literacy and for establishing the aspects of reading comprehension to be assessed. The PIRLS 2016 Reading Framework and the instruments developed to assess this framework reflect IEA's commitment to be forward thinking and incorporate the latest approaches to measuring the reading achievement of young students in their fourth year of schooling. PIRLS is based on the broad notion of what the ability to read means—a notion that includes the ability to reflect on written texts and to use these texts as tools for attaining individual and societal goals, also known as "reading to do" (Stiggins, 1982). This view is increasingly relevant in today's society, where greater emphasis continues to be placed on students' ability to use the information they gain from reading.

Reading Literacy in PIRLS

Reading literacy is the ability to understand and use those written language forms required by society and/or valued by the individual. Readers can construct meaning from texts in a variety of forms. They read to learn, to participate in communities of readers in school and everyday life, and for enjoyment. Meaning is constructed through the interaction between reader and text in the context of a particular reading experience (PEARLS, 2016).

Based on reading purposes and comprehension processes, the PIRLS framework provides the foundation for the PIRLS assessment of students' reading achievement in

their fourth year of schooling, as well as for PIRLS Literacy, a literacy assessment that is an easier version of PIRLS, and ePIRLS, which extends PIRLS to assess online reading. The PIRLS framework focuses on the two overarching purposes for reading that account for most of the reading done by young students both in and out of school: for literary experience, and to acquire and use information. In addition, the PIRLS assessment integrates four broad-based comprehension processes within each of the two purposes for reading: focus on and retrieve explicitly stated information, make straightforward inferences, interpret and integrate ideas and information, and evaluate and critique content and textual elements.

Teaching English in Nepalese context in Class-5

English has been a second language taught in all schools in Nepal and the medium of teaching and learning at higher level. Furthermore, the National Education Commission reports and interaction programs held at different places times and with various groups e.g. stakeholders, teachers etc. have laid great emphases on introducing English as a compulsory subject in all schools of Nepal from the very beginning of school education. This curriculum has been designed for primary level (Grades 1-5) education in Nepal, with a view to catering to the immediate needs of children learning English and building a basic foundation for their further studies in and through English. Moreover, it aims at developing a comprehensive communicative competence on the part of learners. The major focus of this curriculum is on language skills viz. listening, speaking, reading and writing. By the end of Grade 5 children will be able to use English effectively in a limited set of situations.

The objectives of teaching English in the primary schools of Nepal are to give pupils ample exposure to the English language so that they can understand and respond in simple English with acceptable pronunciation and intonation, to provide them with the opportunities to practise their English in and outside the classroom, so that they can communicate in simple English. In addition, the course aims to help them develop enthusiasm for reading so that they will be responsive and knowledgeable readers, to help them develop their potentialities in writing so that they can be creative writers, and to develop a positive attitude towards learning English and build up confidence in using English.

Comparison between PIRLS and National Curriculum of Nepal

The following table highlights the major differences between the PIRLS reading assessment and the national curriculum of Nepal.

Table 32. Analytical comparison between PIRLS and NCF (English)

Domains	PIRLS Contents/Areas of Knowledge	National curriculum contents/Areas of knowledge	What is more in PIRLS	What is more in National curriculum Grade 4	Discrepancy/gap analysis	Relevance for taking PIRLS test by our students

Purpose	Literary Experience Acquire and Use Information	Use of language for information and partially experience	Literary experience	Functional use in readings	Literary use and functional use of language	Literary experience and general understanding
Process of Comprehension	Focus on and Retrieve Explicitly Stated Information Make Straightforward Inferences Interpret and Integrate Ideas and Information Evaluate and Critique Content and Textual Elements	Read different kinds of texts (stories and facts) both for enjoyment and to extract specific information Interpret charts, tables, diagrams Develop reading skills (skimming and more detailed reading) Use glossary	Use of Critique Content and Textual Elements	Integrated use of reading text along developed of accuracy Use of functional approach	Critical content learning and the diverse in the text items	
Focus of literary text	addressing theme, plot events, characters, and setting, and those classified as information -reading fictions, biographies or autobiographies	Use of short poems, stories to develop basic understanding	Detailed literary analysis of basic elements			
Focus of the informational text	comprehension processes are evaluated across all passages,	Use of paraorthograic texts, such as : simple diagrams, maps, graphs and charts	Longer text and vocabs suitable to the level			
Strategies of reading	Four broad-based processes of comprehension typically used by fourth grade readers: focus on and retrieve explicitly stated information; make straightforward inferences; interpret and integrate ideas and information; and evaluate	So such reading stages specified. Strategies to skim texts to answer specific questions or find words.	Use of simple texts Longer instruction			

	and critique content and textual elements.					
Use of learning strategies	Cognitive and metacognitive strategies	Cognitive strategies	Metacog nitive strategies	Cognitive strategies using functional approach.	Balance between the text and the learning strategies	Use metacognit ive strategies in learning English
Aspects and functions used	No such functions specified	Functions specified Expressing wants. Asking and answering about reasons. Talking about the future a. plans, intentions b. action Describing with possessive pronouns Describing location and giving directions. Describing properties or possessions.	No such integratio n of functions	Functions organized and specified		

The general objective of the English curriculum for Grades 5 is to give pupils ample exposure to the English language so that they can understand and respond in simple English with acceptable pronunciation and intonation, to provide them with the opportunities to practice their English in and outside the classroom, so that they can communicate in simple English, to help them develop enthusiasm for reading so that they will be responsive and knowledgeable readers, to help them develop their potentialities in writing so that they can be creative writers, and to develop a positive attitude towards learning English and build up confidence in using English.

The curriculum in grade 4 and 5 for the development of language skills includes listening, speaking, reading, writing.Under the listening category for grade 4, the tasks includes understanding a variety of short texts, respond to aural stimuli by writing, ticking, matching, ordering by following instructions or writing simple sentences, listening to specific information in a context and finally, following directions on a map. Similarly, in grade 5, the curriculum includes listening to short texts (stories, conversation), responding in different ways to questions, true/false, and instructions and listening for specific information.

Similarly, for the development of speaking skills, the curriculum in grade 4 includes activities such as using simple language for a variety of functions (warning, expressing surprise and delight, express liking, knowing, and wanting and simple obligation), giving information and asking and answering questions (about habits and simple "always-true" facts), using ordinal numbers to tell the time and describing frequency, using correct language for countable and uncountable nouns, talking with increasing confidence using real situations and acting or role play. Likewise for grade 5, exercises includes participating in conversation through pair work and group work activities (role play, simple drama and games), using suitable language to warn, express wants, remind, describing possession and location and talk about the future, using tense correctly both for giving information, and asking/answering questions. Furthermore, tasks such as describe things, people, narrating events in simple language, using and responding to tag questions.

The curriculum for the development of reading skills for grade 4 includes exercises such as distinguishing different types of text and extracting information, developing competence to read silently different materials (stories, letters, simple facts, and speech, instructions, charts and time tables), enjoying reading poems aloud and using glossary. Similarly for grade 5, activities includes reading different kinds of texts (stories and facts) both for enjoyment and to extract specific information, interpreting charts, tables, diagrams, developing reading skills (skimming and more detailed reading) and using glossary.

With regard to the development of writing skills, the curriculum for grade 4 includes activities such as writing simple personal letters (thank you, invitation, etc.), describing people, places, things and events very simply and briefly with the help of given clues and using regular punctuation and lay out. Similarly, for grade 5 tasks includes writing simple letters, dialogue and narrative with correct lay-out and punctuation, narrating a sequence of events and describing people, places and things.

The language aspects include pronunciation, vocabulary, grammar and language functions. In grade 4, the task included in the curriculum for development of pronunciation skills involves ordering , matching or correcting pictures from verbal text, drawing pictures of scenes with greater range, following directions on a map (simple), identifying ordinal numbers ,understanding and enjoy stories, and retell simply and correcting wrong words in a repeated verbal text, or well-known story. Similarly, in grade 5 , activities includes ordering, matching, correcting pictures from verbal text, drawing pictures including variety of locations, following directions on a map, extracting times, prices, days, months, menu items from variety of verbal texts, understanding and enjoying stories, correcting mistakes in spoken text. This shows the strong vertical relation in learning English.

Similarly, for the development of vocabulary skills, the curriculum in grade 4 includes word puzzles and activities and the use of glossary. The curriculum in grade 5 includes tasks using large range of word puzzles, writing short personal letters and envelopes and ordering, matching, complete or manipulate material to write good sentences.

