# PISA-D PRELIMINARY ASSESSMENT SURVEY REPORT 2017



## BHUTAN COUNCIL FOR SCHOOL EXAMINATIONS AND ASSESSMENT

## ACKNOWLEDGEMENT

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# Executive summary

Bhutan Council for School Examinations and Assessment (BCSEA) as a National Assessment Agency proposed the conduct of a PISA-D Preliminary Assessment. The main purpose for the conduct of this assessment was to familiarize students and teachers on PISA items and to identify the level of the present students' ability to attempt PISA items. This study also attempts to obtain empirical evidence on the performance of students across the three Domains (Reading Literacy, Mathematical Literacy and Scientific Literacy) so that it would enable the Central Level Core Group (CLCG), Dzongkhag Level Core Group (DLCG) and School Level Core Group (SLCG) to come up with a way forward to help students perform well in PISA-D.

Selective questions from the PISA released items were compiled by the BCSEA for the three Domains which were administered in 13 schools under Thimphu Thromdey and Thimphu Dzongkhag and subsequently evaluated at the school level. The assessment data was analysed and reported by the BCSEA.

The study findings indicated that the students below 14 years studying in Class X under Thimphu Thromdey performed better in all the three Domains and Competencies. Irrespective of age, class and location, female students performed much better than the male students in Reading Literacy. While male students performed better in Mathematical Literacy, both the genders performed equally in Scientific Literacy. Thromdey schools performed better in the Preliminary Assessment than the Dzongkhag schools in general.

Among the three Aspects in Reading Literacy (Access and Retrieve, Integrate and Interpret and Reflect and Evaluate) the findings showed the students were more competent in Integrate and Interpret. In Mathematical Literacy, students were more competent in responding to the items Assessing Competency; Formulating Situations Mathematically compared to Employing Mathematical Concepts, Facts and Procedures and Interpreting, Applying and Evaluating Mathematical Outcomes). In Scientific Literacy students attempted more confidently in the Competency; Evaluate and Design Scientific Enquiry when compared to Explain Phenomena Scientifically and Interpret Data and Evidence Scientifically.

However, the overall performance of the surveyed students is between the proficiency levels 2 and below 1 in the three domains where 1 being the lowest and 6 being the highest achievement level.

# PISA-D PRELIMINARY ASSESSMENT SURVEY REPORT 2017

## 1. INTRODUCTION

As proposed by BCSEA, the need to conduct a preliminary survey to assess how As proposed by the BCSEA, the need to conduct a preliminary survey to assess how our students could perform in a PISA trial test was welcomed and endorsed during the 'consultative meeting of stakeholders held in Paro chaired by the Hon'ble Sherig Lyonpo (24th to 26th February, 2017). Besides providing an insight to the precritical information sought above; the preliminary survey test would also orient and introduce both our teachers and students on PISA experience.

BCSEA as the National Assessment Agency took the lead role compiling the test items and coordination plan.

Subject coordinators for English, Science and Mathematics from BCSEA were appointed as Domain experts for PISA-D project in corresponding three domains in PISA. They were assigned to educate and familiarize themselves with PISA concept and framework of designing assessment items, review all released past PISA questions and to assemble a set each in their respective domains to be used for this task. Question papers in each domain were set with instructions for conduct, basic students' information required, marking scheme with model answers and students' performance reporting format.

For the actual conduct, a consultative meeting was held in BCSEA with the respective school principals and PISA-D focal persons under Dzongkhag/Thromdey schools in Thimphu. The members unanimously resolved with the following outcome.

» Dzongkhag and Thromdey Education Officers to provide support required to the Principals/schools.
» Principals will be responsible for printing the question papers for their students.
» Siting arrangements for the conduct of the assessments to be made as per board examination guidelines.
» Although the actual PISA or PISA-D tests 15 years old students, for our purpose it was decided to assess all students who were in class 9 and 10.
» The Trial Assessment to be conducted at 9.00 AM in all schools on the following dates for the three domains.
  ☞ Reading Literacy – March 27, 2017
  ☞ Scientific Literacy – March 28, 2017
  ☞ Mathematics Literacy – March 29, 2017
» Schools to submit individual students performance report to BCSEA by April 10, 2017.

» BCSEA to analyze the data and make a presentation of the report to concerned stakeholder by April 20, 2017. Make report available for all DEO/TEO and Principals on BCSEA website.

» For other Dzongkhags, assessment materials and guidelines will be available on BCSEA website (of interested to conduct the assessment for their own consumption).

## 1.1. Significance of the study

Through this study, concerned stakeholders (MoE, REC, BCSEA, teachers and students) will be able to understand the ground reality of the performance of the 15-year-old students in PISA items. The findings would help provide professional support to the schools and prepare them for the PISA-D scheduled in November.

## 1.2. PISA and PISA-D in Bhutan

### 1.2.1. Programme for International Student Assessment (PISA)

Programme for International Student Assessment (PISA) is a project carried out by the Organization for Economic Cooperation and Development (OECD) based in Paris, France. PISA assesses the outcomes of education systems, in terms of student achievement, within a common, internationally agreed framework and also checks the state of education across the world and helps in building effective policies and strategies in the education system.

PISA assessment started in 2000 with Reading Literacy as the major domain while the other two being considered as minor domain (Scientific and Mathematical Literacy). The assessment caters to the 15-year-old students who are nearing the end of compulsory secondary education of the participating countries and is conducted on triennial basis across the three Domains (Reading Literacy, Mathematical Literacy and Scientific Literacy). Some 80 countries and economies collaborate to compare how well their school systems prepare young people for life and work. It does not just examine whether students have learned what they were taught, but also assesses whether students can creatively and critically use what they know. The framework for these comparisons is an international assessment of the knowledge and skills of these 15-year-old students.

The assessment instruments are framed by the educational experts from across the world and are internationally valid and takes into account the cultural and curricular context of all the PISA participating countries and economies.

However, PISA does not provide any individual report after the assessment. It simply indicates the state of the education system of the participating countries (whether it is below/above/at par with the international standard). It also shows what is possible in education, they help governments to see themselves in comparison to the education opportunities and results delivered by other education systems, and they help governments to build effective policies and partnerships for improving learning outcomes.

Across the world, policy makers are using PISA findings to:

» gauge the knowledge and skills of students in their own country in comparison with those of other participating countries.

» establish benchmarks for educational improvement, for example, in terms of the mean scores achieved by other countries or their capacity to provide high levels of equity in educational outcomes and opportunities.

» understand opportunities and challenges for their education systems.

This function of PISA is now of global significance in light of the adoption of the Sustainable Development Goals (SDGs), including Goal 4 (Education) in 2015. The Education SDG includes a target and indicator that is focused on learning outcomes at the end of lower secondary education, in particular that all young people achieve at least a minimum proficiency level in reading and mathematics. PISA allows the identification of social, cultural, economic and educational factors that are associated with student performance.

### 1.2.2. Programme for International Student Assessment for Development (PISA-D)

The PISA for Development (PISA-D) initiative was launched by the OECD and its partners in 2013 with aims to encourage and facilitate PISA participation by interested and motivated low and middle-income countries.

The project builds capacity for managing large-scale student learning assessment and using the results to support policy dialogue and decision making in participating countries: Bhutan, Cambodia, Ecuador, Guatemala, Honduras, Panama, Paraguay, Senegal and Zambia.

PISA-D contributes to the monitoring and achievement of the Education Sustainable Development Goal, which emphasises quality and equity of learning outcomes for children, young people and adults.

Using the data collected from questionnaires, an analysis linking contextual information with student outcomes allows the country to:

» gauge the state of education against the international standards.

» ensure use of the results of the assessment for supporting national and international policy dialogue and decision-making.

» build local and institutional capacities in terms of the standards and structures to implement large-scale education assessments.

» provide opportunities for the participating countries to benefit from this experience and expertise and to join in efforts to contextualise the analysis and the implications to particular country contexts in a National Report.

» see where respective countries stand in comparison to their regional and global peers: an opportunity for mutual learning and inspiration.

» know the Policy impact nationally, regionally and globally.

Recognizing the importance of participating in international benchmarking systems to check the state of education in the country against the international standards and acknowledging its need at the earliest, the Ministry of Education endorsed and signed the Memorandum of Understanding (MoU) for PISA participation on 12th January 2017 during the 18th National Education Conference in the presence of His Excellency Lyonchen Tshering Tobgay, the Prime Minister and Lyonpo Norbu Wangchuk, the Minister for Education.

The Royal Government of Bhutan accords highest priority to education sector as the country's quality of health, prosperity, happiness and progression hinges on the quality of its education.  Towards this effect, the Ministry of Education has taken several reform initiatives to ensure that there are improvements in access, equity and system efficiencies to improve the quality of education in the country. The reform initiatives are primarily targeted at improving the school systems, curriculum and the competencies of the teachers.

The education reform initiatives are implemented as per the strategic direction of the aspirational document - Bhutan Education Blueprint 2014-2024, which is a ten-year strategic plan document for the Ministry of Education. The Blueprint recommends several key strategies and interventions to improve access, equity, system efficiency and the overall quality of education. One of the major recommendations is to partake in international benchmarking systems such as the PISA.

The aims of Bhutan's participation in PISA-D are to:

» set a benchmark (baseline) profile of the knowledge, skills and competencies of the students in Bhutan;

» collect evidence about the readiness of the Bhutanese education system for entry into the main PISA in 2021; and

» ensure adequate preparation for participation in the international benchmarking system and to perform well in the PISA-D (2017-2018).

## 2.   Methodology

### 2.1.  Sample Size

All schools within Thimphu Dzongkhag and Thromdey having Classes IX and X for the 2017 academic year were selected as the sample for the study. This included all Higher Secondary and Middle Secondary Schools regardless of Private or Government. In total, 1953 Class IX students and 1741 Class X students participated in the survey.

