

# Patterns and Trends in Achievement

## TIMSS 2016

### 1. Introduction

Although, Sri Lanka is not one of the participating countries in International TIMSS assessment a decision was taken in 2012 to administer a paper, comprising of TIMSS test items which are representative of the Sri Lankan Grade 8 mathematics curriculum. The main objective was to find out Sri Lankan students' performance, in relation to internationally accepted standards.

The purpose of this report is to present the achievement patterns of students in "TIMSS" mathematics paper in 2016. It will further compare these patterns with the achievement patterns of 2014 and identify the trends in achievement.

Student performance in the Sri Lankan version of "TIMSS," would first be analyzed in relation to island wide performance by medium of instruction, school type, gender and location.

### 2. Patterns of achievement at National Level

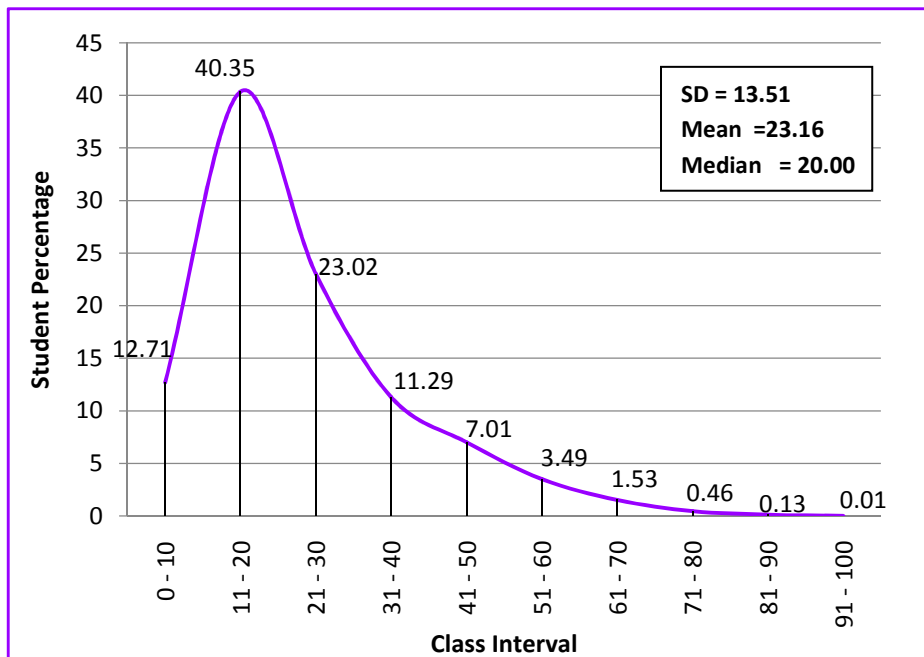


Fig. 1: All island performance in "TIMSS"

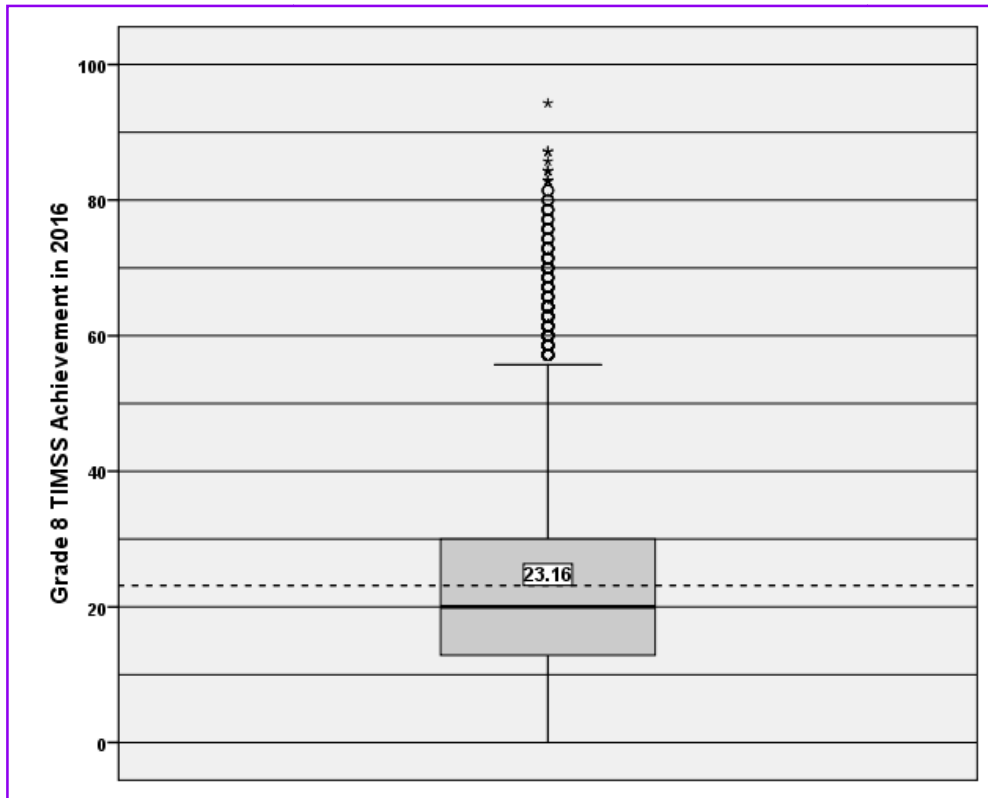
The majority of the students island wide has obtained low scores in “TIMSS”. This low performance is shown through the positively skewed frequency polygon (Fig. 1). The highest percentage of students has scored between 11-20. Table 1 illustrates student achievement patterns further.

**Table 1: All island achievement in TIMSS 2016 – cumulative percentages**

Class Interval	Student %	Cumulative %
0 - 10	12.71	12.71
11 - 20	40.35	53.06
21 - 30	23.02	76.08
31 - 40	11.29	87.38
41 - 50	7.01	94.38
51 - 60	3.49	97.88
61 - 70	1.53	99.40
71 - 80	0.46	99.87
81 - 90	0.13	99.99
91 - 100	0.01	100.00
Total	100.00	

According to Table 1, 87.38 cumulative percentage of students has scored below the pass mark of 40.

Fig. 2 illustrates student achievement patterns further through a boxplot.



**Fig. 2: All island achievement in TIMSS 2016 – box plot**

The all island *median* which is the *mid point value of the marks distribution when it is arranged according to ascending order* is 20. This means that 50% of the students in the sample has scored higher than or equal to 20 mark point. On the other hand the mean of the distribution which is the arithmetic average of the scores is 23.16.

This difference between the mean and the median is due to the positively skewed distribution of marks. That is the higher number of low achievers compared to the high achievers has impacted on the median value.

Fig. 2 also illustrates that there are students who have scored very high marks. There are also four students who have scored exceptionally high marks.

The performance of students according to medium of instruction would be discussed next.

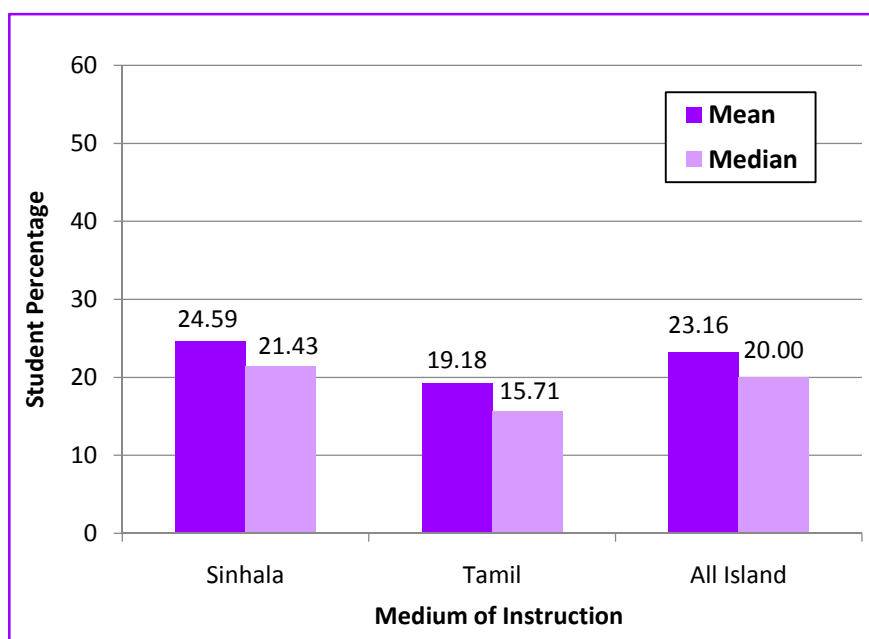
## 2.1 All island achievement by medium of instruction

**Table 2: Achievement level by medium of instruction – summary statistics**

Medium of Instruction	Mean	Std. Error of Mean	Std. Deviation	Skewness	Percentile 25	Median	Percentile 75	F	Sig.
Sinhala	24.59	0.03	14.00	1.19	14.29	21.43	31.43	10855.62	0.000
Tamil	19.18	0.04	11.12	1.78	11.43	15.71	22.86		
All Island	23.16	0.02	13.51	1.32	12.86	20.00	30.00		

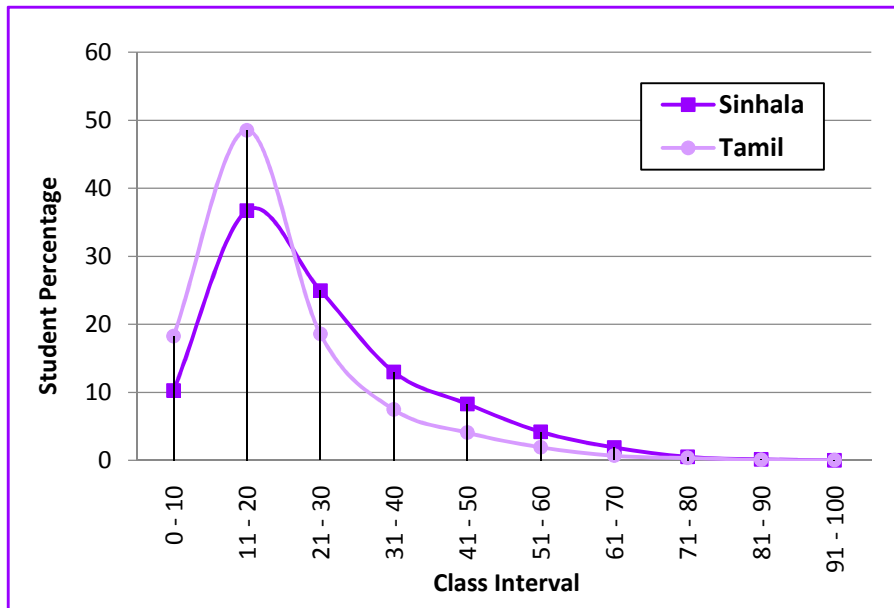
There is disparity between the students belonging to the different medium of instruction. While the Sinhala medium students’ mean achievement is above the all island mean value, the Tamil medium students’ mean achievement is below the national mean value.