For the development of grammar skills, the curriculum in grade 4 includes completing match, ordering, choosing, and composing sentences, writing instructions, writing chart from text, writing answers, writing simple letters, describing people, places and events, correcting correct mistakes, linking ideas to make longer sentences, asking and answering about countable and uncountable nouns, asking and answer using range of Wh questions, responding correctly to a range of questions statements and commands and extracting specific information from text with more redundant information. Similarly for grade 5, curriculum includes writing sentences independently and confirming using negative tags and answer correctly.

The curriculum for the development of language functions in grade 4 includes activities such as warning, expressing surprise, using ordinal numbers, giving directions, expressing likes and dislikes, knowledge and obligations, talking about habits using times and frequency and narrating events in the past and ask questions. Likewise, for grade 5, curriculum includes activities such as giving written responses to texts they have read, expressing wants, and reasons, asking and answering about the future about the future, describing possession, location, months, seasons, times, menus quantities, properties of objects or people, narrating a series of events and to remind.

With regard to grade five, the first purpose of assessment is instructional improvement, conducted through formative assessment which includes unit test, classroom test, participation, attendance, home assignment, life skills and project work. The assessment is conducted by the school. The weightage of English as a subject in the internal examination is 60%, however it is not included in the final test/ external examination. Similarly, the second purpose is qualifying test/promotion which is conducted through summative test / external exam. The responsible agency for the assessment is the RC or the group of schools. The weightage of English as a subject in the final test / external examination is 40%, however it is not included in the internal examination. The mode of the test examination for both—instructional improvement and qualifying test /promotion is theory based.

PIRLS Language Literacy

PIRLS and PIRLS Literacy are designed to provide a complete picture of the reading literacy achievement of the participating students in each country. This includes achievement by reading purpose and comprehension process as well as overall reading achievement. Consistent with the goal of a comprehensive view of reading comprehension, the entire PIRLS assessment consists of 12 reading passages and accompanying questions (known as items); similarly, the PIRLS Literacy assessment

consists of 12 reading passages and accompanying questions, but the passages are less difficult. In each assessment, six passages assess reading for literary experience and six assess reading to acquire and use information. In order to keep the assessment burden on any one student to a minimum, each student is presented with just two passages according to a systematic booklet assembly and rotation procedure, as described in the next section. The PIRLS assessments are designed from the outset to measure trends over time in reading achievement. More specifically, there are two scales for reading purposes: Reading for literary experience; and Reading to acquire and use information. In addition to these, there also are two scales for processes of reading comprehension: Retrieval and straightforward inferencing; and interpreting, integrating, and evaluating. Regarding the time allocation, total testing time for the assessment passages is of eight hours, but far less time available to assess any individual student. The difficulties of scheduling student assessments and because young children cannot be subjected to long testing periods without suffering loss of concentration and fatigue, the testing time is limited to 80 minutes per student, with an additional 15–30 minutes for a student questionnaire.

The PIRLS assessment design uses a matrix sampling technique: each reading passage and its accompanying items is assigned to a block, and the blocks are then systematically distributed among individual student booklets. Both PIRLS and PIRLS Literacy consist of 12 passages/blocks, each of which is expected to require 40 minutes of student testing time.

Students' ability to comprehend text through the four PIRLS comprehension processes is assessed via comprehension questions that accompany each text. Two question formats are used in the PIRLS and PIRLS Literacy assessments: multiple-choice and constructed-response. Each multiple-choice question is worth one point. Constructed-response questions are worth one, two, or three points, depending on the depth of understanding required. Up to half of the total number of points represented by all of the questions come from multiple-choice questions. In the development of comprehension questions, the decision to use either a multiple-choice or a constructed-response format is based on the process being assessed, and on which format best enables test takers to demonstrate their reading comprehension.

The relevance of taking RIRLs assessment in the Nepalese context is essential to develop the skills based on the reading comprehension. Although, the PIRLS curriculum does not follow the functional use of the language, the test focuses on the literary development through reading skills. The PIRLS assessment does not test grammar in isolation and focuses less in the grammar. It tries to teach the passages in the block form.

Nepali: PISA, PIRLS and National Curriculum

Introduction of the reading assessment

The Nepali language is taken as a national language and lingua franca in Nepal. Nepali is used in the everyday communication, basically, to deal with the everyday use, and functions as a basic requirement of trade, commerce, education and even technology in Nepal. The growth and use of Nepali is taken as the primary language in official use and for communication in Nepal. The use is essential to be in the curriculum practices in school and higher studies. As a result, the course Nepali is studied as a compulsory Subject from class 1 to Bachelors' level as core courses and optional in the higher studies. It is an important tool for all students to become successful in local, national and inter cultural communication around the globe with the Nepalese people. Undoubtedly, Nepali is the means of communication in fostering the Nepali cultural norms and values, social rituals, traditions across the nation and the globe. (CDC, 2057).

Program for International Student Assessment (PISA)

PISA is a standardized test which focuses on science, mathematics and reading literacy. It is assessed as a minor domain, providing an opportunity to make comparisons in student performance over time. The mode of reading is based on the both paper and digital media. The framework does not, however, cover digital reading (also referred to as electronic reading in 2009). This is because the 2009 report provided separate scales for print reading and digital reading. Since reading is a minor domain in PISA 2015, and since digital reading was not assessed in all participating countries in 2009 or in 2012, there are no separate data on digital reading, nor was digital reading included as part of the overall concept of reading literacy (OEDC, 2016). The mode of communication was introduced in PISA reading assessment 2015. The computer is the primary mode of delivery for all domains, including reading literacy. However, paper based assessment instruments are provided in the situation that choose not to test their students by computer. The reading literacy component of both the computer-based and paper-based instruments is composed of the same clusters of reading trend items. The number of trend items in the minor domains are increased compared with previous PISA assessments, thereby increasing the construct coverage while reducing the number of students responding to each question. This design is intended to reduce potential bias while stabilizing and improving the measurement of trends.

The PISA situation variables were adapted from the Common European Framework of Reference (CEFR) developed for the Council of Europe (Council of Europe, 1996). The four situation variables – personal, public, educational and occupational

Reading literacy was the major domain assessed in 2000, for the first PISA cycle and in 2009, for the fourth PISA cycle. For the sixth PISA cycle (PISA 2015), reading is a

minor domain and its framework has not changed from the PISA 2009 cycle. There were two major modifications to the PISA 2009 version of the reading framework: the incorporation of an assessment of digital reading and the elaboration of the constructs of reading engagement and metacognition. However, reading is a minor domain in PISA 2015. The reading of digital texts is not included and no data on engagement or metacognition in reading are collected.

Comparison between PISA and National Curriculum of Nepal-Nepali Language Curriculum

The following table highlights the major differences between the PISA reading assessment and the national curriculum of Nepal.

Table 33. Analytical comparison between PISA and NCF (Nepali)

Domains	PISA Contents/Areas of Knowledge	National curriculum contents/Areas of knowledge	More in PISA	National curriculum Grade 10 (More)	Discrepancy/gap analysis	Relevance for taking PISA test by our students
Focus of the text/objectives	Three main domains are mainly focused in the readings text: • *Situation*, which refers to the range of broad contexts or purposes for which reading takes place. The four situation variables – personal, public, educational and Occupational – are described in the following paragraphs. Personal situation Public category	-The functional approach is the adopted in Nepali curriculum. The simple and unseen text such as: general description, letters, posters, calendar, and focus on the children literature. -Use of different silent reading techniques in order to comprehend a variety of authentic texts. -Read short texts intensively for detailed understanding. -Read longer texts extensively for	Reading text based on the situation, text and aspect. The test is based on the skills based. As a result, the functional aspects of language are based on the reading texts.	The integrated approach of functional use through readings is used -use of paraorthograhic text and prosodic features in the reading texts. The grammatical and language functions to be studied are clearly stated in the scope and sequence of the text. The prosodic features of literature are taken into	The use of language for specific purpose is introduced in PISA however the national curriculum focuses on the use of general language functions based on the reading text and scanning and skimming skills. -Both the curriculum lay focus on the contextual use of reading text	The students can develop the reading texts based on the broader context and use Nepali for academic, general and literary purpose.