*Table 1: Details of participants from schools in Thimphu.*

| Location | Schools | Class IX | | | Class X | | | Overall Total |
|---|---|---|---|---|---|---|---|---|
| | | Boys | Girls | Total | Boys | Girls | Total | |
| Thimphu Dzongkhag | Khasadrapchu MSS | 59 | 52 | 111 | 40 | 35 | 75 | 186 |
| | Kuzhugchen MSS | 22 | 14 | 36 | 15 | 15 | 30 | 66 |
| | Wangbarma CS | 96 | 95 | 191 | 95 | 74 | 169 | 360 |
| Thimphu Thromde | Yangchenphug HSS | 119 | 151 | 270 | 95 | 139 | 234 | 504 |
| | Lungtenzampa MSS | 198 | 225 | 423 | 200 | 183 | 383 | 806 |
| | Motithang HSS | 117 | 142 | 259 | 112 | 122 | 234 | 493 |
| | Changangkha MSS | 53 | 73 | 126 | 48 | 56 | 104 | 230 |
| | Babesa MSS | 58 | 78 | 136 | 59 | 75 | 134 | 270 |
| | Zhilukha MSS | 41 | 79 | 120 | 33 | 57 | 90 | 210 |
| | Loseling MSS | 65 | 86 | 151 | 69 | 72 | 141 | 292 |
| | Dechencholing HSS | 59 | 54 | 113 | 48 | 41 | 89 | 202 |
| | Druk School | 10 | 7 | 17 | 16 | 10 | 26 | 43 |
| | Pelkhil School | 0 | 0 | 0 | 17 | 15 | 32 | 32 |
| **Overall Total** | | **897** | **1056** | **1953** | **847** | **894** | **1741** | **3694** |

## 2.2.  Mode of Test Administration

BCSEA compiled a set of question paper for each domain from the PISA released items and is administered in Thimphu schools from 27th to 29th March, 2017. The respective schools administered and evaluated the papers and sent to BCSEA for data analysis

## 2.3.  Instrumentation

A set of two-hour assessment paper for each domain was compiled based on the PISA released items. In order to make the assessment as authentic to the real PISA assessment, PISA blueprint, assessment framework and various competencies for each domain were carefully replicated to design the assessment. The following tables below show the details of various framework used to construct the actual PISA assessment and used by BCSEA.

*Table 2: Types of items set based on response in each domain*

| Domain | Item Types | | | | |
|---|---|---|---|---|---|
| | MCQ: Selected response question | Closed Constructive Response | Open Constructive Response | Full Marks | Writing Duration |
| Reading Literacy | 24 items | 13 items | 9 items | 100 | 2  hours |

| Domain | Item Types | | | | |
|---|---|---|---|---|---|
| | MCQ: Selected response question | Closed Constructive Response | Open Constructive Response | Full Marks | Writing Duration |
| Scientific Literacy | 19 items | 11 items | 15 items | 100 | 2 hours |
| Mathematical Literacy | 25 items | 8 items | 18 items | 100 | 2 hours |

## 2.4.  Assessment Framework

The PISA-D Preiliminary Assessment Framework across the three domains were adapted from the 2015, PISA Assessment Framework.

*Table 3: Number of items set based on core competencies in each domain*

| Domain | Competencies | Number of Items | Total Marks |
|---|---|---|---|
| Reading Literacy | Access and Retrieve | 13 items | 29 marks |
| | Integrate and interpret | 22 items | 45 marks |
| | Reflect and evaluate | 11 items | 26 marks |
| Scientific Literacy | Explain phenomena scientifically | 12 items | 26 marks |
| | Evaluate and design scientific enquiry | 16 items | 36 marks |
| | Interpret data and evidence scientifically | 17 items | 38 marks |
| Mathematical Literacy | Formulating situations mathematically | 14 items | 27 marks |
| | Employing mathematical concepts, facts, procedures | 24 items | 48 marks |
| | Interpreting, applying and evaluating mathematical outcomes | 13 items | 25 marks |

## 2.5. Reporting

The sample schools provided the assessment marks as per the mark entry sheet designed by BCSEA.  Data cleaning, processing and analysis were carried out using SPSS and excel respectively.

## 2.6.  Limitations of the study

Although the survey carried out fulfilled the intended purpose of the study and provided a rich data to create a benchmark of our students' performance on the various questions

and concerns raised at the beginning of the study, the survey findings probe more questions than answers due to the following limitations:

1. The study was conducted for Thimphu and therefore, the findings may not represent the overall performance of the entire country.

2. Full validity and reliability of the sample questions compiled for the survey cannot be confirmed by BCSEA due to limited expertise within the organisation for such assessment and the fact that the PISA-D sample items were not made available by the OECD. The items across the three domains for the study were compiled from the PISA released items which did not consider the appropriateness of the tested items in Bhutanese context for PISA-D.

3. The study is also limited by the limited background information of the participants taking part in the survey. Besides their age, school and gender, no other additional demographic information was sought by the survey to fully comprehend or attribute their performance in the PISA-D preliminary assessment to make other interpretations/correlations.

4. BCSEA had no control over the actual preparation and conduct of the survey assessment other than providing the basic guidelines. Factors such as readiness, motivation level and interest of the participants have bearing on students' performance which were not controlled.

5. Credibility of the marks received from the schools. Although marking scheme and model answers were provided to the schools, the manner in which marking/ assessment were carried out were left to the schools and teachers. One can only assume that the task were carried out with integrity.

# 3.  Survey Findings

## 3.1.  The Overall performance of students across the three domains are presented on the following parameters:

Of the three domains, participants studying in both Classes IX and X performed better in Scientific Literacy with 41.78 mean score. The lowest was in Mathematical Literacy with 28.84 mean score.

*Table 4: Details of participants' performance in the three domains*

| Domain | Students | Mean | SD | Minimum | Maximum |
|---|---|---|---|---|---|
| Scientific Literacy | 3711 | 41.78 | 13.01 | 2.5 | 94 |
| Reading Literacy | 3909 | 37.41 | 13.53 | 6 | 86 |
| Mathematical Literacy | 3692 | 28.84 | 8.63 | 0 | 74 |

### 3.1.1.  Location

Based on location of the schools in Thimphu, Thromdey schools have done reasonably better in all the domains comparing to the Dzongkhag schools.

Similarly, the trend of better performance in Scientific Literacy and with Mathematical Literacy as the lowest performance is identified as a prominent theme both in Dzongkhag schools as well as Thromdey schools

*Table 5: Performance of Thimphu Dzongkhag across the three domains*

| Thimphu Dzongkhag | Number of students | Mean | SD |
|---|---|---|---|
| Scientific Literacy | 572 | 37.63 | 13.76 |
| Reading Literacy | 579 | 32.9 | 12.16 |
| Mathematical Literacy | 549 | 27.80 | 7.23 |
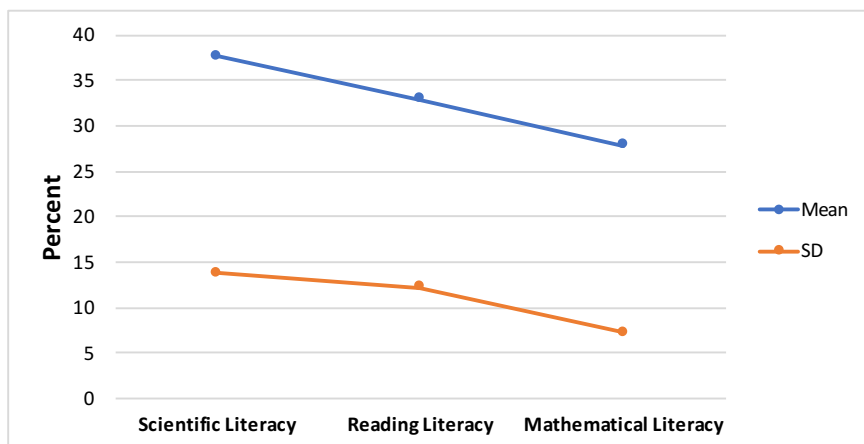


Figure 1 Location-wise Mean and Standard Deviation in Scientific Literacy

*Table 6: Performance of Thimphu Thromdey across the three domains*

| Thimphu Thromde | Number of students | Mean | SD |
|---|---|---|---|
| Scientific Literacy | 3139 | 42.54 | 12.73 |
| Reading Literacy | 3330 | 38.19 | 13.60 |
| Mathematical Literacy | 3143 | 29.02 | 8.84 |
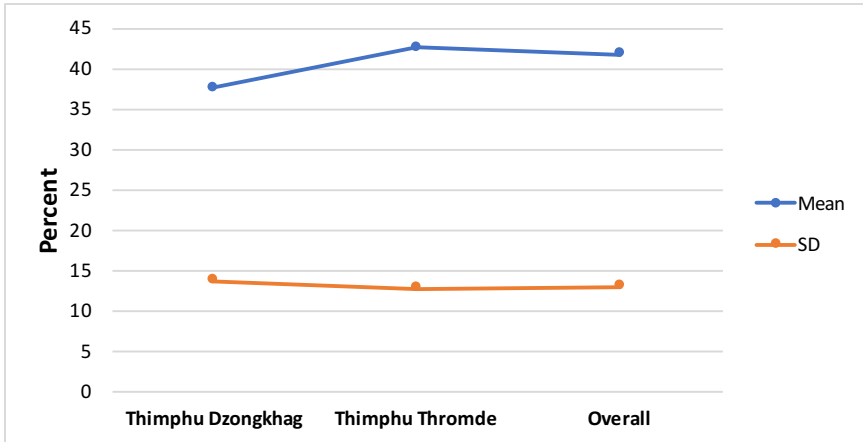
Figure 2 Location-wise Mean and Standard Deviation in Scientific Literacy
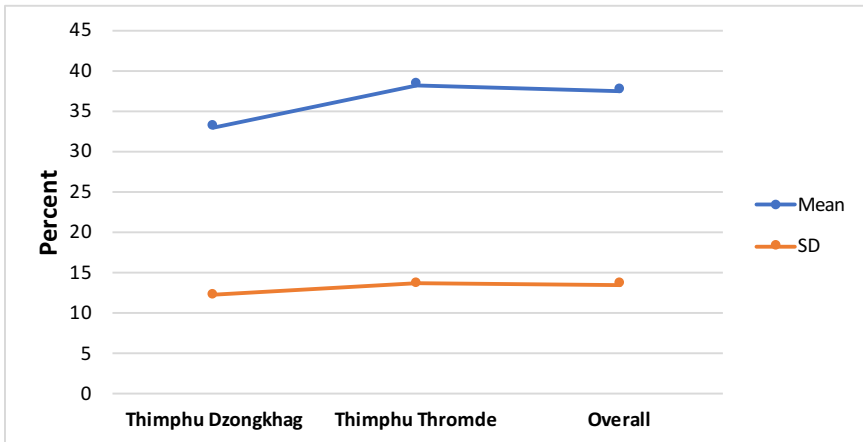