These disparities are further highlighted through the bar chart given in Fig. 3.



**Fig. 3: Bar chart representing mean and median values according to medium of instruction**

The diversity in achievement scores among the students taught through the different medium of instruction, is further highlighted through the frequency distribution graphs.



**Fig. 4: Dispersion of marks by medium of instruction**

The disparity discussed using the mean is also visible through the frequency distribution graph. All curves are positively skewed. These curves show that higher number of students’ achievement lie among lower mark ranges. However, the number of Sinhala medium students scoring low marks are comparatively lower than among Tamil medium students.

This medium wise disparity in students’ achievement can be elaborated better through the cumulative percentages.

**Table 3: Cumulative student percentages according to medium of instruction**

Class Interval	Sinhala		Tamil	
	Student %	Cumulative %	Student %	Cumulative %
0 - 10	10.26	10.26	18.24	18.24
11 - 20	36.73	46.99	48.55	66.79
21 - 30	24.98	71.98	18.58	85.37
31 - 40	12.98	84.96	7.47	92.84
41 - 50	8.30	93.26	4.08	96.92
51 - 60	4.18	97.45	1.92	98.85
61 - 70	1.89	99.34	0.69	99.54
71 - 80	0.51	99.85	0.36	99.90
81 - 90	0.15	100.00	0.08	99.97
91 - 100	0.00	100.00	0.03	100.00
Total	100.00		100.00	

According to Table 3, 84.96 cumulative percentage of Sinhala students has scored below the pass mark of 40. On the other hand, the Tamil medium percentage, 92.84 is even greater.

Box plot for medium wise achievement in Fig. 5 graphically shows the differences that have been discussed already.

The median value of Sinhala medium and Tamil medium is below the mean value indicating that 50% of students' marks lie below the mean value.

Another feature of this box plot is, that in both media there are a few students who have scored very high marks. However, the most significant feature is that among the Tamil medium students there are exceptionally high achievers, even greater than among Sinhala medium students.

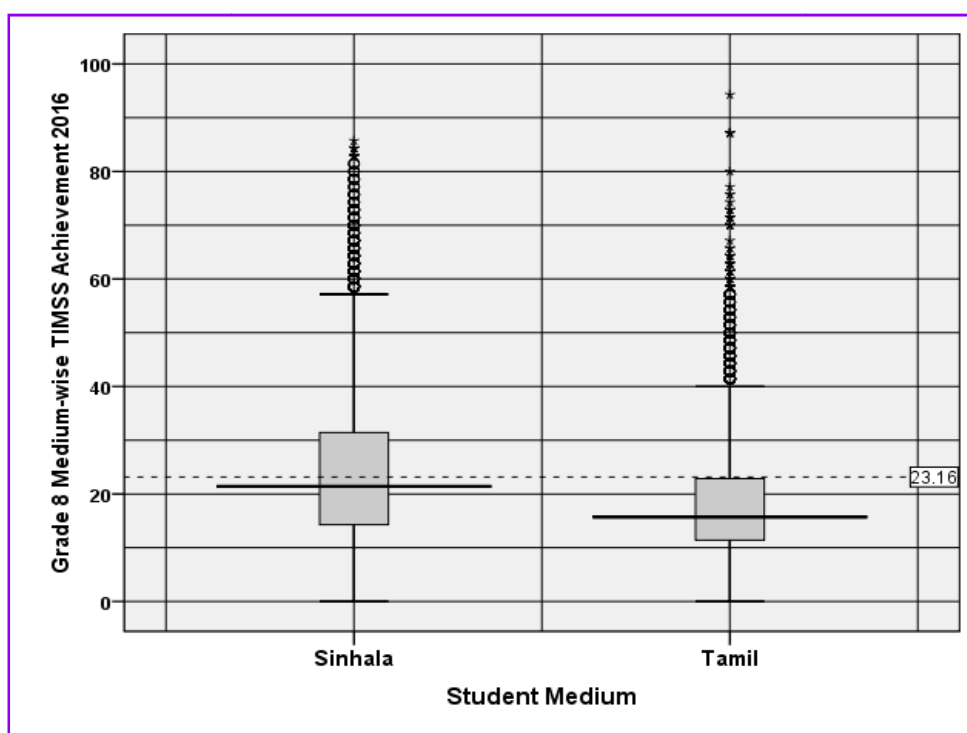


Fig. 5: Box plot for medium wise achievement

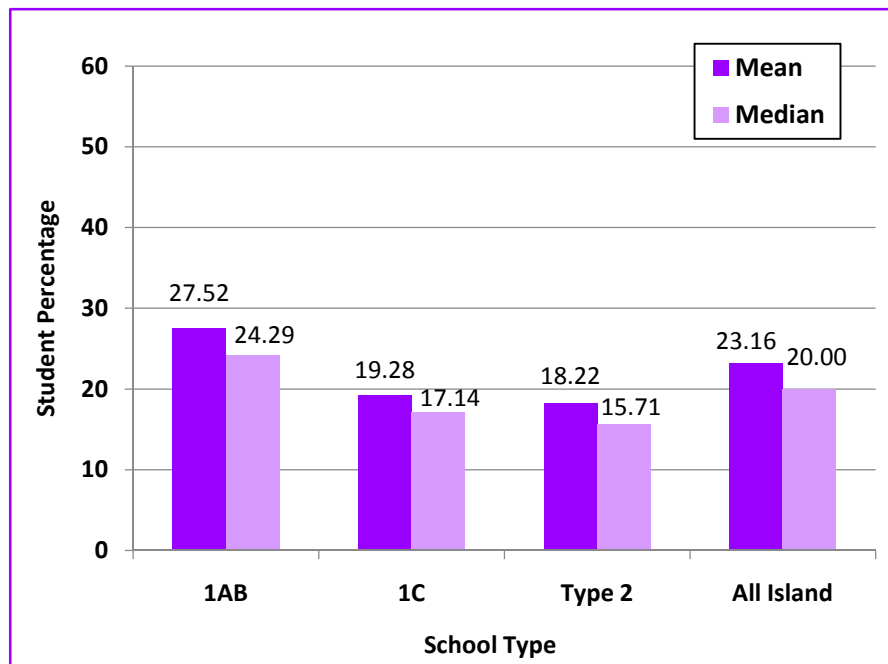
## 2.2 All island achievement by school type

**Table 4: Achievement level by school type**

School Type	Mean	Std. Error of Mean	Std. Deviation	Skewness	Percentile 25	Median	Percentile 75	F	Sig.
1AB	27.52	0.04	15.32	0.94	15.71	24.29	35.71	19288.09	0.000
1C	19.28	0.03	9.87	1.34	12.86	17.14	24.29		
Type 2	18.22	0.04	9.46	1.61	11.43	15.71	21.43		
All Island	23.16	0.02	13.51	1.32	12.86	20.00	30.00		

There is high variation in average achievement among the school types. Further, differences can also be seen in the SD, which suggest that variation in scores within the school types is also different. While the average performance in the 1AB type schools is higher than the Island mean, the 1C and Type 2 schools' performance is lower than the all island mean.

These differences are graphically illustrated in Fig. 6.



**Fig. 6: Bar chart representing mean and median values according to school type**

The diversity in achievement shown in the bar chart is further highlighted in the frequency polygon given below.

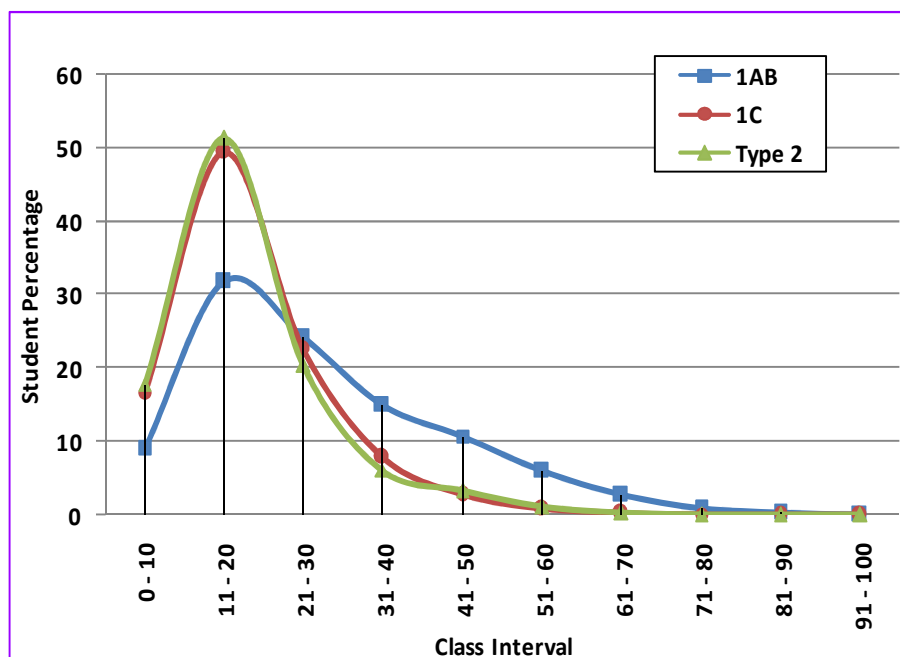


Fig. 7: Dispersion of marks by school type

As Figure 7 shows, all frequency polygons are positively skewed indicating that the majority of the students are low achievers. Only 1AB schools show a slightly different curve indicating that even though majority of the students has scored low marks there are also students who have scored in the middle range.

Table 5: Cumulative student percentages according to school type

Class Interval	1AB		1C		Type 2	
	Student %	Cumulative %	Student %	Cumulative %	Student %	Cumulative %
0 - 10	8.85	8.85	16.63	16.63	17.76	17.76
11 - 20	31.71	40.55	49.35	65.99	51.27	69.03
21 - 30	24.14	64.69	22.53	88.52	20.38	89.41
31 - 40	14.97	79.66	7.79	96.30	6.09	95.50
41 - 50	10.66	90.32	2.74	99.04	3.23	98.73
51 - 60	5.87	96.19	0.72	99.77	1.03	99.77
61 - 70	2.73	98.91	0.16	99.92	0.23	100.00
71 - 80	0.85	99.76	0.05	99.97	0.00	100.00
81 - 90	0.22	99.99	0.03	100.00	0.00	100.00
91 - 100	0.01	100.00	0.00	100.00	0.00	100.00
Total	100.00		100.00		100.00	



Table 5, indicates that the highest percentage of scores with respect to type 1AB schools falls within the class interval 11-20, denoting that majority of the students in these schools had scored below the pass mark. On the other hand, in Type 1C and Type 2 schools the majority of the student scores also fall within the class interval 11-20. However, the percentage is higher, indicating that their performance is even worse.