	Educational texts Occupational readings • *text*, which refers to the range of material that is read There were four main text classifications, because of the print and digital reading assessments proposed in these surveys: • Medium: print and digital • Environment: authored, message-based and mixed (only applicable to digital medium) • Text format: continuous, non-continuous, mixed and multiple • Text type: description, narration, exposition, argumentation, instruction and transaction • *Aspect*, which refers to the cognitive approach that determines	general understanding. -Show understanding of the underlying themes and ideas of texts. -Show understanding of an argument. -Retrieve specific information form texts to synthesize and analyses by means of a variety of reading techniques, e.g. skimming and scanning. -Identify the structure and organization of paragraphs and longer texts through developing an awareness of cohesive devices (thus, that's why, in this way, etc.). -Anticipate the likely continuation of the interrupted text. -Appreciate literary text of an appropriate level. -Deduce the meaning of unfamiliar lexical items by means of contextual, syntactic and semantic clues. -Interpret information		considerati on. The course focuses on the pronunciation of the Nepali words or the sentences in relation to the mother tongue for the second language learners. The course gives a due emphasis on the use of vocabulary, critical analysis of the text.		

	how readers engage with a text. Five aspects guide the development of the reading literacy assessment tasks: • retrieving information • forming a broad understanding • developing an interpretation • reflecting on and evaluating the content of a text • reflecting on and evaluating the form of a text.	presented in diagrammatic forms (pie chart, graph chart, bar/column chart, table, etc.).				
Mode of delivery	Paper-based and computer-based	Paper-based	Computer based test	Speaking skills as a separate component	-	To make the readers more digitally aware with reading
Functional areas/approach	Cognitive based approach interactive nature of text and comprehension based text)	Integrated approach Comprehension-based text.	Cognitive approach of reading	Functional use of language	Use of Nepali for general purpose	Cognitive development through wider texts
Language functions focused	Description, narration, exposition, argumentation, instruction and transaction.	Commands Giving and withholding permission Reporting, giving and withholding permission	Text based on the text types	No such classification of texts	Text and types relation	Wider variety of texts in both languages

		Giving advice/ warnings Expressing conditions Asking for reasons Expressing unexpected results Describing Expressing preferences Talking about personal experience Talking about the past Talking about the past: comparing past and present Confirming and denying Agreeing and disagreeing Indicating time and motions Interpreting tables, graphs, charts, diagrams, etc.				
Aspects focused	• retrieving information • forming a broad understanding • developing an interpretation • reflecting on and evaluating the content of a text • reflecting on and	The grammatical concepts, functional use of language and creative thoughts.	Argumentative readings	General readings Short and long readings	Scanning readings texts in relation to narrative, and argumentative texts	Develop exposition and argumentation

	evaluating the form of a text.					
Digital use	Digital reading practices	No use of digital text	Use of vocabulary in context.	High use of paper based text	Digital interventi on on reading text	Make the learners cope with digital skills
Diversity in readings	Personal, educational, occupational and public	Personal and experiential	Seen and unseen text.	General use of language in learning specific language items	Context based on learning	

Based on these purposes, the secondary curriculum has been prepared in order to make the Grade 10 courses more applicable to society (CDC, 2067BS). A single language function can usually be expressed through more than one grammatical structure or set of vocabulary items. The grammar is inbuilt with the structure of language functions and stylistics. Therefore, students are expected to internalize grammar rules naturally and use correct and grammatical language both in written and spoken expression along the literary texts. The functions remain the same at this advanced level but they are recycled with an increasing expansion of structure, vocabulary, register and stylistics. The curriculum also includes instructional objectives and skills in content areas, and a scope and sequence chart specifying the number of periods for each unit. Further assessment procedures have also been established to assist the educational development of the students. The main objectives of the study are to develop an ability read, critically analyze and enjoy literary texts and develop on contemporary social values and norms relevant to Nepal. The reading items selected in the text are based on the integrated approach of learning. The literary reading texts items are blended on the functional-structural approach. The learners read both the short and long text in which most of the text are related in the national context and develops the scanning and skimming skills of the learners. The curriculum has some links on the skills development like in the PISA curriculum.

However, the reading assessment in PISA is based on the different aspects such as: personal, educational, occupational and public aspects of language learning. The reading items are selected based on these four themes. The curriculum is more content and skills based. It focuses on the specific use of language vocabulary based on the different texts. The major strengths of reading assessment are based on the use of Nepali for specific and general purpose. The digital intervention used in the PISA is a new trend used in the language assessment.

Assessment in Secondary Level Curriculum

There is continuous assessment, both formal and informal to test different four skills and aspects of the Nepali language through literary texts. Oral comprehension as speaking tests as well as dictation will also be used in addition to the usual exercises in the classroom instruction. The use of pictures will prove to be highly motivating and reliable for composition work (describing persons, places, things, objects and actions, etc.) both for discussion, dictation and finally for writing. For Grades Nine, there is terminal (summative) Examination covering 60% and the remaining 40% will be done through Continuous Assessment System. Serious attention should be given to differently-abled students with different ability in designing assessment tools to such students.

In grade nine, the first purpose of assessment is instructional improvement, conducted through formative assessment. The responsible agency for the assessment is the school. The weightage of Nepali as a subject in the internal examination is 100 in the final test/ external examination. Similarly, the second purpose is promotion, which is conducted through summative assessment. The responsible agency for the assessment is the school. The weightage of Nepali as a subject 100% in final test / external examination. The mode of the test examination for promotion is theory based. The course has strong vertical relationship with the grade 9 course.

Similarly, in grade ten, the first purpose of assessment is instructional improvement, conducted through formative assessment which includes unit test, classroom test, participation, attendance, home assignment, life skills and project work. The assessment is conducted by the RC or the group of schools. The weightage of Nepali as a subject is 100% in the final test/ external examination. The weightage of Nepali as a subject in the final test / external examination is 100%. The third purpose is level wise promotion /final examination (SLC) conducted through *Summative assessment at regional level.* The assessment is conducted by the OCE. The weightage of Nepali as a subject in the internal examination as 100% in the final test/ external examination, basically focusing on the reading text, literary analysis, grammar and writing. The curriculum focuses less emphasis on the speaking skills.

PIRLS and National Curriculum

The PIRLS framework for assessing reading achievement was initially developed for the first assessment in 2001, using IEA's 1991 Reading Literacy Study as the basis for the PIRLS definition of reading literacy and for establishing the aspects of reading comprehension to be assessed. The PIRLS 2016 Reading Framework and the instruments developed to assess this framework reflect IEA's commitment to be forward thinking and incorporate the latest approaches to measuring the reading achievement of young students in their fourth year of schooling. PIRLS is based on the broad notion of what the ability to read means—a notion that includes the ability to reflect on written texts and to use these texts as tools for attaining individual and societal goals, also known as "reading to do" (Stiggins, 1982). This view is

increasingly relevant in today's society, where greater emphasis continues to be placed on students' ability to use the information they gain from reading.

Reading Literacy in PEARLS

Reading literacy is the ability to understand and use those written language forms required by society and/or valued by the individual. Readers can construct meaning from texts in a variety of forms. They read to learn, to participate in communities of readers in school and everyday life, and for enjoyment. Meaning is constructed through the interaction between reader and text in the context of a particular reading experience (PEARLS, 2016).

Based on reading purposes and comprehension processes, the PIRLS framework provides the foundation for the PIRLS assessment of students' reading achievement in their fourth year of schooling, as well as for PIRLS Literacy, a literacy assessment that is an easier version of PIRLS, and ePIRLS, which extends PIRLS to assess online reading. The PIRLS framework focuses on the two overarching purposes for reading that account for most of the reading done by young students both in and out of school: for literary experience, and to acquire and use information. In addition, the PIRLS assessment integrates four broad-based comprehension processes within each of the two purposes for reading: focus on and retrieve explicitly stated information, make straightforward inferences, interpret and integrate ideas and information, and evaluate and critique content and textual elements.

Teaching in Nepalese context in Class-5-Nepali Language

Nepali is basically taught as first language taught in all schools in Nepal and the medium of instruction and learning at higher level. This curriculum has been designed for primary level (Grades 1-5) education in Nepal, with a view to catering to the immediate needs of children learning Nepali to foster their everyday use through Nepali. The major focus of this curriculum is on language skills viz. listening, speaking, reading and writing. By the end of Grade 5 children will be able to use Nepali effectively around them.