Figure 3 Location-wise Mean and Standard Deviation in Reading Literacy
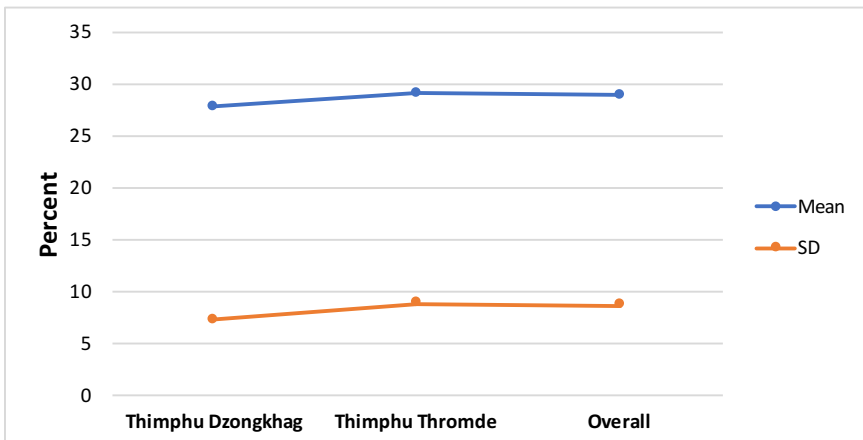


Figure 4 Location-wise Mean and Standard Deviation in Mathematical Literacy

### 3.1.2. Age

As per the survey, students' age were grouped into three categories – less than 14 years, those that were 15 at the time of taking the survey, and those that were 16 years and above. The students below 14 years of age have performed comparatively better than other age groups in all the three domains. Those students who were in the age category of '16 years and above' did not perform as well as the other two categories.

This clearly indicated that our 15 years old students in both Classes IX and X, across the three domains, their performance was better than the older age group but not as good as the younger age group. However, owing to limited demographic information of students, reasons for this difference may not be conclusive hence no assumption is made.

*Table 7: Performance in Reading Literacy based on Age & Gender*

| Age Group | Female | | | Male | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|
| | N | Mean | SD | N | Mean | SD | N | Mean | SD |
| 14 years and below | 661 | 42.68 | 13.99 | 446 | 41.11 | 13.99 | 1107 | 42.05 | |
| 15 years | 658 | 40.83 | 12.92 | 473 | 39.12 | 12.92 | 1131 | 40.12 | |
| 16 years and above | 836 | 33.48 | 12.24 | 835 | 31.53 | 12.24 | 1671 | 32.50 | |



Figure 5 Gender-wise perforamce in Reading Literacy across different age groups

## Table 8: Performance in Mathematical Literacy based on Age & Gender

| Age Group | Female | | | Male | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|
| | N | Mean | SD | N | Mean | SD | N | Mean | SD |
| 14 years and below | 1224 | 29.31 | 8.53 | 870 | 32.26 | 9.37 | 2094 | 30.53 | 9.00 |
| 15 years | 452 | 25.96 | 6.85 | 444 | 28.68 | 8.43 | 896 | 27.31 | 7.79 |
| 16 years and above | 316 | 25.11 | 6.59 | 386 | 26.28 | 7.66 | 702 | 25.75 | 7.21 |
| Total | 1992 | 27.88 | 8.09 | 1700 | 29.97 | 9.11 | 3692 | 28.84 | 8.64 |



Figure 6 Gender-wise perforamce in Mathematical Literacy across different age groups

## Table 9: Performance in Scientific Literacy based on Age & Gender

| Age Group | Female | | | Male | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|
| | N | Mean | SD | N | Mean | SD | N | Mean | SD |
| 14 years and below | 634 | 44.50 | 12.02 | 437 | 46.38 | 13.27 | 1071 | 45.27 | 12.57 |
| 15 years | 621 | 43.21 | 13.88 | 453 | 44.65 | 12.80 | 1074 | 43.82 | 13.45 |
| 16 years and above | 767 | 37.81 | 11.54 | 799 | 38.19 | 12.43 | 1566 | 38.00 | 12.00 |
| **Total** | **2022** | **41.57** | **12.79** | **1689** | **42.04** | **13.27** | **3711** | **41.78** | **13.01** |
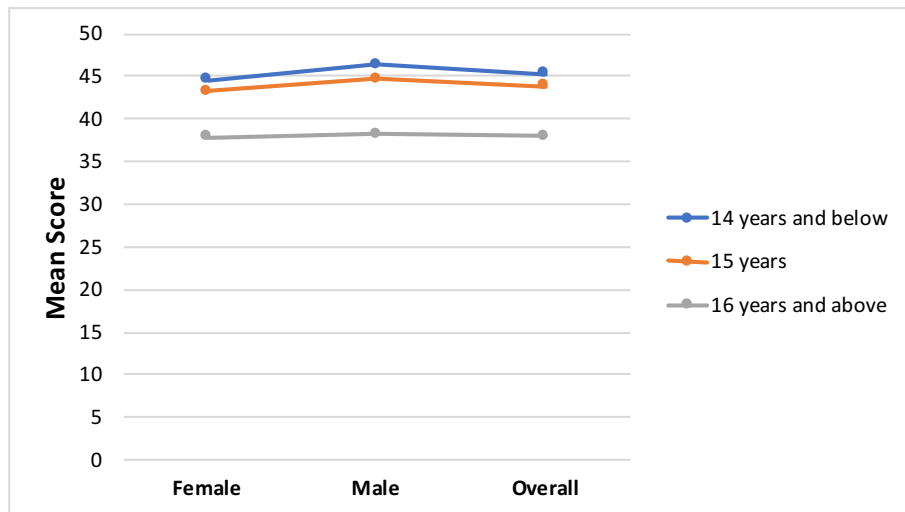
Figure 7 Gender-wise perforamce in Scientific Literacy across different age groups

### 3.1.3. Gender

Irrespective of the location, class and age, the following observations were made:

6. Female students did better than their male counterparts in Reading Literacy.
7. Male students did better than their female counterparts in Mathematical Literacy.
8. Both male and female students performed at par with one another in Scientific Literacy.

*Table 10: Performance in Reading Literacy based on Gender*

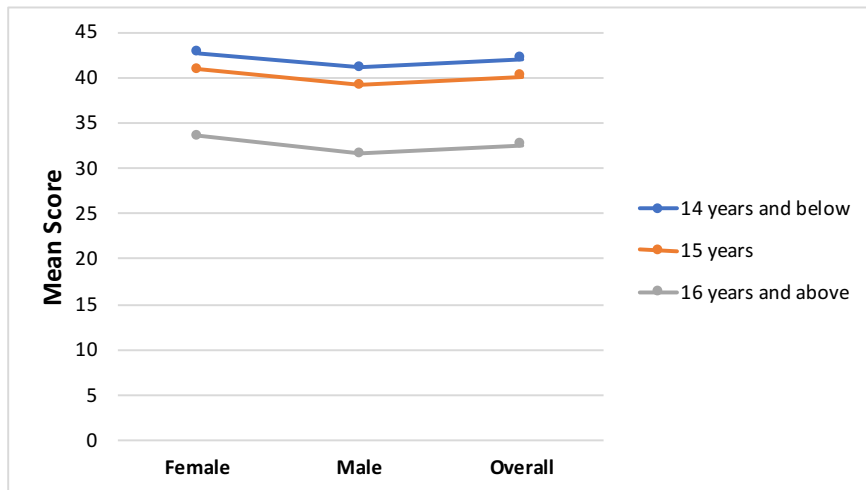| Class | Female | | | Male | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|
| | N | Mean | SD | N | Mean | SD | N | Mean | SD |
| IX | 1172 | 36.82 | 12.64 | 896 | 34.61 | 13.09 | 2068 | 35.86 | 12.88 |
| X | 983 | 40.60 | 13.92 | 858 | 37.48 | 13.95 | 1841 | 39.15 | 14.02 |
| **Overall** | **2155** | **38.54** | **13.37** | **1754** | **36.01** | **13.59** | **3909** | **37.41** | **13.53** |
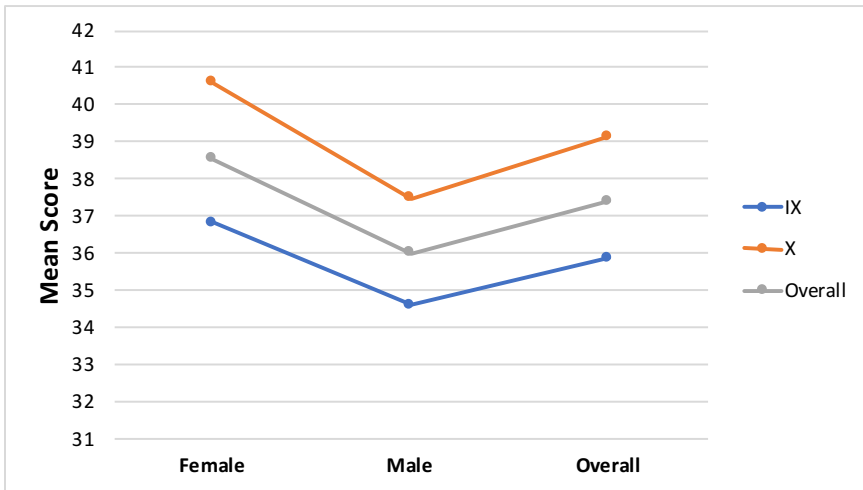
Figure 8 Gender-wise perforamce in Reading Literacy across different grades