While in 1AB schools, 79.66 cumulative percentage of students has scored below the pass mark, in 1C and Type 2 schools these percentages ranged from 96.30 to 95.50 respectively.

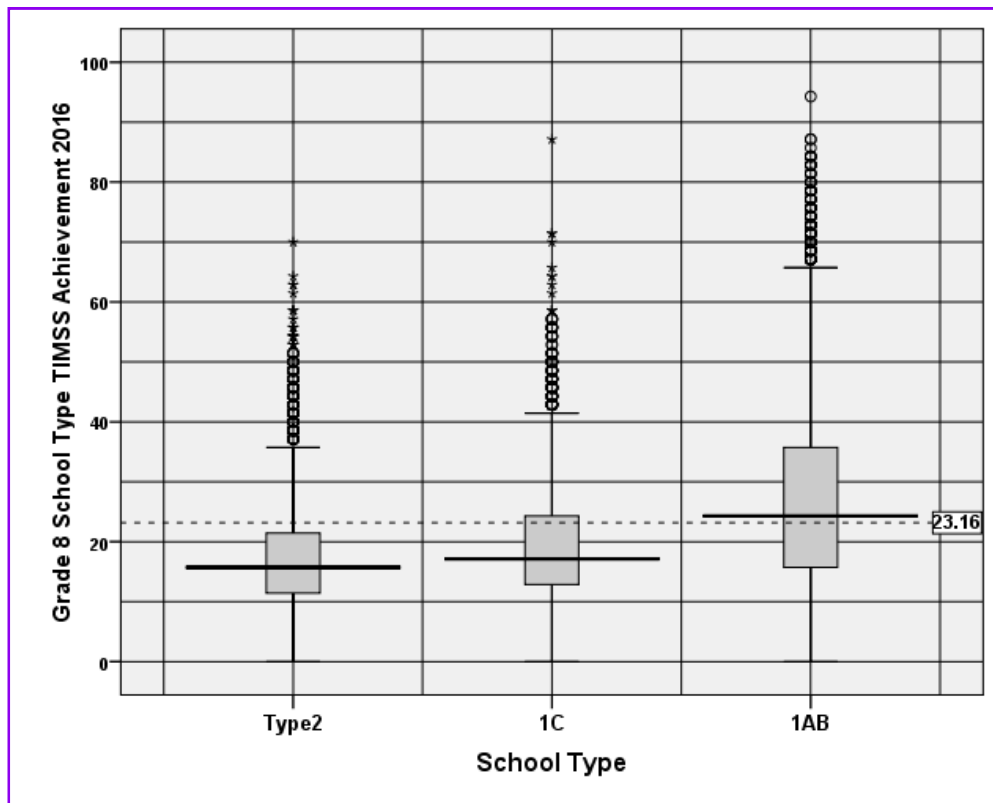


Fig. 8: TIMSS marks according to the school types using Box plot and whisker plot

Boxplot chart graphically shows that Type 1C and Type 2 schools' achievements are very low compared to 1AB school types. All students' scores in Type 1C and Type 2 are below the all island mean statistics indicated by the horizontal line. However, there are also a few students who have scored very high marks in all schools. There are also students who have done exceptionally well in 1C and Type 2 schools. However there are no exceptional cases indicated in the 1AB schools.

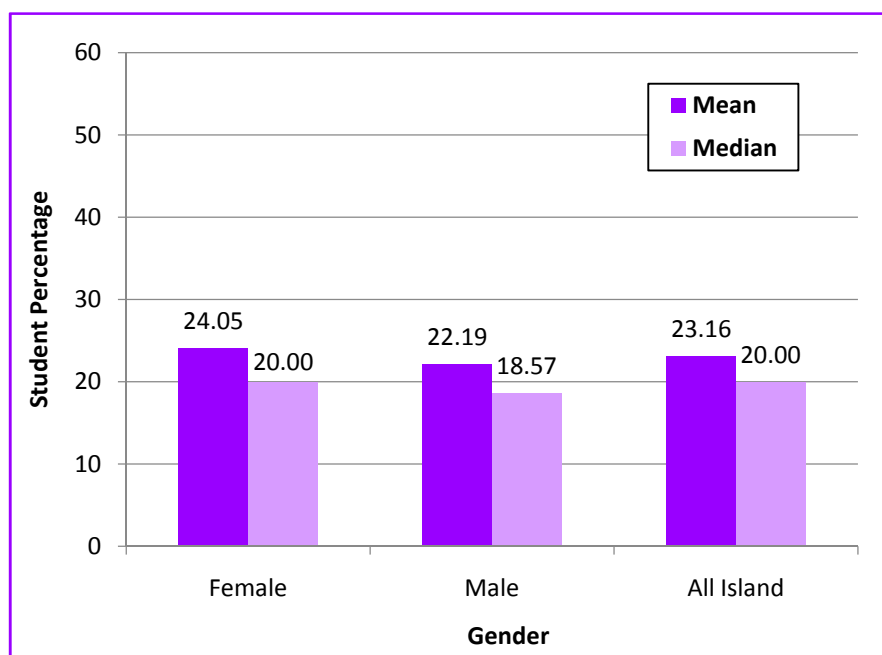
### 2.3 All island achievement by gender

**Table 6: TIMSS achievement by gender - summary statistics**

Gender	Mean	Std. Error of Mean	Std. Deviation	Skewness	Percentile 25	Median	Percentile 75	F	Sig.
Female	24.05	0.03	13.25	1.23	14.29	20.00	30.00	1610.93	0.000
Male	22.19	0.03	13.72	1.44	12.86	18.57	28.57		
All Island	23.16	0.02	13.51	1.32	12.86	20.00	30.00		

There is not much difference in performance by gender. Although, female students' average performance is higher than the male students (Table 6) the standard deviation and the standard error is quite similar. These indicate that the difference among student performance is low and the homogeneity is high.

These differences could also be seen in Fig. 9.



**Fig. 9: Bar chart representing mean and median values according to gender**

Fig. 10 displays two curves which are both positively skewed. However, as Table 6 indicates the male curve has a higher positive value than the female, as well as the all island value.

The positively skewed curves indicate that the majority of both boys and girls have scored low marks.

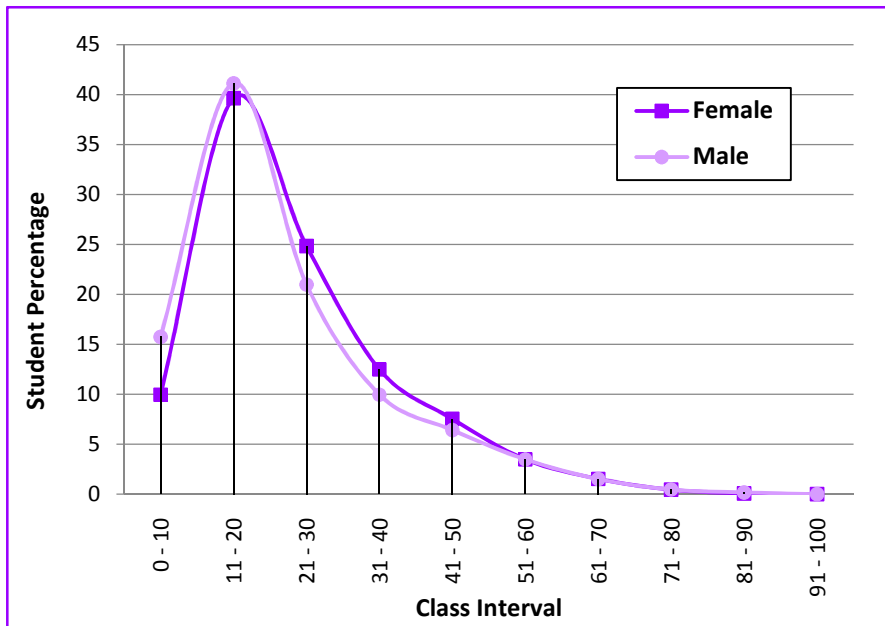


Fig. 10: Dispersion of marks by gender

As Table 7 indicates, the differences between male and female are minimal. While 86.93 cumulative percentage of females has scored below the pass mark 87.87 cumulative percentage of males has failed in the TIMSS paper.

Table 7: Cumulative student percentages according to gender

Class Interval	Female		Male	
	Student %	Cumulative %	Student %	Cumulative %
0 - 10	9.96	9.96	15.77	15.77
11 - 20	39.65	49.60	41.14	56.90
21 - 30	24.85	74.45	20.99	77.90
31 - 40	12.48	86.93	9.97	87.87
41 - 50	7.53	94.47	6.42	94.29
51 - 60	3.48	97.95	3.50	97.79
61 - 70	1.52	99.48	1.53	99.32
71 - 80	0.45	99.93	0.48	99.80
81 - 90	0.07	100.00	0.18	99.98
91 - 100	0.00	100.00	0.02	100.00
Total	100.00		100.00	

As Fig. 11 indicates both male and female students' median values are below the mean values. Therefore, fifty percent of the students has scored below the mean value.

Further, among both male and female students there are students who have scored very high marks as well as those who have done exceptionally well. Therefore, it could be concluded that there is not much disparity gender wise even though there are disparities within the same gender.

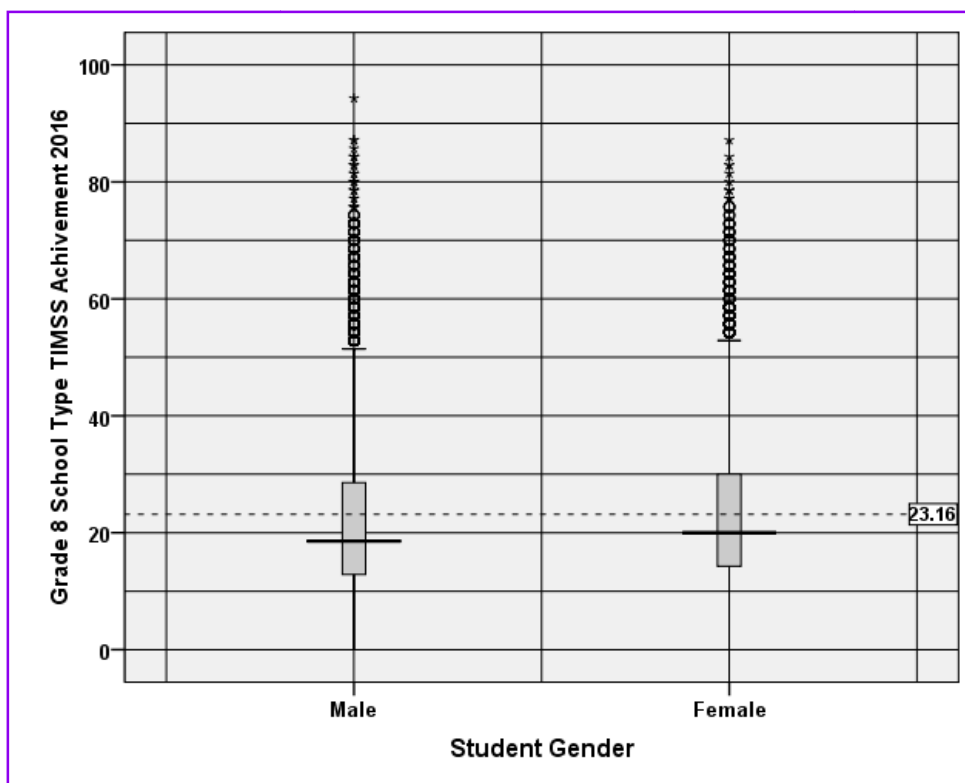


Fig. 11: TIMSS marks according to gender using box plot and whisker plot

## 2.4 All island achievement by location

Table 8: TIMSS achievement according to location

Location	Mean	Std. Error of Mean	Std. Deviation	Skewness	Percentile 25	Median	Percentile 75	F	Sig.
Rural	21.77	0.02	12.29	1.34	12.86	18.57	27.14	9573.18	0.000
Urban	26.78	0.05	15.71	1.08	14.29	22.86	35.71		
All Island	23.16	0.02	13.51	1.32	12.86	20.00	30.00		

Table 8 indicates that the performance of the students attending urban schools is much better than the performance of students in the rural schools.