The objectives of teaching Nepali in the primary schools of Nepal are to give pupils exposure to the Nepali language so that they can understand and respond in Nepali, to provide them with the opportunities to practise their Nepali in and outside the classroom, so that they can communicate in Nepali. In addition, the course aims to help them develop enthusiasm for reading text maintaining prosodic features so that they will be responsive and knowledgeable readers, to help them develop their potentialities in writing so that they can be creative writers, and to develop a positive attitude towards learning Nepali and build up confidence in using Nepali.

Comparison between PIRLS and National Curriculum of Nepal

The following table highlights the major differences between the PIRLS reading assessment and the national curriculum of Nepal.

Table 34. Analytical comparison between PIRLS and NCF (Nepali)

Domains	PIRLS Contents/Areas of Knowledge	National curriculum contents/Areas of knowledge	What is more in PIRLS	What is more in National curriculum Grade 4	Discrepancy/ gap analysis	Relevance for taking PIRLS test by our students
Purpose	Literary Experience Acquire and Use Information	Use of language for information and literary experience	Literary experience	Functional use in readings and children literature	Literary use and functional use of language	Literary experience and general understanding
Process of Comprehension	Focus on and Retrieve Explicitly Stated Information Make Straightforward Inferences Interpret and Integrate Ideas and Information Evaluate and Critique Content and Textual Elements	Read different kinds of texts (stories and facts) both for enjoyment and to extract specific information Interpret charts, tables, diagrams Develop reading skills (skimming and more detailed reading) Use glossary	Use of Critique Content and Textual Elements	Integrated use of reading text along developed of accuracy Use of functional approach	Critical content learning and the diverse in the text items	
Focus of literary text	addressing theme, plot events, characters, and setting, and those classified as information -reading fictions, biographies or autobiographies	Use of short poems, stories to develop basic understanding	Detailed literary analysis of basic elements			

Focus of the informational text	comprehension processes are evaluated across all passages,	Use of paraorthographic texts, such as : simple diagrams, maps, graphs and charts -use of prosodic features	Longer text and vocabs suitable to the level			
Strategies of reading	Four broad-based processes of comprehension typically used by fourth grade readers: focus on and retrieve explicitly stated information; make straightforward inferences; interpret and integrate ideas and information; and evaluate and critique content and textual elements.	So such reading stages specified. Strategies to skim texts to answer specific questions or find words.	Use of simple texts Longer instruction			
Use of learning strategies	Cognitive and metacognitive strategies	Cognitive strategies	Metacognitive strategies	Cognitive strategies using functional approach.	Balance between the text and the learning strategies	Use metacognitive strategies in learning Nepali
Aspects and functions used	No such functions specified	Functions specified Expressing wants. Asking and answering about reasons. Talking about the future a. plans, intentions b. action	No such integration of functions	Functions organized and specified		

		Describing with possessive pronouns Describing location and giving directions.				

The general objective of the Nepali curriculum for Grades 5 is to give pupils ample exposure to the Nepali language so that they can understand and respond in Nepali, to provide them with the opportunities to use their Nepali, so that they can communicate in Nepali, to help them develop enthusiasm for reading children literature so that they will be responsive and knowledgeable readers, to help them develop their potentialities in writing so that they can be creative writers, and to develop a positive attitude towards learning Nepali and build up confidence in using Nepali.

The curriculum in grade 4 and 5 for the development of language skills includes listening, speaking, reading which includes the tasks includes understanding a variety of short texts, respond to aural stimuli by writing, ticking, matching, ordering by following instructions or writing simple sentences, listening to specific information in a context and finally, following directions on a map. Similarly, in grade 5, the curriculum includes listening to short texts (stories, conversation), responding in different ways to questions, true/false, and instructions and listening for specific information.

Similarly, for the development of speaking skills, the curriculum in grade 4 includes activities such as using simple language for a variety of functions (expressing surprise and delight, express liking, knowing, and wanting and simple obligation), giving information and asking and answering questions (about habits and simple "always-true" facts), using ordinal numbers to tell the time and describing frequency, using correct language for countable and uncountable nouns, talking with increasing confidence using real situations and acting or role play. Likewise for grade 5, exercises includes participating in conversation through pair work and group work activities (role play, simple drama and games), using suitable language to warn, express wants, remind, describing possession and location and talk about the future, using tense correctly both for giving information, and asking/answering questions. Furthermore, tasks such as describe things, people, narrating events in simple language, using and responding to tag questions.

The curriculum for the development of reading skills for grade 4 includes exercises such as distinguishing different types of text and extracting information, developing competence to read silently different materials (children stories, simple personal letters, simple facts, and speech, instructions, charts and time tables), enjoying reading poems aloud and using glossary. With regard to the development of writing skills, the

curriculum for grade 4 includes activities such as writing simple personal letters (thank you, invitation, etc.), describing people, places, things and events very simply and briefly with the help of given clues and using regular punctuation and lay out. Similarly, for grade 5 tasks includes writing simple letters, dialogue and narrative with correct lay-out and punctuation, narrating a sequence of events and describing people, places and things. Similarly, in grade 5 , activities includes ordering, matching, correcting pictures from verbal text, drawing pictures including variety of locations, following directions on a map, extracting times, prices, days, months, menu items from variety of verbal texts, understanding and enjoying stories, correcting mistakes in spoken text. This shows the strong vertical relation in learning Nepali.

Similarly, for the development of vocabulary skills, the curriculum in grade 4 includes word puzzles and activities and the use of glossary. The curriculum in grade 5 includes tasks using large range of word puzzles, writing short personal letters and envelopes and ordering, matching, complete or manipulate material to write good sentences.

For the development of grammar skills, the curriculum in grade 4 includes completing match, ordering, choosing, and composing sentences, writing instructions, writing chart from text, writing answers, writing simple letters, describing people, places and events, correcting correct mistakes, linking ideas to make longer sentences, asking and answering about countable and uncountable nouns, responding correctly to a range of questions statements and commands and extracting specific information from text with more redundant information. Similarly for grade 5, curriculum includes writing sentences independently and answering correctly.

With regard to grade five, the first purpose of assessment is instructional improvement, conducted through formative assessment which includes unit test, classroom test, participation, attendance, home assignment, life skills and project work. The assessment is conducted by the school. The weightage of Nepali as a subject in the final test/ external examination as 100% theory. The mode of the test examination for both—instructional improvement and qualifying test /promotion is theory based.

PIRLS Language Literacy

PIRLS and PIRLS Literacy are designed to provide a complete picture of the reading literacy achievement of the participating students in each country. This includes achievement by reading purpose and comprehension process as well as overall reading achievement. Consistent with the goal of a comprehensive view of reading comprehension, the entire PIRLS assessment consists of 12 reading passages and accompanying questions (known as items); similarly, the PIRLS Literacy assessment consists of 12 reading passages and accompanying questions, but the passages are less difficult. In each assessment, six passages assess reading for literary experience and six assess reading to acquire and use information. In order to keep the assessment burden on any one student to a minimum, each student is presented with just two passages

according to a systematic booklet assembly and rotation procedure, as described in the next section. The PIRLS assessments are designed from the outset to measure trends over time in reading achievement. More specifically, there are two scales for reading purposes: Reading for literary experience; and Reading to acquire and use information. In addition to these, there also are two scales for processes of reading comprehension: Retrieval and straightforward inferencing; and interpreting, integrating, and evaluating. Regarding the time allocation, total testing time for the assessment passages is of eight hours, but far less time available to assess any individual student. The difficulties of scheduling student assessments and because young children cannot be subjected to long testing periods without suffering loss of concentration and fatigue, the testing time is limited to 80 minutes per student, with an additional 15–30 minutes for a student questionnaire.

The PIRLS assessment design uses a matrix sampling technique: each reading passage and its accompanying items is assigned to a block, and the blocks are then systematically distributed among individual student booklets. Both PIRLS and PIRLS Literacy consist of 12 passages/blocks, each of which is expected to require 40 minutes of student testing time.

Chapter 4

Feasibility for participating in international assessments

This chapter assesses the feasibility of the methods and process used in international assessment in the context of Nepal, particularly based on existing capacity of ERO on conducting students' assessment. This is done by reviewing the literature and analyzing information provided by ERO staff via a survey questionnaire, email communiation with the staff of international testing organizations and interviews with assessment experts at Tribhuvan and Kathmandu Universities.