### Table 11: Performance in Mathematical Literacy based on Gender

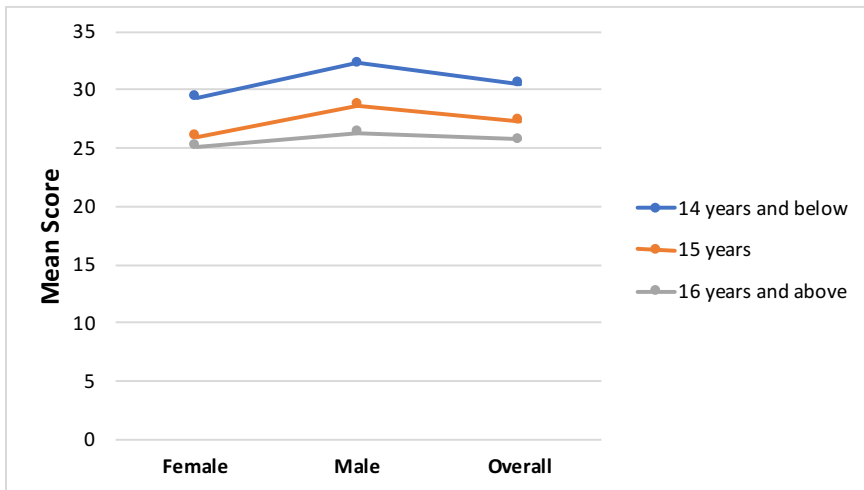| Class | Female | | | Male | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|
| | N | Mean | SD | N | Mean | SD | N | Mean | SD |
| IX | 1072 | 26.77 | 7.10 | 892 | 28.75 | 8.37 | 1964 | 27.67 | 7.76 |
| X | 920 | 29.18 | 8.94 | 808 | 31.32 | 9.68 | 1728 | 30.18 | 9.36 |
| Overall | 1992 | 27.88 | 8.09 | 1700 | 29.97 | 9.11 | 3692 | 28.84 | 8.64 |
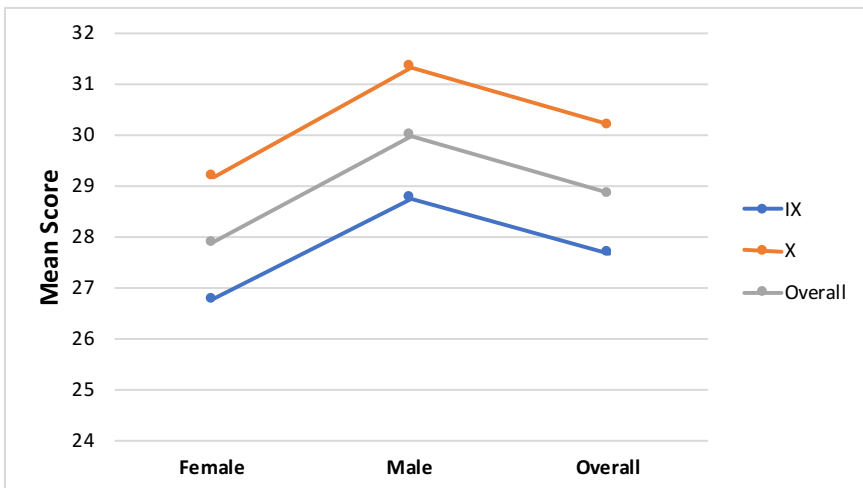


Figure 9 Gender-wise perforamce in Mathematical Literacy across different grades

*Table 12: Performance in Scientific Literacy based on Gender*

| Class | Female | | | Male | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|
| | **N** | **Mean** | **SD** | **N** | **Mean** | **SD** | **N** | **Mean** | **SD** |
| IX | 1091 | 40.48 | 11.87 | 884 | 40.44 | 12.27 | 1975 | 40.46 | 12.05 |
| X | 931 | 42.84 | 13.69 | 805 | 43.80 | 14.09 | 1736 | 43.29 | 13.88 |
| Overall | 2022 | 41.57 | 12.79 | 1689 | 42.04 | 13.27 | 3711 | 41.78 | 13.01 |
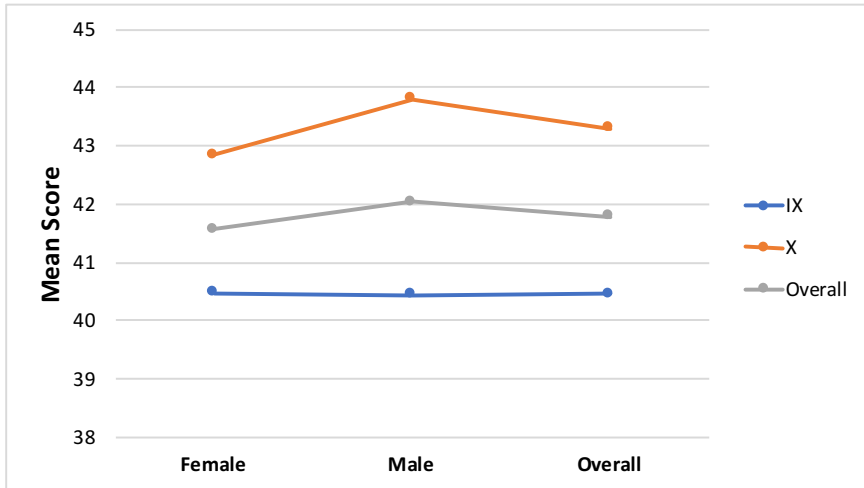


Figure 10 Gender-wise perforamce in Scientific Literacy across different grades

### 3.1.4. Class

Irrespective of the school location and age, students in Class X performed better across the three domains when compared to the students in Class IX. However, the difference is only 2.83 (mean) in favour of class X.

### 3.1.5. Competencies (Aspects)

PISA assesses various aspects/competencies in each of the domain. Similarly students' performance in each aspects/competencies were analyzed across the domains starting with Reading Literacy, Mathematical Literacy and Scientific Literacy.

## 3.2. Survey Findings of Reading Literacy

The performance of students in the Reading Literacy is presented on the following parameters:

### 3.2.1. Aspects

There are three basic Aspects identified in Reading Literacy: Access and Retrieve, Integrate and Interpret and Reflect and Evaluate. Of the three aspects, the overall performance was best in the Aspect: Integrate and Interpret with a mean of 19.81 against 12.02 and 7.42 respectively.

*Table 13: Overall performance based on Aspects*

| Domain | Aspect / Process Standard / Competency | Total Marks | Mean | SD |
|---|---|---|---|---|
| Reading Literacy | Access and Retrieve | 29 | 12.02 | 5.05 |
| | Reflect and Evaluate | 45 | 7.42 | 4.09 |
| | Integrate and Interpret | 26 | 19.81 | 7.07 |

Further, female students have performed better in 'Integrate and Interpret' compared to the male students.

### 3.2.2. Performance of various age groups across the three Aspects

Students below 14 years studying in Class X scored better across the three Aspects (15.49 in Access and Retrieve, 9.49 in Reflect and Evaluate, and 25.18 in Integrate and Interpret) when compared to the other two age groups. However, students of 15 years old studying in Class X performed very closely to the students of 14 years and below studying in Class X (14.81, 23.29 and 9.14 mean score respectively).

*Table 14: Performance of various age groups across the three Aspects in Reading Literacy*

| Aspect | Age group | Class IX | | | Class X | | |
|---|---|---|---|---|---|---|---|
| | | N | Mean | SD | N | Mean | SD |
| Access and Retrieve | 14 years and below | 718 | 12.89 | 4.84 | 123 | 15.49 | 4.96 |
| | 15 years | 439 | 11.29 | 4.43 | 312 | 14.81 | 4.89 |
| | 16 years and above | 412 | 9.10 | 4.49 | 489 | 11.20 | 4.74 |
| Reflect and Evaluate | 14 years and below | 765 | 7.79 | 4.00 | 188 | 9.49 | 4.56 |
| | 15 years | 472 | 6.80 | 3.70 | 463 | 9.14 | 4.51 |
| | 16 years and above | 422 | 5.83 | 3.22 | 780 | 6.79 | 3.82 |
| Integrate and Interpret | 14 years and below | 701 | 20.78 | 7.00 | 184 | 25.18 | 6.95 |
| | 15 years | 432 | 18.63 | 6.42 | 433 | 23.29 | 6.71 |
| | 16 years and above | 396 | 15.95 | 6.10 | 708 | 18.22 | 6.27 |

### 3.2.3. Gender

Female students studying in Class X performed better in all three aspects followed by male students also studying in Class X. Among the three aspects, both male and

female students irrespective of their classes, performed much better in Integrate and Interpret than in Access and Retrieve or Reflect and Evaluate.

*Table 15: Gender wise performance in Reading literacy*

| Aspects | Class IX | | | | | | Class X | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Female | | | Male | | | Female | | | Male | | |
| | N | Mean | SD | N | Mean | SD | N | Mean | SD | N | Mean | SD |
| Access and Retrieve | 904 | 11.48 | 4.71 | 665 | 11.40 | 5.13 | 496 | 13.38 | 5.09 | 428 | 12.54 | 5.25 |
| Reflect and Evaluate | 971 | 7.18 | 3.83 | 688 | 6.77 | 3.78 | 780 | 8.24 | 4.3 5 | 651 | 7.51 | 4.28 |
| Integrate and Interpret | 888 | 19.28 | 6.79 | 641 | 18.42 | 7.02 | 728 | 21.53 | 7.0 2 | 597 | 20.01 | 7.14 |

### 3.2.4. Item types

There are three different types of items in Reading Literacy - Multiple Choice Question, Open Constructed Response and Closed Constructed Response. In the overall performance, students studying in Class X have performed better than Class IX students across all item types. However, it is the students below 14 years studying in Class X who outperformed the other group of students across all item types. Students of 15 years studying in Class IX did not perform as well as the students below 14 years studying in Classes IX and X.