The difference in performance in the two locations is also shown in the bar graphs in Fig. 12.

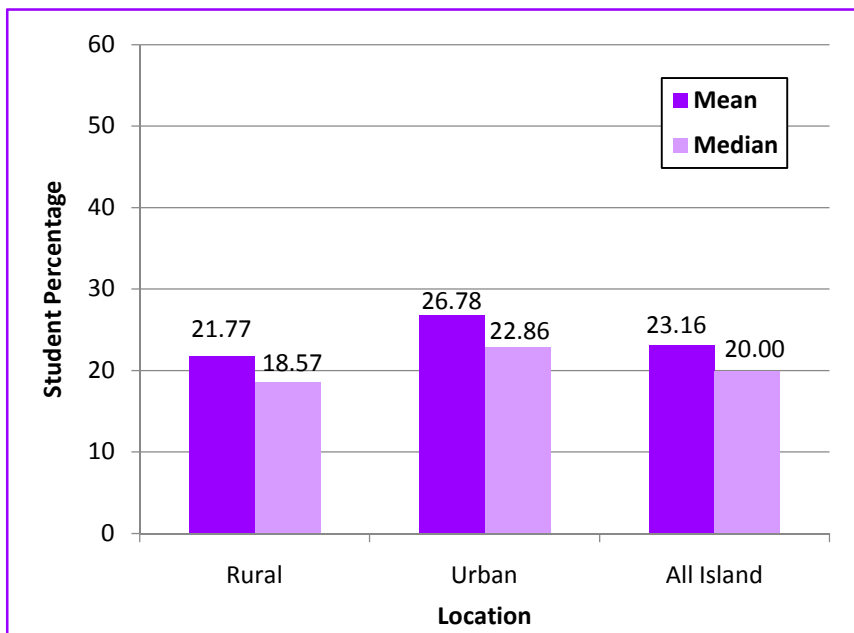


Fig. 12: Bar chart representing mean and median values according to location

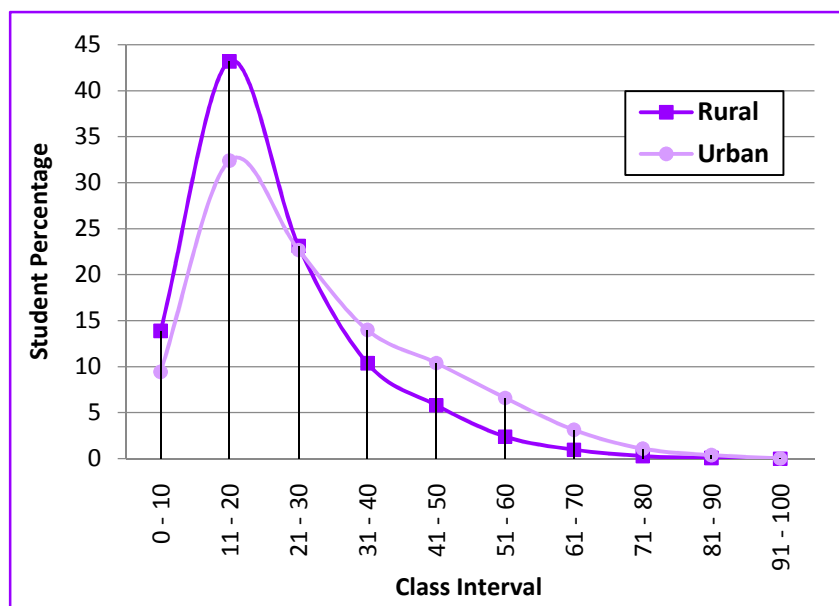


Fig. 13: Dispersion of marks by location

As Figure 13 shows, all frequency polygons are positively skewed indicating that the majority of the students has scored low marks. However, the curve representing urban students achievement shows a slightly different shape indicating that even though majority of the students has scored low marks there are also students who have scored

in the middle range. Further, the percentage of low achievers is comparatively less among the urban schools.

**Table 9: Cumulative student percentages according to location**

Class Interval	Rural		Urban	
	Student %	Cumulative %	Student %	Cumulative %
0 - 10	13.87	13.87	9.41	9.41
11 - 20	43.17	57.04	32.37	41.78
21 - 30	23.14	80.18	22.68	64.46
31 - 40	10.35	90.53	13.97	78.43
41 - 50	5.81	96.34	10.41	88.84
51 - 60	2.39	98.73	6.61	95.44
61 - 70	0.97	99.70	3.11	98.55
71 - 80	0.26	99.96	1.06	99.61
81 - 90	0.04	100.00	0.36	99.97
91 - 100	0.00	100.00	0.03	100.00
Total	100.00		100.00	

As Fig. 14 indicates both urban and rural students' median values are below the mean values. Therefore, fifty percent of the students has scored above the mean value.

Further among both urban and rural students there are students who have scored very high marks. However, among rural students there are those who have done exceptionally well, as well.

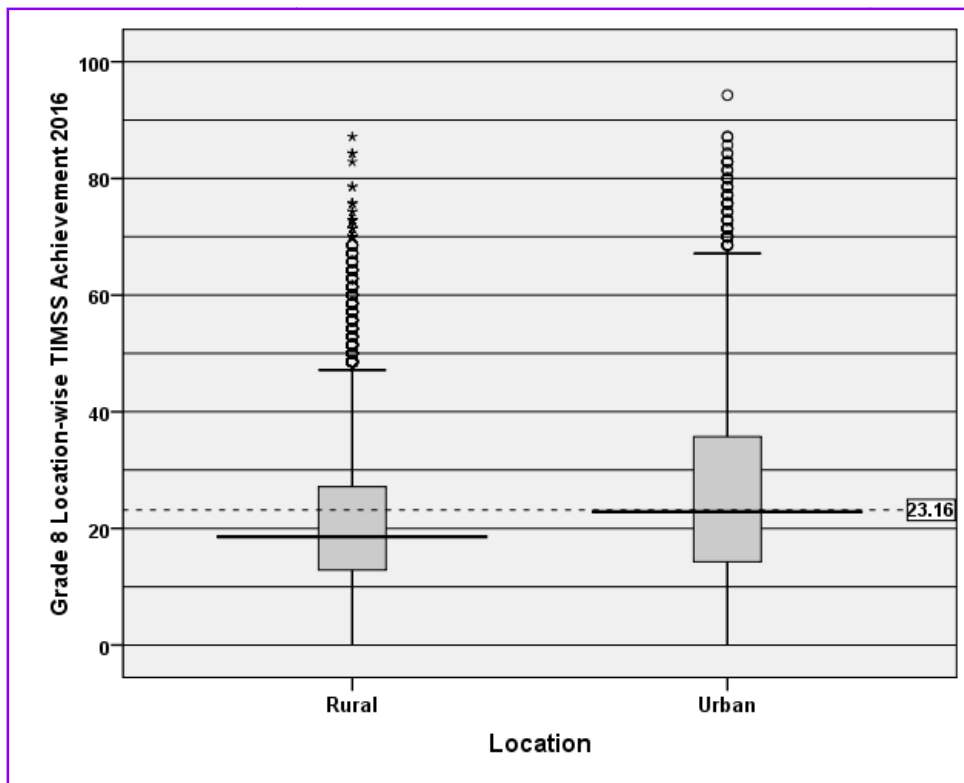


Fig. 14: TIMSS marks according to location using box plot and whisker plot

Provincial wise student achievement will be discussed next.

### 3. Provincial wise student achievement

Table 10: Provincial wise achievement in TIMSS 2016 – Summary Statistics

Province	Mean	Rank	Std. Error of Mean	Std. Deviation	Skewness	Percentile 25	Median	Percentile 75
Southern	26.03	1	0.07	14.91	1.00	14.29	21.43	34.29
Western	24.84	2	0.05	14.23	1.25	14.29	21.43	31.43
Sabaragamuwa	24.58	3	0.08	14.34	1.18	14.29	20.00	31.43
North Western	23.91	4	0.07	13.49	1.14	14.29	20.00	30.00
North Central	22.41	5	0.08	12.22	1.44	14.29	20.00	27.14
Uva	21.49	6	0.07	11.13	1.19	12.86	18.57	27.14
Central	21.40	7	0.06	12.51	1.55	12.86	17.14	27.14
Northern	20.36	8	0.09	13.23	1.76	11.43	15.71	24.29
Eastern	19.00	9	0.06	10.95	1.58	11.43	15.71	22.86
All Island	23.16		0.02	13.51	1.32	12.86	20.00	30.00

As Table 10 indicates, based on provincial wise mean achievements Southern Province ranks first. While the Western Province is ranked second, the Sabaragamuwa Province is ranked third with a slightly lower mean value.