Requirement for undertaking TIMSS, PISA and PIRLS and National capacity

All major international assessments – PISA, TIMSS and PIRLS – require the participating country to assign a national institution (national center for TIMSS and PIRLS) to undertake this assessment under the broader framework and guidelines provided by the test organizations (e.g. OECD for PISA and IEA for TIMSS and PIRLS). The head of this institution – National Research Coordinator (NRC for TIMSS and PIRLS) or National Project Manager (NPM for PISA) who plays a major role in international assessment projects and is the main contact person in the country. In Nepal, ERO could be the national institution to undertake this assessment and head of ERO could act as NRC or NPM. However, as the ERO head and staff are the government's employees, their independent role as suggested by international testing organizations could be questionable.

NRC has following responsibility in order to conduct TIMSS and PIRLS:

- Organization and management of the national center to ensure that all tasks are fulfilled
- Employment and supervision of the staff
- Assurance of the availability of required hardware and software and other necessary equipment/materials
- Participation in the international NRC meetings.

Similar to TIMSS and PERLS, the National Project Managers work with the OECD contractor on all issues related to the implementation of PISA in their country. They play an important role not just in the successful implementation of PISA in accordance with OECD quality standards, but also in the development and review of PISA reports and publications.

There are other staff in each country to successfully conduct the study, such as

1) Sampling coordinator
2) Data manager
3) Translators/Translation reviews
4) School coordinators

5) Test administrators
6) National quality control monitor
7) Scorers
8) Staff for data entry
9) Office staff

The overall tasks of the national team is to prepare school samples, contact schools and sampling classes for the assessment using particular software (e.g. WinW3S for TIMSS and PIRLS), contributing to preparing the achievement items, translating, reviewing and producing the assessment materials, submitting the survey instruments for international translation verification, administering the assessment with the supervision of international quality control monitor, scoring the assessment, creating the data files entering test information into the software, submitting the national database and related materials to the international data processing center, preparing national analysis of the data, writing the national report and disseminating the national report in synchronization with the release of the international report. In addition, the national center will need to complete a national context questionnaire.

In order to accomplish these responsibilities the existing human resources and technical set-up at ERO is inadequate, particularly in accomplishing the technical task of data entry, processing, and reporting at par with the standard of international assessments. The existing human resource strength at ERO is largely non-technical (see Table 1), experienced more on administrative tasks. None of the ERO staff is professionally expert in testing and assessment, although some are trained to undertake technical work of large-scale assessment. Notably, only one officer at NASA has been trained on analyzing test score using IRT modelling.

Table 35. ERO's human resource for carrying out large-scale assessment

S.N.	Position	No	Qualification	Assessment experience
1.	ERO Head	1	PhD	Item development to report writing, curriculum and evaluation, Overall planning and implementation including item development, writing reports, M&E
2.	Under-secretary	1	Masters/MPhil	Overall planning and monitoring, orientation and dissemination, partial support to NASA including writing reports,
3.	Section head, NASA	1	Masters	Planning and coordination of NASA activities, including items and tools development to test administration and analysis and reporting (Currently vacant).
4.	Section officer	4	Masters/MPhil	Test planning to report writing, test development and analyzing, reporting, training & orientation, (only one officer is trained in item analysis including IRT modelling), coordination, field-visit, training and orientation.

5.	Under-secretary	2	Masters	Assigned for another job other than NASA
5.	Section officer	7	Masters	Assigned for another job other than NASA

Comparing human resources required for international assessments and the existing capacity of ERO suggests that ERO needs additional technical staff for participating in international assessment.

Despite the human resource constraint at ERO, it has been undertaking NASAs hiring national consultant firms and both party share work of NASA. The following table summarizes the NASA tasks shared by ERO and consultant firms.

Table 36. NASA tasks shared by ERO and consultant firms

S.N.	NASA components	Role of ERO	Role of outsource consultants	Remarks
1.	Pre-work: item writing, pre-testing, item selection	√		Worked with experts, school and university teachers and
2.	Questions printing, packing		√	
3.	Test administration in schools	√	√	DEO also supported test administration at school
4.	Scoring answer book		√	
5.	Data entry		√	
6.	Data analysis and delivery of key results	√		
7.	Report writing	√		Some expert service also used
8.	Editing, publishing and disseminating	√		Some expert service also used
9.	Item-bank updating	√		

The above table shows that much of the technical work of NASA has been undertaken by consulting firms. The consulting firms, however have to be equipped with theoretical and technical skills required for using cutting-edge technology of assessment. As suggested by ERO officials, the consulting firms should have "adequate knowledge and skill on three parametric Item Response Theory, use IRT

models in R and STATA, curriculum and assessment, criteria based test development, data analysis and reporting".

Requirements and preparedness for participating in international assessment

For international testing, there is a requirement of strong institutional and human resource foundation for undertaking the assessment. For example, both PISA and TIMSS assessments, require a national institution with adequate technological infrastructure, including computers and software, as well as human resource qualified and trained in large scale national and international testing. The assurance of competent testing staff and availability of required hardware and other necessary equipment and materials. The human resource such as sampling coordinator, data manager, translators, test administer, quality control monitor, scorers, staff for data entry and analysis are not available at ERO who is mandatory for participating in the international testing. The additional requirement is to train all staff in computer-assisted testing, including IRT modeling for test analysis.

This study has also solicited from the ERO officials and assessment experts about the policy, legal and financial requirements in order to strengthen the existing capacity of ERO for the sustainable conduction of NASA, the following information has been obtained:

Policy requirements

- ERO should be run as an autonomous institution in order to take decision independently, keeping itself away from political and administrative control and direct regulation of the Ministry of Education.
- Technical staff are inadequate. The policy should make some structural adjustment in existing system of allocation of quota of administrative staff and their recruitment through a transparent procedure. The ERO should also have policy and adequate budget for hiring and training of technical staff required for the international assessment. Rather than project-based fixed term appointment, they should be deputed as permanent staff of ERO so that assessment can be conducted as a regular cycle, informed by regular research and evaluation.
- There should be a clear policy for capacity development of ERO staff with a view to keep them abreast with the new and state-of-the art methods and tools of testing and assessment.

Legal requirements

- Under the Ministry of Education, ERO has been established as a permanent center for assessing student achievement at the national level. And recently,

the ERO has obtained a legal status through the eighth amendment to the Education Act which could pave the way for fulfilling the legal requirements for the effective functioning of the ERO. Therefore, the ERO has been established as a permanent legal institution. In this context, Education Regulations should clearly specify mandates, roles and responsibilities of ERO. The recent amendment (8th) to the Education Act

Technical and human resource requirements:

- ERO requires the state-of-the-art IT and software facilities required for IRT modelling or other form of modern testing. There are a few trained data analysts, mostly inadequately trained in IRT modelling. For the previous NASAs, technical works were undertaken by outsourcing consulting firms and staffs. In this context, ERO, which could be the national center for undertaking the international assessment, is essential to be equipped with adequate technological infrastructure and IT system as a par with the international testing standard. There is a need of adequate trained staff at ERO for developing, administrating and analyzing the test.

Financial implications

Conducting international assessments also requires significant financial investment on the part of the participating countries. For example, the international overhead costs for new participants in PISA 2018 is EUR 182 000 payable over four years at EUR 45,500 per year from 2016 to 2018 inclusive (OECD, 2016). The total amount is equivalent to NRs 2,18,40,000.00 (1 EUR = NRs 120). In addition, the costs for the national implementation of the program are borne entirely by the participating countries. This includes both the staff cost and operating cost of the assessment. There will be additional cost for attending the regular meetings to be held periodically. If we take NASA as reference, the cost for implementation was NRs 2,15,42,000.00 for the Year 2013. This suggests that the cost will be more than double of the existing NASA cost to participate in the PISA assessment.

Similarly, the basic fee per grade for participating in IEA paper TIMSS or IEA eTIMSS in 2019 is 225,000 ICU (IEA's International currency unit) = US$ 112,500 plus EURO 112,500 (IEA, 2016). This is equivalent to NRs 2,56,50,000 for one grade and NRs 5,13,00,000 for two grades (1 US$ = NRs 108 and 1 EUR = NRs 120). The payment can be made in yearly instalments (Table 37):

Table 37. Payment installment for TIMSS 2019

Year	Amount
2017	30%
2018	30%
2019	25%
2020	15%

Source: IEA (2016b)

However, countries paying the full four-year fee in the first year (2017) will get a discount of 5%. The participating cost in PIRLS is also similar. For example, the participation cost for PIRLS 2016 should be paid for 2013 to 2017 with annual amount of US$ 20,000 and EURO 20,000 with total US$ 100,000 and EURO 100,000 equivalent to NRs 2,68,00,000 for the five-year period. As with the PISA, the entire cost for implementing the TIMSS and PIRLS should be beard by the participating country and this could be significantly higher due to the IEA's additional requirement for staffing, software, training, benchmarking and international meetings.