*Table 16: Item Types*

| Item Type | Age Group | IX | | | X | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | N | Mean | SD | N | Mean | SD | N | Mean | SD |
| MCQ | 14 years and below | 719 | 24.01 | 7.68 | 175 | 29.04 | 6.97 | 894 | 25.00 | 7.80 |
| | 15 years | 429 | 21.19 | 6.98 | 438 | 27.07 | 7.49 | 867 | 24.16 | 7.81 |
| | 16 years and above | 427 | 18.45 | 6.67 | 719 | 21.15 | 6.54 | 1146 | 20.15 | 6.71 |
| | **Total** | **1575** | **21.74** | **7.59** | **1332** | **24.14** | **7.66** | **2907** | **22.84** | **7.71** |
| OCR | 14 years and below | 773 | 5.76 | 3.56 | 192 | 6.94 | 4.19 | 965 | 5.99 | 3.72 |
| | 15 years | 484 | 4.95 | 3.30 | 473 | 6.89 | 3.93 | 957 | 5.91 | 3.75 |
| | 16 years and above | 435 | 3.91 | 2.83 | 799 | 4.85 | 3.48 | 1234 | 4.52 | 3.30 |
| | **Total** | **1692** | **5.05** | **3.39** | **1464** | **5.78** | **3.86** | **3156** | **5.39** | **3.64** |
| CCR | 14 years and below | 755 | 10.14 | 4.37 | 134 | 12.18 | 4.70 | 889 | 10.44 | 4.48 |
| | 15 years | 463 | 9.01 | 4.22 | 311 | 11.77 | 4.80 | 774 | 10.12 | 4.66 |
| | 16 years and above | 413 | 6.99 | 3.94 | 518 | 8.85 | 4.55 | 931 | 8.02 | 4.39 |
| | **Total** | **1631** | **9.02** | **4.41** | **963** | **10.25** | **4.89** | **2594** | **9.48** | **4.63** |

### 3.2.5. Overall difficulty index

The difficulty of items are distributed based on the number of items correctly attempted. Open Constructed Response item number 2 from Text V was found to be the most difficult item as it being the least correctly attempted item. Only 5.48% of the students attempted this item. Next was Closed Constructed Response item number 1, from Text IX and item number 1, from Text XI. Only 8.18% and 8.35% of the students attempted these items. All these three items assessed the Aspects - Access and Retrieve and Reflect and Evaluate indicating that the students were not competent in these aspects.

Multiple choice item number 2 from Text IX and item number 1 from Text VI were found the easiest items. Indicated by most correctly attempted items by more than 75% of the students. The Aspect assessed by these two items is Integrate and Interpret. Thus, showing that the students were more competent in this Aspect.

*Table 17: Item classification*

| Item Type | Difficulty Level | Description |
|---|---|---|
| IXQ2MCQ | 79.30 | Easy |
| VIQ1MCQ | 77.60 | |
| VIIIQ3MCQ | 73.30 | |
| VIIQ2 CCR | 72.23 | Moderately difficult |
| IVQ3 CCR | 71.14 | |
| VQ1MCQ | 69.90 | |
| IVQ4MCQ | 63.30 | |
| IQ5MCQ | 60.10 | |
| VIIQ1MCQ | 59.20 | |
| VIIIQ2MCQ | 56.10 | |
| IVQ2 CCR | 55.46 | |
| IIQ1MCQ | 54.20 | |
| VIQ2 CCR | 53.21 | |
| VIQ3MCQ | 53.20 | |
| IXQ4 OCR | 50.50 | |
| VIQ4 CCR | 47.62 | |
| IVQ1MCQ | 45.10 | |
| XQ2MCQ | 44.80 | |
| VIIIQ1MCQ | 43.90 | |
| IIIQ4MCQ | 43.20 | |

### 3.2.6. The most and least correctly attempted Item Types

The most correctly attempted item type by both Classes IX and X was Multiple choice question (21.74 and 24.14 mean score) and the least correctly attempted being Open Constructed Response (5.05 and 5.78 mean score).

### 3.2.7. Proficiency scale in Reading Literacy

BCSEA has adapted it's reporting on the performance of the students from the OECD PISA Reading Literacy Framework 2015. This proficiency scale ranges from level 1 to 6.

The highest level of achievement of the majority of the students was 314 mean score which determines the proficiency of students to be below level 1. The tasks at this level require the reader to locate one or more independent pieces of explicitly stated information; to recognise the main theme or author's purpose in a text about a familiar topic, or to make a simple connection between information in the text and common, everyday knowledge. Typically the required information in the text is prominent and there is little, if any, competing information. The reader is explicitly directed to consider relevant factors in the task and in the text.

*Table 18: Proficiency level in Reading Literacy*

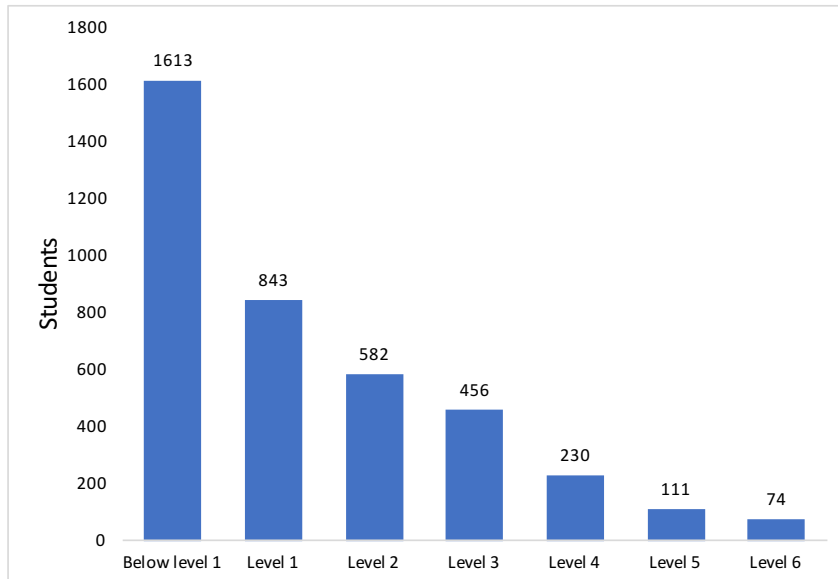| Proficiency Level | Frequency | Percent |
|---|---|---|
| Level 6 | 74 | 1.9 |
| Level 5 | 111 | 2.8 |
| Level 4 | 230 | 5.9 |
| Level 3 | 456 | 11.7 |
| Level 2 | 582 | 14.9 |
| Level 1 | 843 | 21.6 |
| Below level 1 | 1613 | 41.3 |
| **Total** | **3909** | **100** |



Figure 11 Proficiency level in Reading Literacy

### 3.3. Survey Findings of Mathematical Literacy

The performance of students in the Mathematical Literacy is presented on the following parameters:

### 3.3.1. Aspects

There are three basic competencies identified in Mathematical Literacy - Formulating situations mathematically, Employing mathematical concepts, facts, procedures and Interpreting, applying and evaluating mathematical outcomes. The overall performance of the students was slightly better in the Competency: Formulating situations mathematically with a mean of 10.48 against 9.76 and 9.19 respectively in the other two competencies.

*Table 19: Overall performance based on Aspects*

| Domain | Process Category | Total Marks | Mean | SD |
|---|---|---|---|---|
| Mathematical Literacy | Employing mathematical concepts, facts and procedures | 27 | 9.76 | 4.91 |
| | Formulating situations mathematically | 48 | 10.48 | 3.09 |
| | Interpreting, applying and evaluating mathematical outcomes | 25 | 9.19 | 3.28 |

### 3.3.2. Performance of various age groups across the three Aspects

The students under 14 years of age studying in Class X did better across the three competencies (11.53 mean score, 12.19 mean score, 10.78 mean score) when compared to the other two age groups.

The findings also showed that the overall performance of 15 year old students studying in Class IX performed slightly better in Formulating situations mathematically (9.75 mean score) than in the other two competencies.

*Table 20: Performance of various age groups across the three Aspects*

| Aspect | Age group | Class IX | | | Class X | | |
|---|---|---|---|---|---|---|---|
| | | N | Mean | SD | N | Mean | SD |
| Access and Retrieve | 14 years and below | 869 | 10.64 | 4.31 | 202 | 11.95 | 4.36 |
| | 15 years | 555 | 9.24 | 4.13 | 519 | 11.63 | 4.56 |
| | 16 years and above | 551 | 7.84 | 3.71 | 1015 | 9.26 | 4.08 |
| | **Overall** | **1975** | **9.47** | **4.26** | **1736** | **10.28** | **4.43** |
| Reflect and Evaluate | 14 years and below | 869 | 17.69 | 5.03 | 202 | 19.12 | 5.02 |
| | 15 years | 555 | 16.39 | 4.64 | 519 | 18.95 | 5.45 |
| | 16 years and above | 551 | 14.22 | 4.87 | 1015 | 16.28 | 5.25 |
| | **Overall** | **1975** | **16.36** | **5.08** | **1736** | **17.41** | **5.45** |

| Aspect | Age group | Class IX | | | Class X | | |
|---|---|---|---|---|---|---|---|
| | | N | Mean | SD | N | Mean | SD |
| Integrate and Interpret | 14 years and below | 869 | 16.05 | 5.54 | 202 | 17.98 | 6.83 |
| | 15 years | 555 | 14.57 | 5.46 | 519 | 17.11 | 6.96 |
| | 16 years and above | 551 | 12.46 | 4.86 | 1015 | 14.35 | 5.93 |
| | **Overall** | **1975** | **14.63** | **5.54** | **1736** | **15.60** | **6.53** |

### 3.3.3. Gender

Both male and female students under 14 years of age outperformed better in all the three competencies when compared to the other two age groups.