Achievement wise the provinces fall into two categories. Southern, Western Sabaragamuwa and North Western, falling above the all island mean values and other provinces below the national mean score. These disparities are further highlighted through the bar chart given in Fig. 15 and the box plot in Fig.16

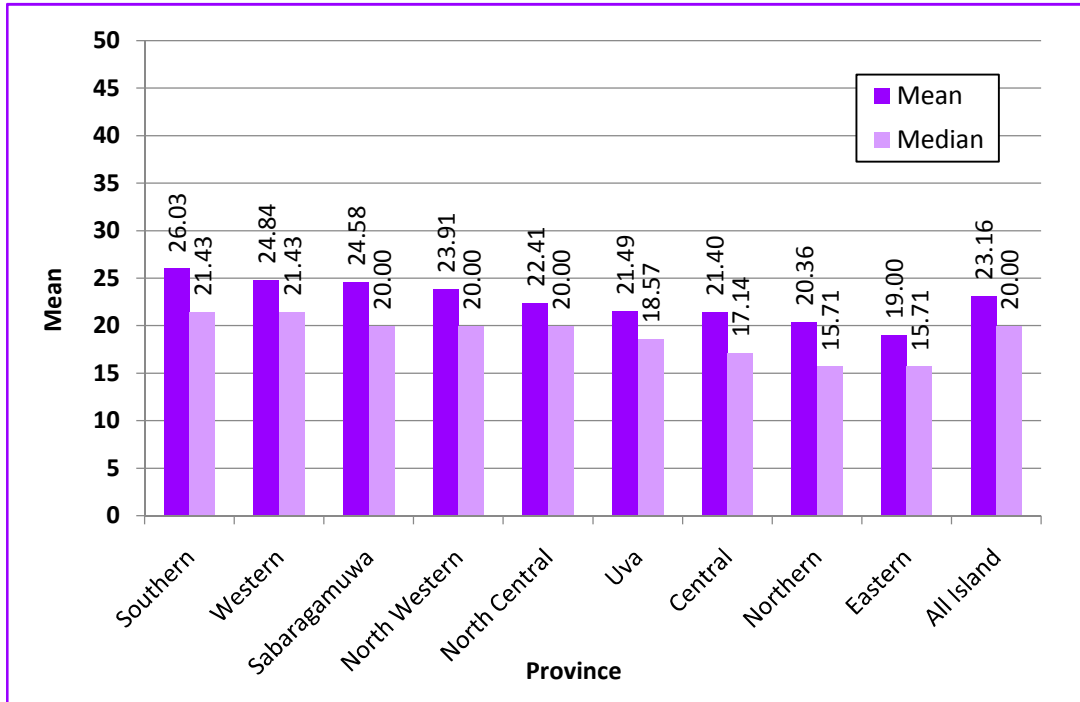


Fig. 15: Bar chart representing mean and median values according to provinces – TIMSS

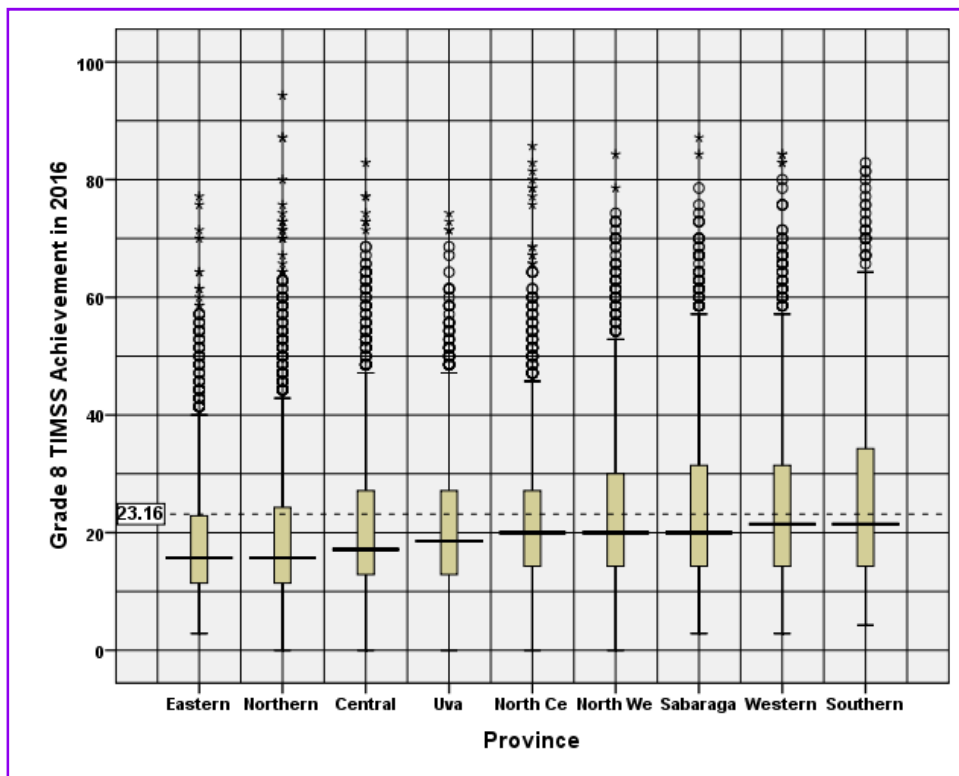


Fig. 16: Box plot for provincial wise TIMSS achievement



As Fig. 16 indicates, in all provinces the median value is below the mean. Thus 50% of the student scores are above the mean value of 23.16.

A significant feature observed is that, even though the mean value is low in all the provinces, there are students who have scored very high marks. Further, except in the Southern Province there are exceptionally high scorers in other provinces.

Students achievement of different skills would be discussed next.

#### 4. Skill analysis

There is a clearly defined assessment framework, for the TIMSS (International) Mathematics test papers. TIMSS test papers are framed by two organizing dimensions, a content domain and a cognitive domain.

The same Framework was followed in selecting items, for the “TIMSS,” in the Sri Lankan Grade Eight National Assessment, 2012. This Framework is summarized in Table 11.

**Table 11: Framework for selecting TIMSS items**

Content Domain	Cognitive Domain			Total
	Knowing	Applying	Reasoning	
Number	6, 10, 12, 16, 35	3, 20, 23, 39, 43, 44	27, 31, 46, 47	15
Algebra	1, 5, 9, 32, 42,	14, 18, 22, 36, 40	25, 26, 28, 45, 48	15
Geometry	8, 13, 30	4, 17, 34, 38	21, 24, 41	09
Data and chance	7, 50	11, 15, 29, 33, 49	2, 19, 37	11
Total	15	20	15	50

Since the same “TIMSS” paper was used in 2014 and 2016 the analysis of students’ performance in the “TIMSS” paper 2016 will be based on this framework.

The first domain, Knowing covers the facts, procedures, and concepts students need to know, while the second, applying focuses on the ability of students to apply knowledge and conceptual understanding to solve problems or answer questions. The third

domain, reasoning shows the ability of higher order problem solving skills to encompass unfamiliar situations, complex, and multistep problems (Mllis et al, 2005).

The next section of the report presents students' performance in each content domain in relation to the three cognitive domains.

#### 4.1 Cognitive domain related to number

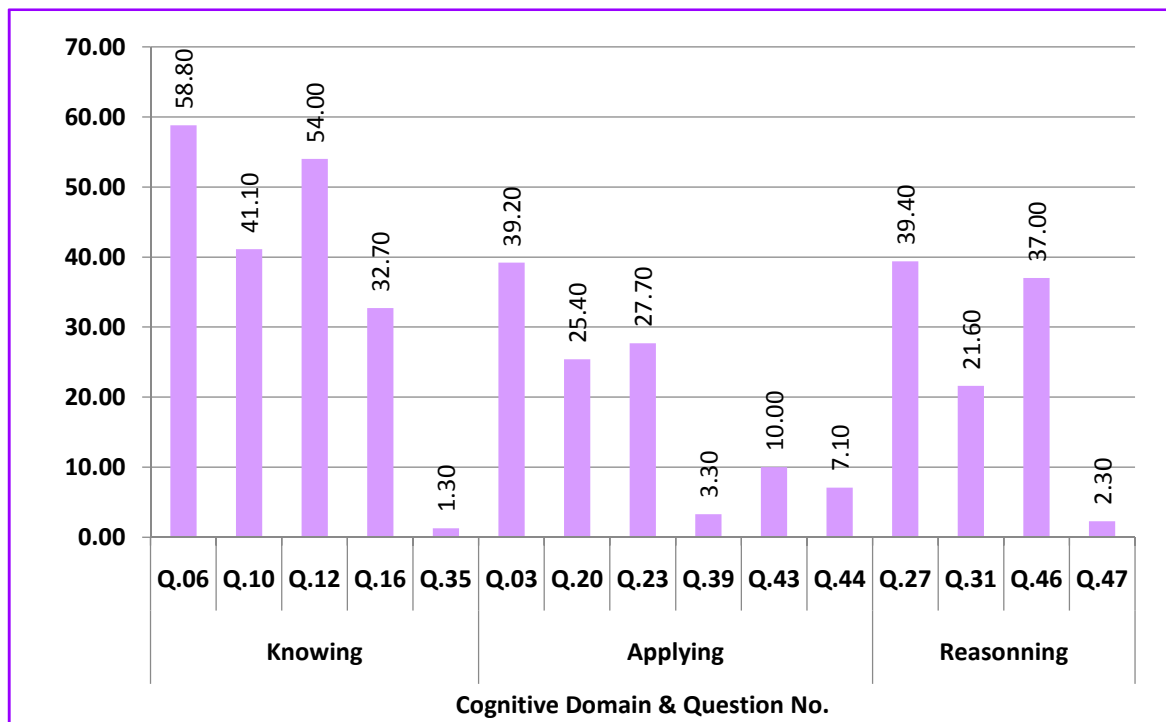
**Table 12: Students' achievement in relation to the content domain - Number**

Cognitive Domain		Q. No.	%
Knowing	Fractions and number sense(estimation)	6	58.80
	Fractions and number sense	10	41.10
	Ratios, proportions and percent	12	54.00
	Division of numbers	16	32.70
	Division of decimal number by a decimal number	35	1.30
Applying	Fractions and number sense	03	39.20
	integers	20	25.40
	Ratios, proportions and percent	23	27.70
	Number arrangement from greatest to least	39	3.30
	Ratios, proportions and percent	43	10.00
	Addition and subtraction of numbers	44	7.10
Reasoning	Number and fractions	27	39.40
	Fractions and number sense	31	21.60
	Ratios, proportions and percent	46	37.00
	Percentage of a quantity	47	2.30

In relation to the content Domain – Number, Table 12 shows that the highest number of correct responses relate to question no. 06 which measures knowledge of Fractions and number sense and it is an objective type test item. On the other hand, even the lowest number of correct responses (question no. 35) also corresponds to knowledge. However, it measures division of decimal number by a decimal number and the students have to do the sum on paper. When the skills of applying and reasoning are concerned, the highest percentage of correct responses is 39.20% and 39.40% respectively for question numbers 03 and 27 which are objective type test items.

With respect to applying the lowest percentage of responses (3.30) is for question no. 39. This question relates to number arrangement from the greatest to the least. However, it is not a multiple choice question. On the other hand, for reasoning the lowest percentage of responses is for question no. 47. This relates to percentage of a quantity and a written sum that students have to do to find the answer.

The information in Table 12 is also shown through the bar graph in Fig. 17.



**Fig. 17: Achievement in relation to the content domain – Number**

The students have been able to achieve above 50% of correct responses with respect to only two questions.