UNESCO has made a cross-country comparative study about the international assessment costs of the participating countries which also indicated that the cost for undertaking international assessment is too high, which could be a real challenge for countries and economies with low fiscal capacity or that do not have development partners to support them (UNESCO, 2016). Table 3 below shows the average country cost and per student cost for participating in three major international testing.

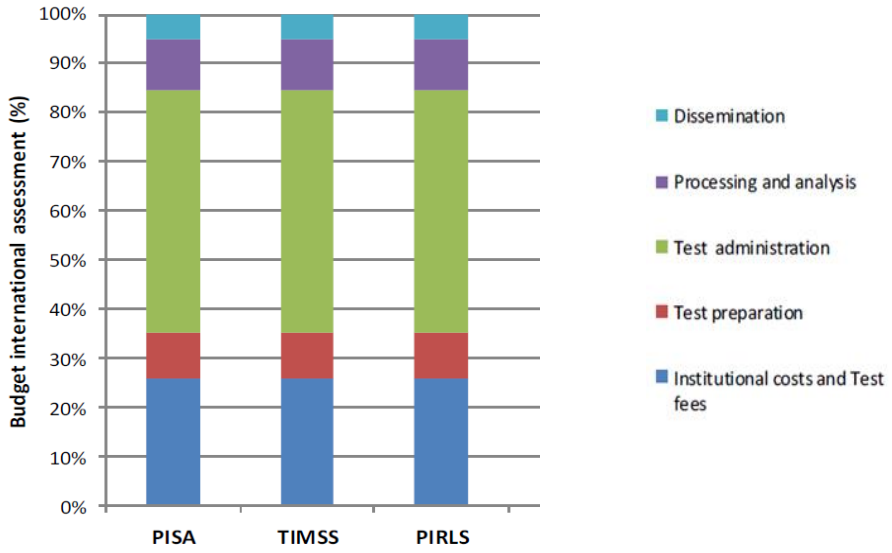
Table 38. International assessment costs (in US$)

Responsible organization	Assessment	No. of participating countries	Total cost per country	Cost per student (sampled)
IEA	TIMSS 2015	57	839,424	228
IEA	PIRLS 2016	48	839,424	196
OECD	PISA 2015	73	824,008	156

Source: UNESCO (2016)

This study also suggested that test-fees of major international assessment is nearly one-fourth of the total expenditure (Figure 3). The other cost includes test preparation, test administration, processing and analysis, and dissemination.

Figure 3. Distribution of cost for major international assessments



Projecting the cost in this way, Nepal's estimated cost including the international fees will be following:

Table 39. Nepal's projected cost for international assessment

International Assessment	International fees (in NRs)	Total estimated cost for Nepal (in NRs)
PISA 2018	2,18,40,000.00	8,73,60,000.00
TIMSS 2019 (Grade 4 & 8)	5,13,00,000.00	20,52,00,000.00
PIRLS 2016	2,68,00,000.00	10,72,00,000.00

Comparing the above total cost with the Nepal's NASA 2013 cost (NRs 2,15,42,000.00), four-times more budget will be needed to participate in PISA 2018, nearly 10 times more for TIMSS 2019 (Grade 4 & 8) and nearly five times more for the PIRLS 2016. This suggests that participation in international assessment for the developing country is too high which is difficult to justify in terms of the value for money.

Chapter 5

Summary, conclusion and recommendations

NASA experience and future prospect

With the establishment of ERO in 2010, Nepal laid foundation for conducting national assessment and applying the assessment result for the diagnosis of systematic problems of schooling and thereby taking necessary remedial actions. Along with the system development for national assessment, the successfully complemented NASA 2011, NASA 2012, NASA 2013 and NASA 2015 are the groundwork for conducting international assessments in future. The assessment and analysis framework used in NASA assessments are designed and verified by national international experts. Example of computer-based IRT modeling used in test analysis in previous NASAs suggests that national assessment has been technically sound, authentic and reliable. Alongside, a number of lessons are being learnt to standardize national assessments on a par with the international assessment standard.

Obviously, previous NASAs have strengthened Nepal's capacity to undertake large-scale standardized testing, though much has to be learnt and done. NASA 2011 which assessed learning status of grade 8 students in Mathematics, Nepali and Social Study, NASA 2012 that assessed learning of grade 3 and grade 5 students in Mathematics, Nepali and English, NASA 2013 which measured achievement of eighth graders in Mathematics, Science and Nepali and NASA 2015 that assessed learning of grade 3 and grade 5 students in Mathematics, Nepali and English not only provided policy makers with a wealth of information about students' learning along the line of subjects, gender, caste, ethnicity, regions and school kind (private and public), but also provided information for policy reform, system development and international comparison. One significant lesson learnt is that before taking decision to take part in international assessments existing national capacity and culture for large-scale assessment should be enhanced. For this purpose, ERO's autonomous functioning with adequate regular technical staff is must and this should be accompanied by adequate technological and budgetary support on the part of the government and ministry.

Options for international testing

A number of options are available for Nepal to participate in international testing. The three major options are: PISA, TIMSS and PIRLS. The following table summarizes the options provided by these three assessments.

Table 40. Summary of major international assessments

	PISA	TIMSS	PIRLS
Area of assessment	Reading, mathematics, science, problem solving	Mathematics and science	Reading
Age	15	10 and 14	10
Grade	Grade 9 (UK Year 10)	Grade 4 and 8 (UK Year 5 and 9)	Grade 4 (UK Year 5)
Purpose	Evaluates education systems by assessing to what extent students at the end of compulsory education can apply their knowledge to real-life situations and be equipped for society	Measures trends in maths and science achievement Describes educational context, including home support, students' attitudes, curriculum, teachers' training, classroom activities	Measures trends in reading comprehension Investigates the experiences young children have at home and school in learning to read

Along with the above opportunities, PISA and PIRLS have provided special options to developing countries that suit to their needs. They are PISA for Development and prePIRLS. PISA for Development is a new assessment opportunity that aims to support evidence-based policy making in emerging and developing economies by 1) developing contextual questionnaires and data-collection instruments that better capture diverse situations in emerging and developing countries, 2) adjusting the PISA test instruments so that they are sensitive to a wider range of performance levels, and 3) establishing methods and approaches to include out-of-school students in the PISA assessment.

prePIRLS is another preparatory option for the developing countries to participate in PIRLS which reflects the same conception of reading as PIRLS, except it is less difficult. Depending upon a country's educational development, prePIRLS can be given at the fourth, fifth, or sixth grade. It is expected that participation in prePIRLS prepares countries for moving toward participation in PIRLS.

National curriculum and international testing

Mathematics Grade V, TIMSS and NCF

Both TIMSS and NCF have major content areas such as number system, geometry and measures, and data display, with as much as 90% overlap of the contents in all areas of mathematics. This suggests that there is not a large gap and content mismatch while adopting TIMSS test items for Nepalese students' assessment at the end of grade V. However, the Nepalese curriculum practices, including instruction and assessment need to be aligned with the TIMSS framework in relation to context/problem generation, mathematization of the context/problem, calculation, and verification with the context to adopt TIMSS level assessment.

Mathematics Grade VIII, TIMSS and NCF

As with Grade V, both TIMSS and NCF have similar contents such as number, algebra, geometry, and data, with 90% similar content in all areas of mathematics. Therefore there will not be a large gap and content mismatch while adopting TIMSS test items by Nepalese students' assessment at the end of grade VIII. Howerver, there is a requirement of curricular alignment in relation to context/problem generation, mathematization of the context/problem, calculation, and verification with the context while adopting TIMSS assessment items.

Mathematics Grade X, PISA

Both PISA and NCF have aimed to develop knowledge and problem solving skills in the content area of change and relationships, space and shape, quantity, and uncertainty and data. There is around 90% overlapin all contents. Therefore there will not be a large gap and content mismatch between the two and no such problem is foreseen while adopting PISA test items by Nepalese students' assessment at the end of grade X. Since the PISA assessment are based on context, process, and content, the Nepalese curriculum practices of grade X need to be adapted for context/problem generation, mathematization of the context/problem, calculation, and verification with the context while adopting PISA assessment items.