Irrespective of age and class, the overall performance of male students across the three competencies was better than female students.

*Table 21: Gender*

| Aspects | Class IX | | | | | | Class X | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Female | | | Male | | | Female | | | Male | | |
| | N | Mean | SD | N | Mean | SD | N | Mean | SD | N | Mean | SD |
| Employing mathematical concepts, facts and procedures | 10.19 | 886 | 2.83 | 10.4 5 | 712 | 3.18 | 10.53 | 783 | 10.8 6 | 644 | 3.46 | 5.25 |
| Formulating situations mathematically | 8.46 | 757 | 4.18 | 9.80 | 592 | 4.93 | 10.15 | 683 | 10.9 7 | 566 | 5.25 | 4.28 |
| Interpreting, applying and evaluating mathematical outcomes | 8.57 | 881 | 2.94 | 9.11 | 679 | 3.30 | 9.24 | 764 | 10.0 8 | 648 | 3.45 | 7.14 |

### 3.3.4. Item types

There were three different types of items in Mathematical Literacy -Multiple Choice Question (MCQ), Open Constructed Response (OCR) and Closed Constructed Response CCR). In Mathematics Literacy, students studying in Class X have performed better than Class IX students across all item types. However, it's the students below 14 years studying in Class X who outperformed the other two age groups of students across all item types. Students of 15 years studying in Class IX did not perform so well compared to the students below 14years studying in both Classes IX and X.

| Item Type | Age Group | IX | | | X | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | N | Mean | SD | N | Mean | SD | N | Mean | SD |
| MCQ (50) | 14 years and below | 1206 | 19.11 | 6.27 9 | 606 | 22.23 | 7.27 | 1812 | 20.15 | 6.79 |
| | 15 years | 282 | 16.38 | 5.50 0 | 484 | 18.82 | 6.23 | 766 | 17.92 | 6.09 |
| | 16 years and above | 222 | 16.28 | 5.18 7 | 374 | 16.88 | 5.89 | 596 | 16.65 | 5.64 |
| OCR (35) | 14 years and below | 1064 | 2.42 | 2.43 1 | 581 | 3.88 | 3.27 | 1645 | 2.94 | 2.84 |
| | 15 years | 221 | 1.48 | 1.64 5 | 423 | 2.37 | 2.23 | 644 | 2.06 | 2.09 |
| | 16 years and above | 142 | 1.55 | 1.99 3 | 304 | 1.89 | 2.23 | 446 | 1.78 | 2.16 |
| CCR (15) | 14 years and below | 1319 | 7.68 | 1.66 5 | 693 | 8.19 | 1.70 | 2012 | 7.85 | 1.69 |
| | 15 years | 303 | 7.36 | 1.72 4 | 543 | 7.84 | 1.56 | 846 | 7.67 | 1.64 |
| | 16 years and above | 227 | 7.19 | 1.71 8 | 421 | 7.61 | 1.65 | 648 | 7.46 | 1.68 |

### 3.3.5. Overall Difficulty Index

The difficulty of items were distributed based on the number of items correctly attempted. In MCQ, item number 23 and 32 were found to be the most difficult item as it being the least correctly attempted item (only 10.1% and 11.5% of the students attempted). These two items assessed the competencies - Employing Mathematical Concepts, Facts and Procedures and Interpreting, Applying and Evaluating Mathematical Outcomes indicating that the students were not competent in these competencies. Item number 45 and 44 were found to be the easiest items as they being the most correctly attempted items (82.7% and 80.4% of the students attempted). The competencies assessed by these two items was Formulating situations mathematically. Thus, showing that the students are better in this competencies.

*Table 23: Details of performance on MCQ items in Mathematical Literacy*

| Item | Difficulty Index | Description |
|---|---|---|
| MCQ-45 | 82.7 | |
| MCQ-44 | 80.4 | Easy |
| MCQ-6 | 77 | |

| Item | Difficulty Index | Description |
|------|------------------|-------------|
| MCQ7-B | 64.6 | |
| MCQ-20 | 50.8 | |
| MCQ-31 | 49.6 | |
| MCQ-1 | 49.3 | |
| MCQ-10 | 47.2 | |
| MCQ-13 | 41.6 | |
| MCQ-7A | 40.5 | Moderate |
| MCQ-28 | 38.9 | |
| MCQ-9 | 38.1 | |
| MCQ-12 | 37.6 | |
| MCQ-46 | 29.7 | |
| MCQ-11 | 28 | |
| MCQ-3 | 26.8 | |
| MCQ-2 | 24.7 | |
| MCQ-37 | 23.7 | |
| MCQ-25 | 23.2 | |
| MCQ-34 | 21.4 | |
| MCQ-16 | 18.6 | Difficult |
| MCQ-5 | 18.1 | |
| MCQ-4 | 16.7 | |
| MCQ-32 | 11.5 | |
| MCQ-23 | 10.1 | |

In OCR, item number 47 was found to be the most difficult item or as the least correctly attempted item (only 0.5% of the students attempted). This is followed by item number 49 and 48 (0.7% and 0.8% of the students attempted). These three items assess the Aspects; Employing Mathematical Concepts, Facts and Procedures indicating that the students have difficulty in these aspects.

In CCR, item number 39 was the most correctly attempted items (attempted by 85% of the students). The Aspect assessed by this item is Formulating situations mathematically indicating the students surveyed are competent in this Aspect.

*Table 24: Details of performance on CCR and OCR items in Mathematical Literacy*

| Item No. | N | Mean | Full Mark | Percentage | Difficulty Index |
|----------|---|------|-----------|------------|------------------|
| Q39-CCR | 3650 | 1.70 | 2 | 84.91 | Easy |

| Item No. | N | Mean | Full Mark | Percentage | Difficulty Index |
|----------|-----|------|-----------|------------|------------------|
| Q27-CCR | 3663 | 1.31 | 2 | 65.27 | |
| Q26-CCR | 3675 | 1.23 | 2 | 61.41 | |
| Q21-CCR | 3678 | 0.90 | 1.5 | 59.97 | |
| Q17-CCR | 3675 | 0.77 | 1.5 | 51.16 | Moderate |
| Q22-CCR | 3663 | 0.92 | 2 | 46.15 | |
| Q36-CCR | 3641 | 0.55 | 1.5 | 36.68 | |
| Q42-CCR | 3597 | 0.36 | 1.5 | 23.69 | |
| Q15-OCR | 3574 | 0.46 | 2 | 22.95 | |
| Q19-OCR | 3496 | 0.39 | 2 | 19.34 | |
| Q18-OCR | 3279 | 0.35 | 2 | 17.63 | |
| Q33-OCR | 3361 | 0.28 | 2 | 14.11 | |
| Q50-OCR | 3393 | 0.11 | 1 | 10.58 | |
| Q8-OCR | 3368 | 0.13 | 2 | 6.28 | |
| Q24-OCR | 3609 | 0.12 | 2 | 5.78 | |
| Q43-OCR | 3410 | 0.16 | 3 | 5.23 | |
| Q40-OCR | 3324 | 0.10 | 2 | 4.96 | |
| Q41-OCR | 3358 | 0.09 | 2 | 4.71 | Difficult |
| Q30-OCR | 3234 | 0.09 | 2 | 4.55 | |
| Q35-OCR | 2948 | 0.07 | 2 | 3.65 | |
| Q14-OCR | 3494 | 0.05 | 2 | 2.47 | |
| Q38-OCR | 3358 | 0.04 | 2 | 2.23 | |
| Q29-OCR | 3257 | 0.04 | 2 | 1.96 | |
| Q48-OCR | 3220 | 0.02 | 2 | 0.80 | |
| Q49-OCR | 3192 | 0.01 | 2 | 0.74 | |
| Q47-OCR | 3318 | 0.01 | 2 | 0.47 | |

### 3.3.6. The most and least correctly attempted item type

The most correctly attempted item type by both class IX and X was CCR and the least correctly attempted item type was OCR.

*Table 25: Details of difficulty percentage based on item types in Mathematical Literacy*

| ITEM TYPE | Difficulty Percentage | |
|-----------|------|------|
| | IX | X |
| MCQ | 37 | 39 |
| OCR | 6 | 8 |
| CCR | 50 | 52 |

### 3.3.7. Proficiency scale

In Mathematical Literacy, BCSEA has adapted it's reporting on the performance of the students from the OECD PISA Mathematical Literacy Framework 2015. This proficiency scale ranges from level 1 to 6 based on the scores achieved by the participants.

The mean score in Mathematics was 288 determining the majority of the students to be proficient at level 1. Proficiency at Level 1 indicates, that students can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. They are able to identify information and to carry out routine procedures according to direct instructions in explicit situations. They can perform actions that are almost always obvious and follow immediately from the given stimuli.