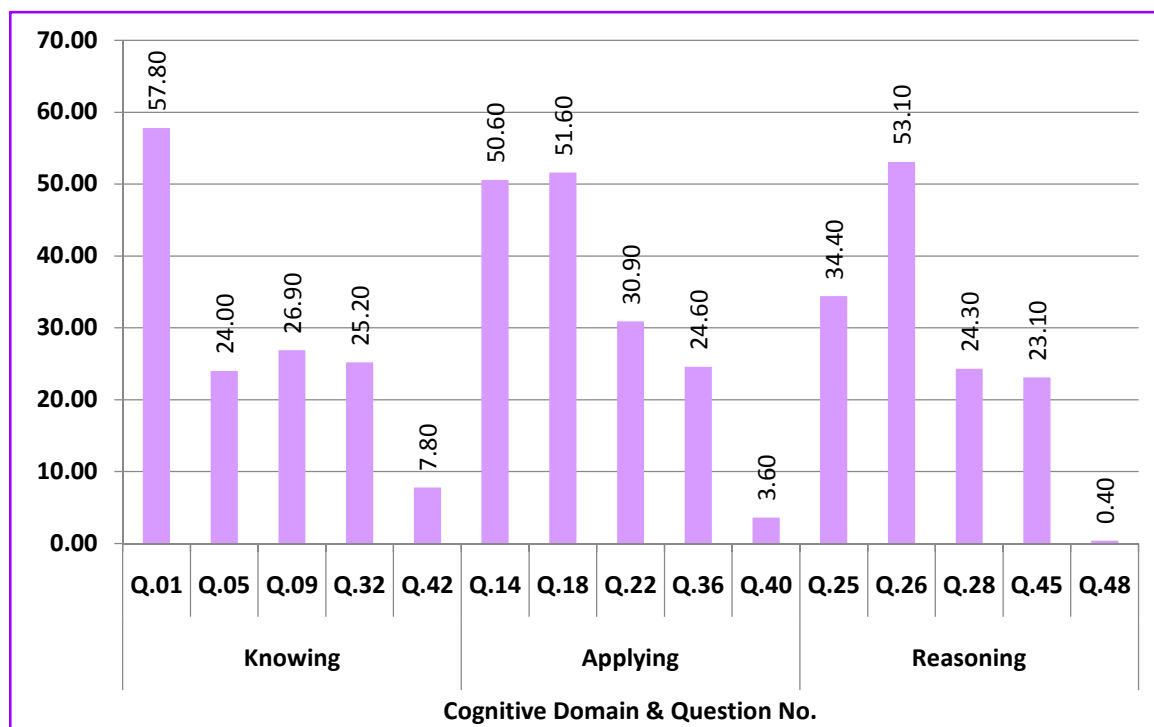
Achievement related to cognitive domain algebra will be discussed next.

## 4.2 Cognitive domain related to algebra

**Table 13: Students' achievement in relation to the content domain - Algebra**

Cognitive Domain		Q. No.	%
Knowing	Algebraic terms	1	57.80
	Algebraic expressions	5	24.00
	Algebraic expressions	9	26.90
	Algebraic expressions	32	25.20
	Algebraic expressions with brackets	42	7.80
Applying	Equations and formulas	14	50.60
	Number patterns	18	51.60
	Algebraic expressions	22	30.90
	Equations and formulas	36	24.60
	Equations and formulas	40	3.60
Reasoning	Algebraic expressions	25	34.40
	Number patterns	26	53.10
	Algebraic expressions by substituting integers	28	24.30
	Number patterns	45	23.10
	Algebraic expressions	48	0.40

As Table 13 indicates the highest percentage of responses are obtained for knowledge.



**Fig. 18: Achievement in relation to the content domain - Algebra**

In relation to the content domain – Algebra the Fig. 18 shows that the highest number of correct responses (57.80%) relate to question no. 01 which measures knowledge on algebraic terms and this is an objective type test item. On the other hand, the lowest number of correct responses relate to question no. 48 (0.04%) which corresponds to reasoning and relates to algebraic expressions. This is also a test item that demands doing the sum. When the skills of applying and reasoning are concerned the highest percentage of correct responses, 51.6% and 53.10% is for question numbers 18 and 26. Overall only in four questions the students have been able to obtain more than 50% correct responses.

Achievement with respect to Geometry will be discussed next.

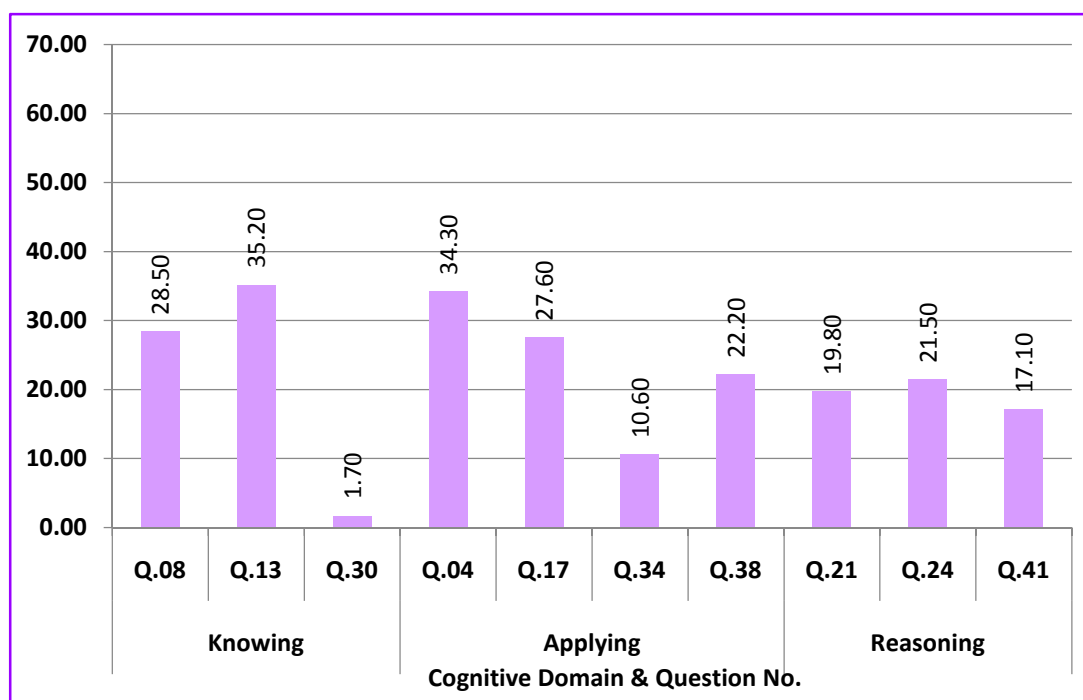
### 4.3 Cognitive domain related to geometry

**Table 14: Student s' achievement in relation to the content domain – Geometry**

Cognitive Domain		Q. No.	%
Knowing	Locations and spatial relationships	8	28.50
	Measurement ( units of time)	13	35.20
	Drawing plane figures to scale	30	1.70
Applying	Knowledge of cube nets	4	34.30
	Measurement(length)	17	27.60
	Measurement ( time)	34	10.60
	Measurement (Area of a triangle))	38	22.20
Reasoning	Values of angles	21	19.80
	Ratios in terms of fractions	24	21.50
	Measurement (Area of a rectangle))	41	17.10

As Table 14 indicates the highest percentage of student response is for knowledge.

In relation to the content domain – Geometry, the Fig. 19 shows that the highest number of correct responses 35.2%, relate to question no. 13 which measures measurements, through and objective type test item.



**Fig. 19: Achievement in relation to the content domain - Geometry**

On the other hand, even the lowest number of correct responses 1.70% (Question No. 30) also corresponds to knowledge. However, it tests the ability of drawing figures to scale. When the skills of applying and reasoning are concerned the highest percentage of correct responses 34.30% and 21.5% is for question no. 4 and question no. 24.

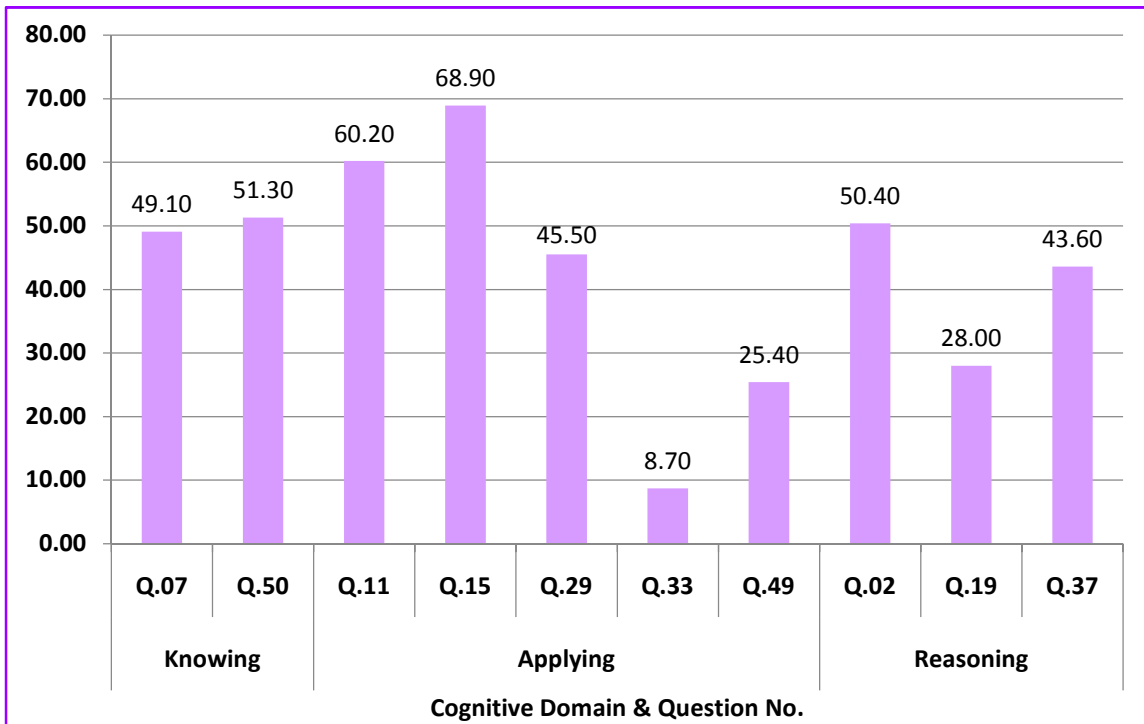
According to the above analysis it could be claimed that students’ performance across the cognitive domains appears to be similar. However, compared to the performance in the other content areas, students’ performance in geometry appears to be low with the percentage of correct responses to all questions recording less than 40%.

Cognitive domain related to Data and Chance will be discussed next.