Science Grade V, TIMSS and NCF

There is greater overlapping of the contents between the two. While living beings, matter, energy and environment and Earth and universe has 35%, 32% and 17% weightage in NCF the equivalent is 45% (life science), 35% (physical science) and 20% (Earth Science) in TIMSS. The additional content in Grade V in NCF is information technology (8%) and simple technologies (8%). The content breakdown overlaps 70 to 80%. Regarding the area and domain of learning, knowledge, understanding and higher abilities carry 20%, 30% and 50% weightage in NCF against 40% (knowing), 40% (applying) and 20% (reasoning) in TIMSS.

Science Grade VIII, TIMSS and NCF

The overlapping of contents of grade 8 in both is high. Physics, chemistry, biology and earth science have 25%, 20%, 35% and 20% in TIMSS while the same areas have 25%, 15%, 15%, 20% respectively. The NCF have additional 25% weightage allocated for practical activities. The content breakdown overlaps 70 to 80%. In terms of learning areas or domain, knowledge, understanding, and higher abilities have 20%, 30% and 50% weightage while the corresponding domain is 35% for knowing, 35% for applying and 30% for reasoning. The NCF has additional emphasis on 'higher abilities' domain.

Science PISA Grade X

While PISA is not a curriculum-based test, there is significance overlapping of the content and domain of learning. Secondary school science curriculum of Grade 10, for example, constitutes 30% physics, 15% chemistry, 22.5% biology and 7.5% astronomy and geology portion, PISA has 36%, 36% and 28% weightage allocated for physical, living and earth and space sectors. PISA has less emphasis on chemistry. While the NCF has subject-based focus on knowledge, understanding, application, and higher abilities of science learning, the PISA have a focus on three competency areas 1) explain phenomenon scientifically, 2) evaluate and design scientific enquiry, and interpret data and evidence scientifically. This will require Nepal's students preparing for higher order competency in explaining, evaluating, designing and interpreting the scientific phenomena and design.

PISA Reading

PISA reading is focused on understanding, using, reflecting on and engaging with written texts, in order to achieve one's goals, develop one's knowledge and potential, and participate in society. While reading is core part of the PISA, the Grade 10 language curriculum (both English and Nepali) focuses on all four language skills – listening, speaking, reading and writing. The PISA literary assessments select items from different situation (e.g. personal 30%, educational 25%, occupational 15% and public 30%, the Grade 10 language curriculum (both English and Nepali) focuses more on selected educational contents, and few on personal and public situation. There has been no focus on occupational situation. While most of the reading exercise in Grade 10 language curriculum is based on continuous texts formed by sentences organized into paragraphs, PISA reading assessment has 60% items from continuous text, 30% from non-continuous (list, tables, graphs, diagrams, advertisements, schedules, catalogues, indexes and forms), mixed (5%) and multiple (5%) text format. Text in PISA includes description, narration, exposition, argumentation and instruction while Grade 10 language curriculum includes description and narration largely. Rather, Grade 10 curriculum focuses reading exercises on different genres such as poetry, prose, drama, letter-writing, fiction, autobiography and story. While the main mode of delivery for the previous PISA assessment was paper, PISA 2015

has also an option for computer-based delivery. This option does not exist in NCF Grade language curriculum.

PIRLS Reading

Reading literacy, according to PIRLS 2016, is the ability to understand and use those written languages forms required by society and/or valued by the individual. While reading to learn is key learning domain of PIRLS, Grade V curriculum (both English and Nepali) aims to develop all four skills of languages – listening, speaking, reading and writing. In PIRLS reading has two particular purposes – literary experience (50%) and acquire and use information (50%). Similarly, reading comprehension has focus on retrieving explicitly stated information (20%), make straightforward inferences (30%), interpret and integrate ideas and information (30%) and evaluate and critique. Whereas, NCF curriculum (Nepali and English) focuses more on functional use of reading, read different kinds of texts (stories and facts) both for enjoyment and to extract specific information, interpret charts, tables, diagrams, develop reading skills (skimming and more detailed reading). The curriculum for the development of reading skills is associated with the grammar skills and include exercise such as completing, matching, ordering, choosing, and composing sentences. The reading skills will be develop in tandem with the writing, reading and other learning activities. While PIRLS reading is structured and standardized form of testing focusing on the key skills of reading, comprehending, analyzing and evaluating both the continuous and non-continuous, the national curriculum largely focuses on text-based continuous reading.

Benefits and challenges for participating in international assessments

Participating in international assessments like PISA, TIMSS and PIRLS certainly have benefits and challenges. The researchers have interviewed assessment experts at Tribhuvan University and Kathmandu University about the possible benefits and challenges if Nepal choose to participate in international assessments. The result is mixed. However, rather than immediate benefits, challenges to implement and use of international assessments are found grater. The following sections summarizes both benefits and challenges.

Benefits

For Nepal, participation in international studies enables policy makers and educators to compare the performance of Nepalese students with international students. Domestically, international studies provide information on the strengths and weaknesses of Nepalese students in particular domains such as reading, mathematics and science.

Not only are studies of student outcomes important but, equally, studies of teacher training, teaching techniques and background information of students and schools are important in identifying factors which help students learn and achieve their potential.

International studies provide schools and students with an opportunity to experience cutting-edge assessments that are designed by international experts. Schools have opportunity to compare with the overall results of the country.

Participating in international assessment help to develop technical and human resource capacity to undertake state-of-the art methods and techniques of assessing student achievement which in turns contribute to building better and reliable system of national assessment.

Challenges

Nepal's educational investment and policy focus should be centered on access, quality and management. Despite the concerted effort of the Government of Nepal, a significant number of school-age children are still outside the school. For example, Flash Report 2014/15 suggests that Net Enrolment Rate (NER) at basic and secondary levels are 87.6% and 56.1%, suggesting a large number of children are required to provide access to schooling (Department of Education, 2015). As mentioned in Chapter One, national average of Grade 3 and 5 students in Nepali, Mathematics and English remained at 45 to 52, suggesting that quality of schooling measured in terms of students' learning is below than satisfactory. It is therefore argued that before taking part in internationally comparable testing, Nepal should fulfil the basic requirements for quality schooling. An expert in educational policy and assessment has this to say:

> 'The goal of participating in international assessment is to provide information on the achievement of Nepali students relative to that of students in other countries, and identify factors that have influenced this achievement. Nepal is still struggling to ensure that all children are now in schools. Then we have to think about quality. So we have to do a lot before making decision to participate in international assessments. Obviously, we are now at the bottom of ranking'

As expressed in the open letter by a dozen of education researchers and educators (Meyer et al., 2014) to the director of PISA, there has been raising concerns about the negative consequences of international assessment like PISA to education policy around the world. According to Meyer et al. (2014) international assessments have a narrow focus that measures learning achievements in terms of quantity using mostly by the structured multiple questions. They have less emphasis on physical, moral, civic and artistic development, thereby dangerously narrowing our collective imagination regarding what education is and ought to be about. These tests have been criticized for invoking 'race to the tope' and for ranking and labelling students, as well as teachers and administers according to the results of tests widely known to be imperfect. Pointing to the similar consequence, an assessment expert shared, "The international testing does not take account of unique social, cultural, linguistic and economic realities of Nepal".

Taking consideration of contextual factors of schooling, one could also argue that international assessment put its emphasis merely on learning outcomes of students no matter how the context, input and process variables are different. As an expert informs, "The international assessments do not take account of input and process variables of schooling. Treating all school systems equally and looking only at the learning outcomes of students is problematic. Considering unequal societies in our country, we should work on equity-based assessment".

International assessments are largely based on state-of-the-art technology for administrating and analyzing the test. The latest version of these assessments requires students to take computer-based tests. Nepal does not have developed infra infrastructural and technical standards to implement international assessments. We also lack of human resource to carry out the assessment supported by up-to-date technology and software. Jumping into the international assessment without such prerequisites would be problematic.

As demonstrated earlier, International testing comes with high expenditure of public money, so it is difficult to justify for the value of money for the developing countries like Nepal.