*Table 26: Details of Proficiency Level in Mathematical Literacy*

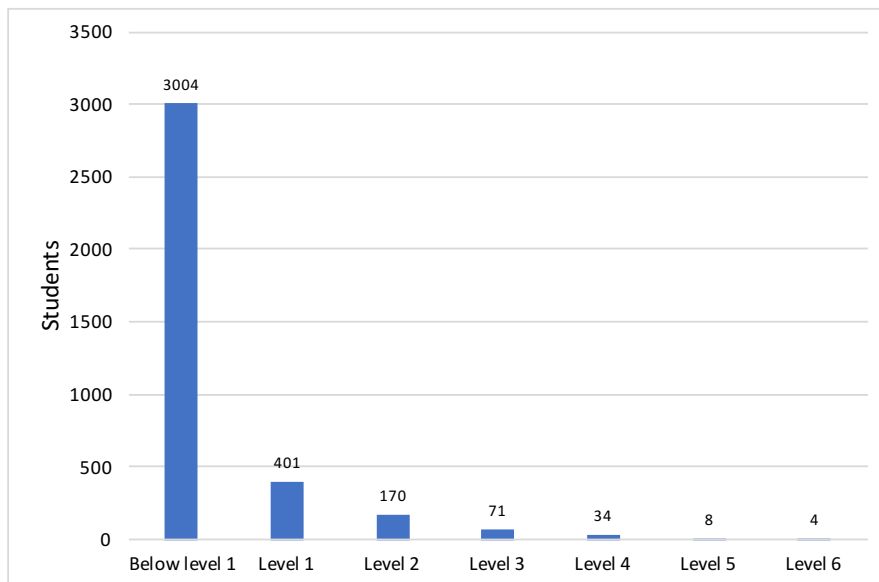| Proficiency Level | Frequency | Percent |
|---|---|---|
| Level 6 | 4 | 0.1 |
| Level 5 | 8 | 0.2 |
| Level 4 | 34 | 0.9 |
| Level 3 | 71 | 1.9 |
| Level 2 | 170 | 4.6 |
| Level 1 | 401 | 10.9 |
| Below level 1 | 3004 | 81.4 |
| **Total** | **3692** | **100** |



Figure 11 Proficiency level in Mathematical Literacy

## 3.4. Survey Findings of Scientific Literacy

The performance of students in the Scientific Literacy is presented on the following parameters:

### 3.4.1. Aspects

There are three basic competencies identified in Scientific Literacy - Explain phenomena scientifically, Evaluate and design scientific enquiry and Interpret data and evidence scientifically. The findings showed that the performance of both male and female students across the three competencies was the same.

Students below 14 years studying in Class X have performed better in all three competencies compared to the other age groups and class. Their performance was highest in Evaluate and Design Scientific Enquiry (17.98 mean score).

The findings also showed that the performance of students above 16 years was comparatively lower than the other two age groups across the three competencies.

*Table 27: Aspects*

| Domain | Aspect / Process Standard / Competency | Total Marks | Mean | SD |
|---|---|---|---|---|
| Scientific Literacy | Explain Phenomena Scientifically | 26 | 9.85 | 4.36 |
| | Evaluate and Design Scientific Enquiry | 36 | 16.85 | 5.28 |
| | Interpret Data and Evidence Scientifically | 38 | 15.08 | 6.04 |

### 3.4.2 Performance of various age groups across the three Aspects

Students in the age group 'below 14 years' have performed better than other age groups (the students of 15 years and above 16 years) in both Thromdey and Dzongkhag.

For Thimphu Dzongkhag, the mean score of male and female students below 14 years was 47.25 and 40.04 mean score respectively. On the other hand, the mean score of students above 16 years was 35.09.

Similarly for Thimphu Thromdey, the mean score of students of 14 years and below' was 45.46 followed closely by the students of 15 years with 44.23 mean score.

*Table 28: Performance of various age groups across the three Aspects*

| Aspect | Age group | Class IX | | | Class X | | |
|---|---|---|---|---|---|---|---|
| | | **N** | **Mean** | **SD** | **N** | **Mean** | **SD** |
| Explain Phenomena Scientifically | 14 years and below | 869 | 10.64 | 4.31 | 202 | 11.95 | 4.36 |
| | 15 years | 555 | 9.24 | 4.13 | 519 | 11.63 | 4.56 |
| | 16 years and above | 551 | 7.84 | 3.71 | 1015 | 9.26 | 4.08 |
| | **Overall** | **1975** | **9.47** | **4.26** | **1736** | **10.28** | **4.43** |
| Evaluate and Design Scientific Enquiry | 14 years and below | 869 | 17.69 | 5.03 | 202 | 19.12 | 5.02 |
| | 15 years | 555 | 16.39 | 4.64 | 519 | 18.95 | 5.45 |
| | 16 years and above | 551 | 14.22 | 4.87 | 1015 | 16.28 | 5.25 |
| | **Overall** | **1975** | **16.36** | **5.08** | **1736** | **17.41** | **5.45** |
| Interpret Data and Evidence Scientifically | 14 years and below | 869 | 16.05 | 5.54 | 202 | 17.98 | 6.83 |
| | 15 years | 555 | 14.57 | 5.46 | 519 | 17.11 | 6.96 |
| | 16 years and above | 551 | 12.46 | 4.86 | 1015 | 14.35 | 5.93 |
| | **Overall** | **1975** | **14.63** | **5.54** | **1736** | **15.60** | **6.53** |

### 3.4.3. Gender

Irrespective of the location and class, the overall performance of male students (42.04) is at par with the female students (41.57) students.

*Table 29: Gender*

| Aspects | Class IX | | | | | | Class X | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Female | | | Male | | | Female | | | Male | | |
| | **N** | **Mean** | **SD** | **N** | **Mean** | **SD** | **N** | **Mean** | **SD** | **N** | **Mean** | **SD** |
| Explain Phenomena Scientifically | 1091 | 9.31 | 4.20 | 884 | 9.67 | 4.33 | 931 | 10.04 | 4.29 | 805 | 10.57 | 4.58 |
| Evaluate and Design Scientific Enquiry | 1091 | 16.69 | 4.98 | 884 | 15.95 | 5.18 | 931 | 17.63 | 5.43 | 805 | 17.15 | 5.47 |
| Interpret Data and Evidence Scientifically | 1091 | 14.48 | 5.52 | 884 | 14.82 | 5.55 | 931 | 15.18 | 6.49 | 805 | 16.09 | 6.54 |

### 3.4.4. Item types

Scientific Literacy paper consisted of three different types of items - Multiple Choice Questions (MCQ), Open Constructed Response (OCR) and Closed Constructed Response (CCR).

Performance compared between classes - over all the Class X students have done better than class IX in all the item types.

Considering performance by age group, Classes IX and X students in age category '14 years and below' in both class IX and X have performed better than other two age groups in all item types. The least performing age cohort is '16-years and above' without the 15 years students in the middle.

*Table 30: Item types Performance in Scientific Literacy*

| Item Type | Age Group | IX | | | X | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | N | Mean | SD | N | Mean | SD | N | Mean | SD |
| MCQ | 14 years and below | 730 | 15.94 | 5.99 | 164 | 18.95 | 5.89 | 894 | 16.49 | 6.08 |
| | 15 years | 478 | 14.48 | 5.47 | 428 | 17.94 | 6.27 | 906 | 16.12 | 6.11 |
| | 16 years and above | 456 | 12.29 | 4.84 | 810 | 14.91 | 5.81 | 1266 | 13.97 | 5.62 |
| | **Total** | **1664** | **14.52** | **5.74** | **1402** | **16.31** | **6.19** | **3066** | **15.34** | **6.01** |
| OCR | 14 years and below | 805 | 20.59 | 4.33 | 189 | 22.49 | 4.44 | 994 | 20.95 | 4.41 |
| | 15 years | 500 | 18.89 | 4.49 | 462 | 22.07 | 4.27 | 962 | 20.42 | 4.66 |
| | 16 years and above | 451 | 17.25 | 4.49 | 864 | 19.60 | 4.30 | 1315 | 18.80 | 4.50 |
| | **Total** | **1756** | **19.25** | **4.62** | **1515** | **20.71** | **4.49** | **3271** | **19.93** | **4.62** |
| CCR | 14 years and below | 743 | 8.72 | 4.81 | 156 | 10.43 | 5.32 | 899 | 9.02 | 4.94 |
| | 15 years | 449 | 7.66 | 4.52 | 405 | 10.56 | 5.37 | 854 | 9.03 | 5.15 |
| | 16 years and above | 414 | 6.09 | 3.91 | 722 | 7.82 | 4.52 | 1136 | 7.19 | 4.39 |
| | **Total** | **1606** | **7.75** | **4.63** | **1283** | **9.00** | **5.08** | **2889** | **8.31** | **4.88** |

## 3.4.5. Overall Difficulty Index

The difficulty of items were distributed based on the number of items correctly attempted. Out of 45 questions, 3 items were easy, 29 were moderately difficult and 13 were difficult. Both Classes IX and X students found the item number 2 from Topic XIV, item number 2 from Topic IX and item number 5 from Topic XVIII the most easiest. All these items assessed Evaluate and Design Scientific Enquiry requiring the students to provide only one word response.

Both Classes IX and X students found item number 1 and 2 from Topic XV and item number 1 from Topic XVI the most difficult as they being the least correctly attempted items. The Competency assessed by these three items is Evaluate and Design Scientific Enquiry requiring students to provide extended response.

*Table 31: Details of difficulty index*

| Item | Difficulty Index | Description |
|---|---|---|
| XIV_Q2_SRQ(3) | 81 | Easy |
| XIX_Q2_SRQ(3) | 78 | |

| Item | Difficulty Index | Description |
|---|---|---|
| XVIII_Q5_SRQ(3) | 77 | |
| I_Q1 | 47 | Moderate |
| II_Q1 | 36 | |
| III_Q1 | 53 | |
| III_Q2_SRQ(6) | 57 | |
| IV_Q1 | 61 | |
| IX_Q1 | 39 | |
| IX_Q2_ERQ(2) | 41 | |
| V_Q1_SRQ(2) | 52 | |
| VI_Q1_ERQ(2) | 53 | |
| VI_Q2 | 56 | |
| VII_Q1_SRQ(3) | 63 | |
| VII_Q2_SRQ(2) | 69 | |
| VIII_Q1 | 61 | |
| VIII_Q2 | 43 | |
| X_Q1 | 39 | |
| XIII_Q1 | 43 | |
| XIII_Q2 | 36 | |
| XIII_Q3_SRQ(2) | 53 | |
| XIV_Q1 | 32 | |
| XIV_Q3 | 33 | |
| XIV_Q4_SRQ(3) | 46 | |
| XIX_Q1_ERQ(2) | 28 | |
| XVI_Q2 | 26 | |
| XVII_Q1_SRQ(3) | 61 | |
| XVII_Q2_SRQ(2) | 28 | |
| XVII_Q3 | 37 | |
| XVIII_Q2 | 37 | |
| XVIII_Q3_ERQ(2) | 49 | |
| XVIII_Q4_ERQ(2) | 69 | |
| II_Q2_ERQ(2) | 12 | Difficult |
| II_Q3 | 16 | |
| IV_Q2 | 20 | |
| V_Q2 | 18 | |
| VI_Q3_ERQ(2) | 15 | |
| VII_Q3_ERQ(2) | 24 | |
| XI_Q1_ERQ(2) | 21 | |
| XII_Q1_ERQ(2) | 14 | |

| Item | Difficulty Index | Description |
|---|---|---|
| XV_Q1_ERQ(2) | 10 | |
| XV_Q2_ERQ(2) | 11 | |
| XVI_Q1_ERQ(2) | 10 | |
| XVI_Q3_ERQ(2) | 25 | |
| XVIII_Q1_ERQ(2) | 25 | |

### 3.4.6. The most and least correctly attempted item type

The most correctly attempted item type by both Classes IX and X was SRQ/CCR and the least correctly attempted being ERQ/OCR.