#### 4.4 Cognitive domain related to data and chance

**Table 15: Student s’ achievement in relation to the content domain – Data and Chance**

Cognitive Domain		Q. No.	%
Knowing	Fraction of success	7	49.10
	Data interpretation (using bar charts)	50	51.30
Applying	Data interpretation	11	60.20
	Data interpretation (using pie charts)	15	68.90
	Data representation (using figures)	29	45.50
	Data interpretation	33	8.70
	Probability of an event	49	25.40
Reasoning	Theoretical probability of an event	02	50.40
	Data interpretation	19	28.00
	Data interpretation	37	43.60



**Fig. 20: Achievement in relation to the content domain – Data and Chance**

This is the content domain that the highest number of students has responded correctly. The highest percentage of correct responses 68.90% has been obtained for question no.15. This tests the skill of applying. On the other hand, the lowest percentage of correct responses 8.70%, is for question 33 which also tests the skill of Applying, but

students have to find the answer by reading the graphs. The answers are not provided. However, the two questions even though both tests the ability to interpret the latter is more complex. On the other hand the highest percentage of correct responses in relation to the skill of reasoning is 50.40 which is for question no.2.

The next section will discuss the trends in achievement over the period 2014 -2016.

## 5. Trends in achievement

### 5.1 Trends in achievement at national level

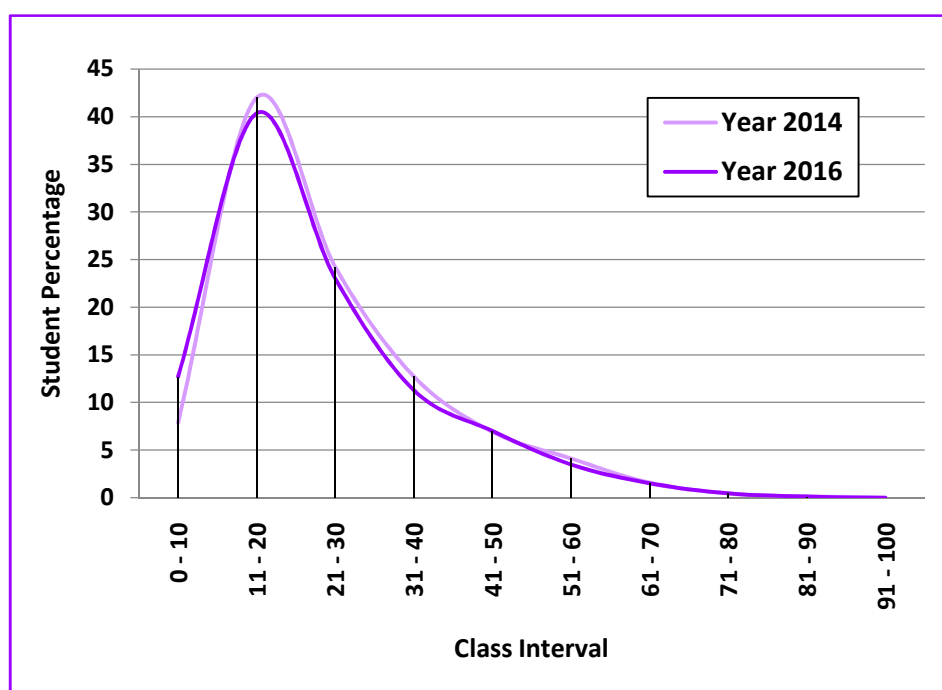


Fig. 21: All island achievement in TIMSS comparison 2014 -2016- dispersion of marks

Fig. 21 displays two curves which are quite similar. The peak of the 2016 curve is slightly lower. This could be explained through the cumulative frequency table.



**Table 16: Comparison of all island achievement in TIMSS - cumulative percentages**

Class Interval	Year 2014		Year 2016	
	Student %	Cumulative %	Student %	Cumulative %
0 - 10	7.86	7.86	12.71	12.71
11-20	42.00	49.86	40.35	53.06
21 - 30	24.24	74.10	23.02	76.08
31 - 40	12.73	86.83	11.29	87.38
41 - 50	6.91	93.74	7.01	94.38
51 - 60	4.12	97.86	3.49	97.88
61 - 70	1.57	99.43	1.53	99.40
71 - 80	0.44	99.87	0.46	99.87
81 - 90	0.13	100.00	0.13	99.99
91-100	0.00	100.00	0.01	100.00
Total	1 00		100	

As Table 16 indicates the percentage of students scoring between 0-10 has increased in 2016 while the percentage scoring between 11– 40 has decreased.

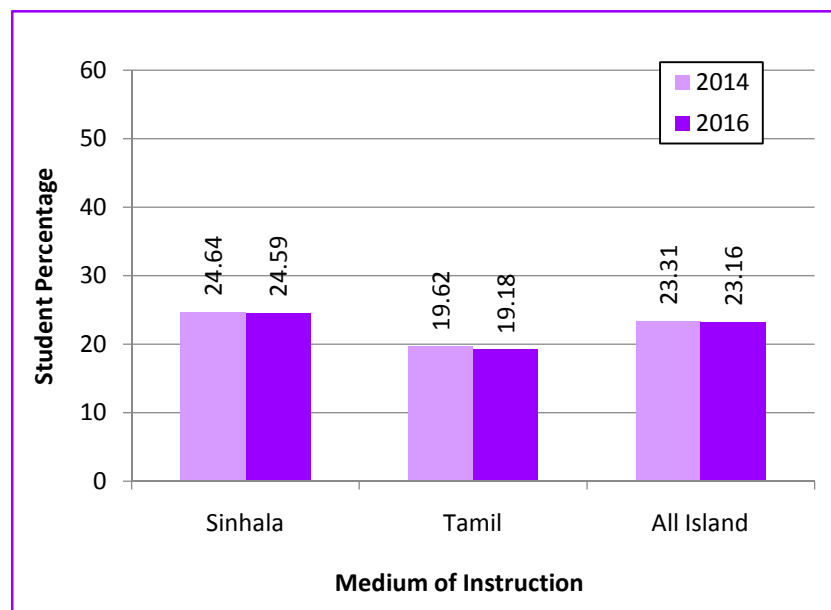
The trend in achievement medium wise will be discussed next.

## 5.2 Trends in achievement according to medium of instruction

**Table 17: Comparison of TIMSS achievement according to medium of instruction**

Medium of Instruction	Year 2014		Year 2016		Z
	Mean	Standard Deviation	Mean	Standard Deviation	
Sinhala	24.64	14.51	24.59	14.00	-0.26
Tamil	19.62	11.11	19.18	11.12	-1.84*
<b>All Island</b>	23.31	13.60	23.16	13.51	-0.96

As seen from Table 17, the all island change in student performance discussed above has resulted in a slight decrease in all island mean values in 2016.



**Fig. 22: All island comparison of mean values according to medium of instruction**

As can be seen from Table 17 student performance among both Sinhala and Tamil medium students has declined slightly.

However, as Table 17 indicates this change is significant only in Tamil medium achievement.

Trends in all island achievement according to school type will be discussed next.

### 5.3 Trends in achievement according to school type

**Table 18: Comparison of TIMSS achievement according to school type**

School Type	Year 2014		Year 2016		Z
	Mean	Standard Deviation	Mean	Standard Deviation	
1AB	27.97	15.06	27.52	15.32	-1.88*
1C	18.39	15.71	19.28	9.87	3.19**
Type 2	17.69	15.71	18.22	9.46	1.48
<b>All Island</b>	23.31	13.60	23.16	13.51	-0.96

\* Values are significant at 95%

\*\* Values are significant at 99%

As Table 18 indicates there is a slight decrease in performance in 1AB schools. However, this decrease is significant. On the other hand as both Table 18 and Fig 23 indicates there is an increase in performance in both 1C and Type 2 schools. However, while the increase in 1C schools is significant the increase in Type 2 schools is not significant.

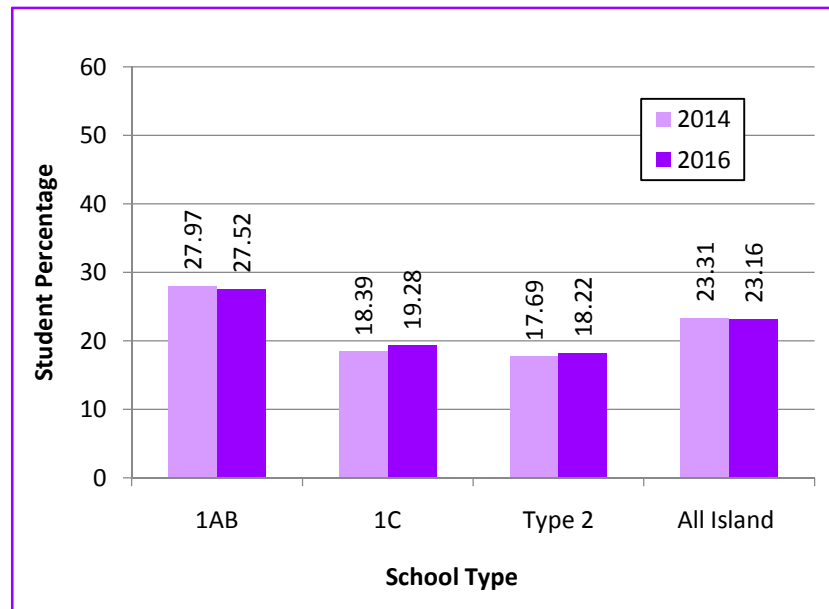


Fig. 23: All island comparison of mean values according to school type

Trends in achievement gender wise will be discussed next.

#### 5.4 Trends in achievement according to gender

Table 19: Comparison of TIMSS achievement according to gender

Student Gender	Year 2014		Year 2016		Z
	Mean	Standard Deviation	Mean	Standard Deviation	
Male	22.22	13.43	22.19	13.72	-0.13
Female	24.34	13.67	24.05	13.25	-1.32
<b>All Island</b>	23.31	13.60	23.16	13.51	-0.96

As Table 19 indicates both male and female performance has decreased in 2016. However, this decrease is not significant.

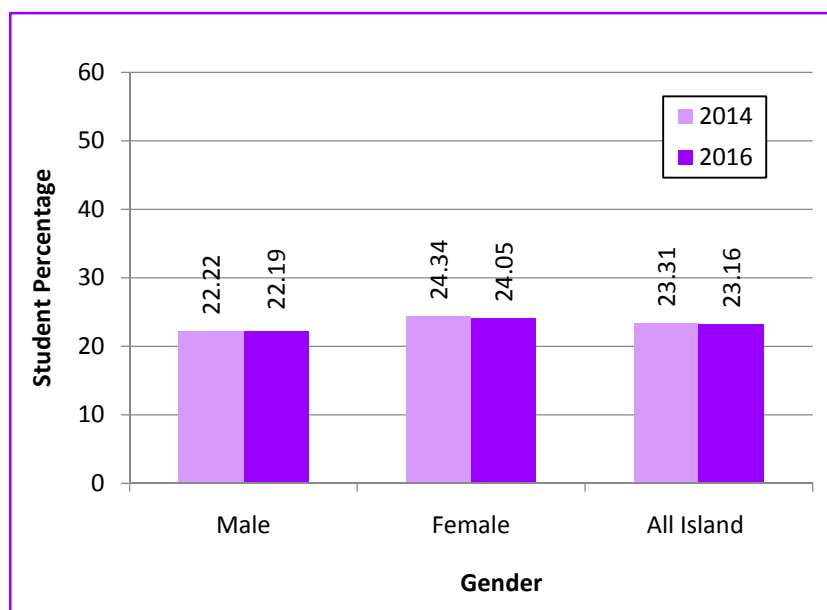


Fig. 24: All island comparison of mean values according to school type

Trends in achievement location wise would be discussed next.