International assessments have a narrow focus that measures learning achievements in terms of quantity using mostly by the structured multiple questions. It has less emphasis on physical, moral, civic and artistic development, thereby dangerously narrowing our collective imagination regarding what education is and ought to be about. These tests have been criticized for invoking 'race to the tope' and for ranking and labelling students, as well as teachers and administers according to the results of tests widely known to be imperfect. As one of the experts assert, "Nepal should not opt for international testing because it would certainly label us poor and imperfect."

Finally, rather than rush to international testing, the requirement is to strengthen our capacity of national testing and use the result of national assessments for improving our educational input and delivery. An expert seriously expressed, "Our own periodic national assessment is telling us we are not getting good enough maths or reading results and we have a great regional and school-wise variation. This information is enough to review our policy and system. Why choose to participate in international assessment?" This suggests that Nepal should better focus on putting more investment and efforts on educational inputs and process so that better outcomes are expected. Then only, participation in international assessment would be practicable.

Conclusion

Nepal's experience of periodic national assessments since 2011 has suggested that there are a number of reform areas in school education in order to enhance quality and equity of schooling. Therefore, before taking decision to participate in some international assessments, the Ministry of Education should take account of the considerations and recommendations of previous large-scale national assessments and

prepare ERO systems, schools and students for the international testing. As mentioned earlier, there are obviously both opportunities and challenges for participation in international testing. But at this stage, Nepal has more challenges and issues ahead than the volume of benefits it could seize from the international assessment opportunity. As Lockheed, Prokic-Bruer and Shadrova (2015) informed, three major challenges are pressing at this moment – cost, capacity and context. Costs involve the direct incremental cost of participation, including international participation fees; cost for test adaptation, administration and analysis; travel costs for international meetings, and personnel costs associated with conducting the assessment. As mentioned earlier, the cost for participating in international testing could rise up to 10 times higher than the amount spent in national assessment. This could raise an obvious question for the value of public money. Capacity involves the institutional and technical preparedness to conduct the assessment and to analyze the results. This comes with analytical and operational challenges. Analytical challenges are associated with psychometrics, sampling, data analysis and reporting whereas operational challenges include data collection and processing as a par with the expectation and standard of international testing. There is an obvious challenge of translation and adaptation of the test within the broader parameter of the international testing. The context-related challenges associated with the unique cultural, linguistic, economic and political situation of the country. The international assessments may not necessarily reflect such uniqueness as they are designed in the educational and country context of the developed economies.

Recommendations

1. *Strengthening national assessment system*

The analysis of existing national capacity for undertaking technology-based large-scale international assessments, curricular compatibility, existing data on access and achievement of students and the value for money suggests policy makers not to rush for participation in international testing. Rather, this study makes a strong recommendation for strengthening the national assessment system and developing a strong technological and human resource foundation for accomplishing the cutting-edge international assessments that are standardized and valid. For this purpose, the following recommendations are made:

- Policy and culture: ERO needs to be organized and developed as an autonomous and independent organization, keeping it free from the direct influence and regulation of the Ministry of Education. This organization can be developed and run as an expert-led independent institution with its regular business of study and research in parallel with periodic national assessment. The ERO should continue to work towards the establishment of an assessment culture that seeks to learn from international large-scale assessments. It should increase outreach to stakeholders through both conventional media and professional seminars.

- Infrastructure and technology: It is essential to equip ERO with more sophisticated infrastructure and technology, with servers and systems required at the level of international standard. An uninterrupted high band-width internet with its own server system should be developed. As required, regional centers of ERO should be established.
- Human resource preparedness: As this study suggests, a number of technical experts, with university qualification in testing and measurement and training on the state-of-the art technology for data analysis, are required for undertaking technology-based standardized testing. ERO should have adequate permanent positions to recruit staff qualified and trained in different aspects of testing. It is also recommended for considering that the relevant representatives of ERO should be provided opportunities to attend the various capacity building sessions offered by international testing organizations and contractors.
- Application and reform: The result of the periodic national assessment should be disseminated to the school level. According to the result of individual school, schools' league table should be developed. Following the result of inter-school, inter-district and inter-region comparison, appropriate support mechanism and reform should be introduced in order to reduce the gap between well-performing and poor performing schools, districts and regions.
- Comparability with international testing: While strengthening national assessment system some comparison with international assessment could be done by calibrating some relevant items from international items and equating the scores using IRT modelling. Although such practices have already been introduced in previous NASAs, this should be made more rigorous and comprehensive in future assessments.

2. *Curricular reform*: Although a greater overlap has been noted between the framework of national curriculum and international testing, a further alinement of curricular contents and learning domains is necessary if Nepal aims to participate in international assessments. While the national curriculum of Nepal should have a focus on cultural, linguistic and ethnic diversity of its population, standardizing curricular contents with a greater global-local linkage is necessary. In addition, emphasis on reading throughout the school curriculum, with greater weightage on early grade reading is necessary in order to develop compatibility of PISA, PIRLS and national curriculum. Introduction of technology-based curricula is another important requirement whereby students develop skills for taking computer-based testing. For this, a course for computer literacy is must from elementary grades.

3. *Instruction and mode of delivery*: The existing mode and techniques of delivery in most of Nepalese schools are dominated by teacher-led lectures and presentations. The ill-equipped classroom with minimum technological and material facilities and lack of motivated and trained teachers are some hindrances for the interactive student-centered pedagogy. This kind of traditional delivery options help students do some basic cognitive tasks of learning, such memorizing, reproducing, problem solving and writing, but could not prepare them for tasks required higher abilities such as analysis synthesis, critical thinking and judgement. While the international assessments require more analytical, critical and judgmental capacity of the students to respond to the different high-ability questions, the domination of teacher-centered mode of delivery should be replaced by more participatory, interactive and technology-assisted instruction whereby students take part in construction of knowledge and critical analysis of it.

4. *Use of ICT in learning and teaching*: Both TIMSS and PISA are now developed as computer-based tests, though there is an option for paper-based testing. This suggests that if Nepal aims to participate in PISA or TIMSS, there may not be the paper-based option available in their next assessment cycle. We therefore required our schools to equip with technological infrastructure including electricity, computers, projectors, printers and required learning software. With compulsory computer literacy course, the students should require to develop basic computer skills for participating in computer-based testing.

5. *Considering PISA for Development and prePIRLS options first*: With the fulfillment of basic pre-requisites of international testing mentioned above, Nepal could participate in preparatory testing aimed particularly for the developing countries, and depending on the lessons learnt, further decision can be made to go for the main testing such as PISA, TIMSS and PIRLS. PISA for Development and pre-PIRLS are the new preparatory testing opportunity developed particularly for the developing countries. PISA for Development aims to "increase developing countries' use of PISA assessment for monitoring progress towards nationally-set targets for improvement, for the analysis of the factors associated with student learning outcomes, particularly for poor and marginalized populations, for institutional capacity-building and tracking international educational targets in the post-2015 framework" (OECD, 2016a). Using enhanced PISA survey instruments that are more relevant for the contexts found in developing countries and with the methods and approaches to include out-of-school students, PISA for Development produces scores that are on the same scales as the main PISA assessment.

prePIRLS is another preparatory option for the developing countries to participate in PIRLS which reflects the same conception of reading as PIRLS, except it is less difficult. Depending upon a country's educational development, prePIRLS can be given at the fourth, fifth, or sixth grade. It is expected that participation in prePIRLS prepares countries for moving toward participation in PIRLS. According to IEA (2016), "the prePIRLS assessment will provide valuable diagnostic information about strengths and weaknesses in students' reading skills and important policy information about the necessary steps to improve students' reading."

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Appendix

List of persons consulted for collecting information and opinion

No.	Name	Organization	Post
1.	Dr. Lekha Nath Poudel	Education Review Office	Joint Secretary, Head
2.	Mr. Gopal Prasad Bhattarai	Education Review Office	Under Secretary
3.	Rudra Prasad Adhikari	Education Review Office	Under Secretary
4.	Mr. Shyam Prasad Acharya	Education Review Office	Section Officer
5.	Dr. Prem Narayan Aryal	Tribhuvan University	Professor
6.	Mr. Kiran Ram Ranjitkar	Tribhuvan University	Associate Professor
7.	Dr. Prakash Chandra Bhattarai	Kathmandu University	Assistant Professor
8.	Paulína Koršňáková	International Association for the Evaluation of Educational Achievement (IEA)	Director of the IEA Secretariat