*Table 32: Details of difficulty percentage based on item types in Scientific Literacy*

| ITEM TYPE | Difficulty Percentage | |
|---|---|---|
| | IX | X |
| MCQ | 41 | 43 |
| OCR | 64 | 69 |
| CCR | 24 | 28 |

Note: 0 ot 25 - Difficult; 25 to 75 - Moderate; 76 to 100 - Easy

### 3.4.7. Proficiency Level in Scientific Literacy

For Scientific Literacy, proficiency scale ranging from 1b to 6 was used in reporting the students' performance, which was adapted from the OECD PISA Scientific Literacy Framework 2015. On the basis of scores or marks attained by the participants, 6 levels were identified corresponding to the range of scores received - level 1 being the lowest to level 6 being the most proficient level.

Accordingly, the highest level of achievement of the majority of the cohorts was at level 2 with a mean score of 418. At this level, students are able to use content, procedural and epistemic knowledge to provide explanations, evaluate and design scientific enquiries and interpret data in some given familiar life situations that require mostly a low level of cognitive demand. They are also able to make a few inferences from different sources of data, in few contexts, and can describe simple causal relationships. They can distinguish some simple scientific and non-scientific questions, and distinguish between independent and dependent variables in a given scientific enquiry or in a simple experimental design of their own. They can transform and describe simple data, identify straightforward errors, and make some valid comments on the trustworthiness of scientific claims. Further they can develop partial arguments to question and comment on the merits of competing explanations, interpretations of data and proposed experimental designs in some personal, local and global contexts.

*Table 33: Proficiency level in Scientific Literacy*

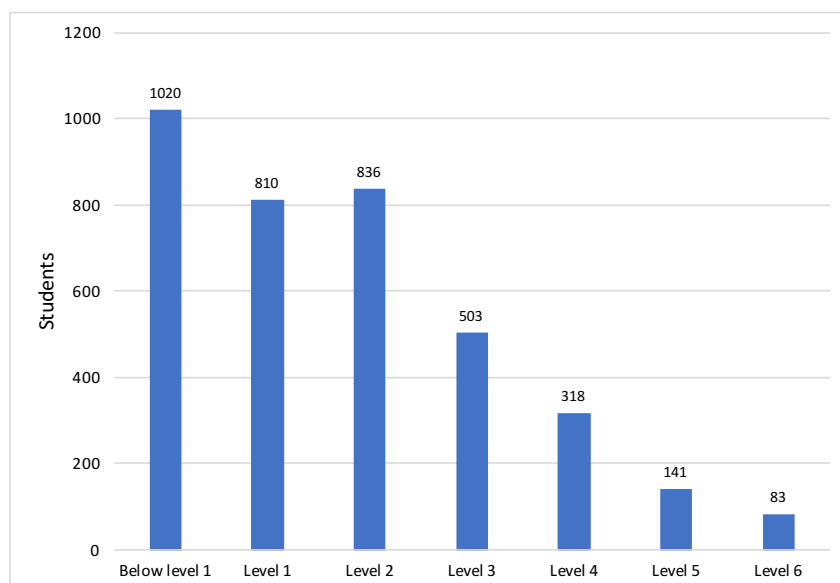| Proficiency Level | Frequency | Percent |
|---|---|---|
| Level 6 | 83 | 2.2 |
| Level 5 | 141 | 3.8 |
| Level 4 | 318 | 8.6 |
| Level 3 | 503 | 13.6 |
| Level 2 | 836 | 22.5 |
| Level 1 | 801 | 21.8 |
| Below level 1 | 1020 | 27.5 |
| **Total** | **3711** | **100** |



Figure 11 Proficiency level in Scientific Literacy

## 4.    Recommendations

1.  CLCG to focus more on the Class IX students who would turn 15 years 3 months and 16 years 2 months in November because PISA-D checks the basic profile of the knowledge and skills among these group of students at which the students begin to demonstrate the competencies that will enable them to participate effectively and productively in life as a continuing student, workers and citizens.

2.  Promote professional collaboration among schools and teachers by exchanging ideas and materials when teaching specific units of the three domains as PISA findings show that an average 15 year-old-students in OECD scores 9 points higher in Science and 36 points higher in Science in Slovenia when the teachers exchange

ideas and materials while teaching specific lessons.

3.  SLCG to incorporate mixed gender grouping during teaching-learning process to narrow the gender gap in Mathematical and Reading Literacy so that both the genders can learn strategies of studying from one another.

4.  SLCG to focus more on the following competencies across the three Domains.

    ☞ Scientific Competency: Explain phenomena scientifically

    ☞ Reading Aspect: Reflect and Evaluate

    ☞ Mathematical Competency: Interpreting, applying and evaluating mathematical outcomes

5.  Domain teachers to place more emphasis on testing HOTs in order to train students in thinking critically and in applying knowledge in different settings.

6.  Allocate sufficient time and provide support to the students to answer PISA released items available on the OECD website as PISA results indicate that for every additional hour spent in Science lessons, student in OECD countries score 5 points higher.

7.  Teachers to teach students the techniques of answering Open Constructive Response items.

8.  Spend more time in conducting 'planned' or 'deliberate' learning for students in schools based on the PISA recommendation as some education system have fewer opportunities to learn informally outside of schools.

9.  Offer additional support to the struggling students rather than require them to repeat the grade as the PISA findings indicate the countries performing poorly have many students repeating grades.

10. Reading Literacy teachers to explore effective ways of increasing boy's interest in reading at schools or at home. Even in OECD countries, boys are on average 39 points behind girls in reading which is equivalent of one year of schooling showing less engagement of boys in reading.

11. Reading Literacy domain teachers to encourage students to

    ☞ enjoy reading wide variety of materials besides fiction as PISA results indicate a positive correlation with the performance in reading.

    ☞ use appropriate strategies to understand and remember such as underlining important parts and discussing with friends. PISA findings confirms such strategies enable students to achieve 73 points higher in PISA assessment.

12. Understand the strategies to summarize the information because the PISA results show a huge difference in the reading performance by 107 score points between the student who know about appropriate strategies to summarize information and students who know the least about such strategies.

13. Mathematical Literacy domain teachers to provide more opportunities to the students to learn applied mathematics so that students can use mathematics in a real world context. PISA assessment explicitly points out, the strong performance in mathematics is not only determined by providing opportunities to learn formal

mathematics but also by providing opportunities to learn applied mathematics but most of the countries have not provided such opportunities to their students having negative bearing on the results. Adopt mnemonic instrumental strategy to help students improve their memory of important formulas and information.

14. Scientific Literacy domain teachers to

☞ offer extracurricular activities such as science clubs and competitions as such activities can enable students to understand scientific concepts better, raise interest in science and even nurture future scientist. On average across OECD countries, students in schools that offer science competitions score 36 points higher and those offering science clubs score 21 points higher.

☞ use strategies such as frequently explaining and demonstrating scientific ideas, conducting classroom debates, discussing student's questions and providing feedbacks that have a positive association with the performance of students in science. PISA results show that in most education systems, the percentage of qualified science teachers is not related to student's science performance but it is the way science is taught.

☞ emphasize more on practical application of knowledge through laboratory and project-based works as students have stronger beliefs in the value of scientific enquiry.

## 5.    Conclusion

The study has delved into comparing Classes IX and X students' performance across all three domains based on their age, gender, competencies and location. The result of the study provides important information to all the concerned stakeholders (MoE, REC, BCSEA, teachers and students) pertaining to the ground reality of the performance of the 15-year-old students in PISA items. In addition, it would help to make informed decision and provide professional support to the schools in order to improve the student performance.

The comparative analysis also revealed that the students below 14 years studying in Class X outperformed across all domains at all variables while 15-year-olds performed moderate and 16-years and above were the lowest performer.

Irrespective of age, class and location, female students performed much better than the male students in Reading Literacy. While male students performed better in Mathematical Literacy, both the genders performed equally in Scientific Literacy. Among the three Aspects in Reading Literacy (Access and Retrieve, Integrate and Interpret and Reflect and Evaluate) the findings showed the students were more competent in Integrate and Interpret. In Mathematical Literacy, students were more competent in responding to the items assessing Competency; Formulating Situations Mathematically compared to Employing Mathematical Concepts, Facts and Procedures and Interpreting, Applying and Evaluating Mathematical Outcomes. In Scientific Literacy students attempted more confidently in the Competency; Evaluate and Design Scientific Enquiry when compared

to Explain Phenomena Scientifically and Interpret Data and Evidence Scientifically.

In general, Thromdey schools performed better in the Preliminary Assessment than the Dzongkhag schools. However, the overall performance of the surveyed students is at level 3-4 in the three domains where 1 being the lowest and 6 being the highest achievement level.

Due to the limited demographic information of the students, the difference in the performance of Dzongkhag and Thromdey schools, male and female students, three domains and different age groups couldn't be conclusive. Therefore, there is a future scope for further research on these areas.

# 6.    Reference

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