## 5.5 Trends in achievement according to location

Table 20: Comparison of TIMSS achievement according to location

Location	Year 2014		Year 2016		Z
	Mean	Standard Deviation	Mean	Standard Deviation	
Rural	21.00	11.46	21.77	12.29	4.81**
Urban	27.89	16.11	26.78	15.71	-3.10**
<b>All Island</b>	23.31	13.60	23.16	13.51	-0.96

As Table 20 indicates there is an increase in student performance in the rural area schools and a decrease in performance in the urban area schools. Both these changes are significant. However, the contribution of these changes to the all island performance has resulted in a slight decrease in the mean value which is insignificant.

The changes discussed above are graphically depicted in Fig. 25.

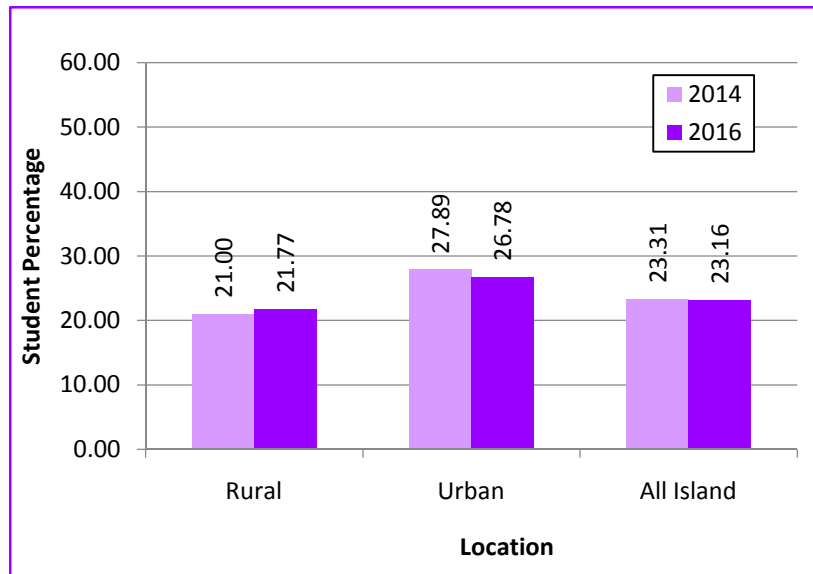


Fig. 25: All island comparison of mean values according to location

Provincial wise trends in achievement between 2014 -2016 will be discussed next.

### 5.6 Provincial comparison

As Table 21 indicates there are only two significant changes in performance between 2014 and 2015. While the performance in the Southern Province has increased, the performance in the Eastern Province has decreased.

Table 21: Provincial wise comparison of student achievement – 2014 & 2016

Province	Year 2014		Year 2016		Z
	Mean	Standard Deviation	Mean	Standard Deviation	
Southern	23.91	14.81	26.03	14.91	4.27**
Eastern	22.66	13.09	19.00	10.95	-8.35**
Western	25.20	14.78	24.84	14.23	-0.75
Sabaragamuwa	24.35	13.60	24.58	14.34	0.49
North Central	21.83	12.33	22.41	12.22	1.35
North western	23.90	12.48	23.91	13.49	0.02
Central	21.13	12.66	21.40	12.51	0.63
Northern	21.07	12.39	20.36	13.23	-1.45
Uva	22.11	12.54	21.49	11.13	-1.50
All Island	23.31	13.60	23.16	13.51	-0.96

\* Values are significant at 95%

\*\* Values are significant at 99%

As Fig. 26 indicates the changes in performance in the other provinces are very slight. Further, as Table 21 indicates these changes are insignificant.

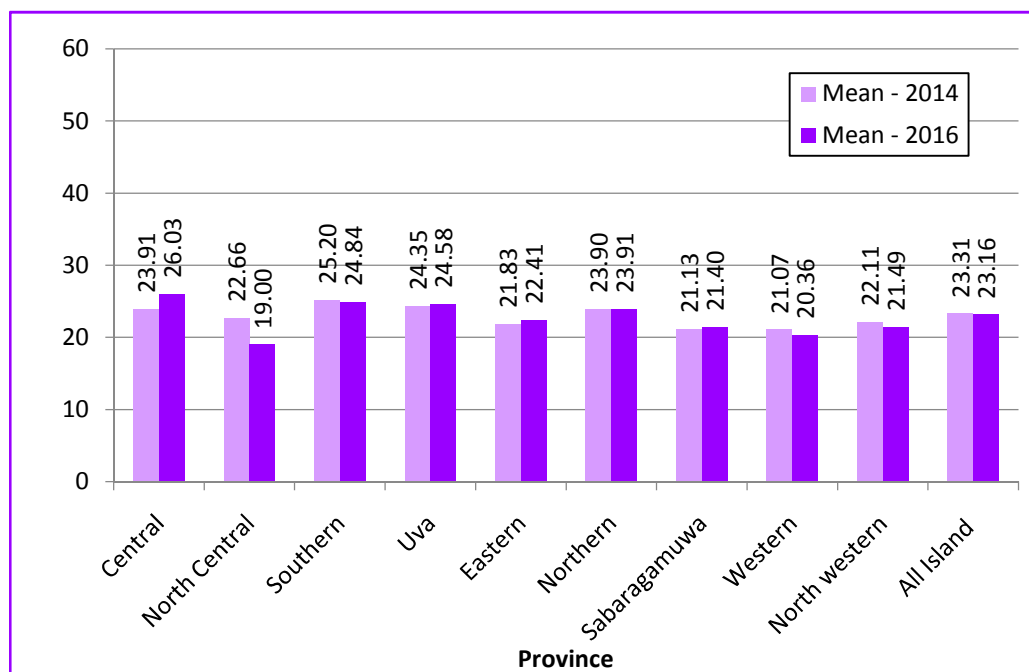


Fig. 26: Provincial wise comparison of student achievement - 2014 -2016

## 5.7 Trends in Skill analysis

Table 22: Comparison of students’ achievement in relation to the content domain – Number

Cognitive Domain		Q. No	2014	2016
Knowing	Fractions and number sense(estimation)	6	59.23	58.80
	Fractions and number sense	10	42.52	41.10
	Ratios, proportions and percent	12	50.82	54.00
	Division of numbers	16	31.95	32.70
	Division of decimal number by a decimal number	35	0.37	1.30
Applying	Fractions and number sense	03	38.50	39.20
	integers	20	25.14	25.40
	Ratios, proportions and percent	23	28.52	27.70
	Number arrangement from greatest to least	39	4.72	3.30
	Ratios, proportions and percent	43	5.65	10.00
	Addition and subtraction of numbers	44	33.58	7.10
Reasoning	Number and fractions	27	38.97	39.40
	Fractions and number sense	31	21.24	21.60
	Ratios, proportions and percent	46	38.71	37.00
	Percentage of a quantity	47	1.45	2.30

The comparison between 2014 and 2016 indicates that there is no satisfactory improvement in achievement. In 2014, 50% or above achievement was recorded only in respect of two questions. In 2016 also the same pattern in achievement could be observed. The items where the achievement has been low, remains low with a slight increase or at times as the table indicates with a decline in performance.

**Table 23: Comparison of students' achievement in relation to the content domain – Algebra**

Cognitive Domain		Q. No.	2014	2016
Knowing	Algebraic terms	1	58.35	57.80
	Algebraic expressions	5	23.18	24.00
	Algebraic expressions	9	26.58	26.90
	Algebraic expressions	32	27.24	25.20
	Algebraic expressions with brackets	42	3.20	7.80
Applying	Equations and formulas	14	52.22	50.60
	Number patterns	18	50.87	51.60
	Algebraic expressions	22	29.87	30.90
	Equations and formulas	36	10.61	24.60
	Equations and formulas	40	2.00	3.60
Reasoning	Algebraic expressions	25	32.72	34.40
	Number patterns	26	51.17	53.10
	Algebraic expressions by substituting integers	28	17.95	24.30
	Number patterns	45	21.32	23.10
	Algebraic expressions	48	0.71	0.40

With respect to algebra also no significant difference could be observed in performance between 2014 and 2016. As in 2014, in 2016 also only four items record 50% or above achievement. Slight improvement in performance could be seen with respect to few items.

**Table 24: Comparison of students' achievement in relation to the content domain – Geometry**

Cognitive Domain		Q. No.	2014	2016
Knowing	Locations and spatial relationships	8	29.00	28.50
	Measurement ( units of time)	13	36.99	35.20
	Drawing plane figures to scale	30	0.48	1.70
Applying	Knowledge of cube nets	4	33.28	34.30
	Measurement(length)	17	27.80	27.60
	Measurement ( time)	34	9.71	10.60
	Measurement (Area of a triangle))	38	25.01	22.20
Reasoning	Values of angles	21	20.70	19.80
	Ratios in terms of fractions	24	21.43	21.50
	Measurement (Area of a rectangle))	41	15.91	17.10

Geometry remained the lowest performing skill in 2014 without a single item scoring above 50%.

As the Table 24 indicates this situation has not improved in 2016.

**Table 25: Comparison of students' achievement in relation to the content domain – Data and Chance**

Cognitive Domain		Q. No.	2014	2016
Knowing	Fraction of success	7	46.32	49.10
	Data interpretation (using bar charts)	50	51.51	51.30
Applying	Data interpretation	11	60.24	60.20
	Data interpretation (using pie charts)	15	69.70	68.90
	Data representation (using figures)	29	47.03	45.50
	Data interpretation	33	9.30	8.70
	Probability of an event	49	25.76	25.40
Reasoning	Theoretical probability of an event	02	48.02	50.40
	Data interpretation	19	27.82	28.00
	Data interpretation	37	41.53	43.60

Skills in data and chance recorded 50% and above performance with respect only to three items in 2014. In 2016 there is an improvement in one more item (02). However, the item that recorded the weakest performance, question no.33 records a further decline in performance.



## **6. Conclusion**

The students' performance in TIMSS is low with an all island mean score of 23.16 and an SD = 14.29.

Provincial performance indicates that only four provinces have been able to achieve a mean score above the national mean. Southern Province is the best performing province. Yet its mean value is only 26.03.

There is variation in student achievement, as in all the provinces there are high achievers and even students performing exceptionally well.

In the analysis of cognitive skills, it was revealed that students' performance across all three skills – knowing, applying and reasoning appears to be similar. On the other hand, in subject content students' performance in geometry is the lowest while performance is highest in algebra.

The comparison in performance between 2014 and 2016 reveals a decline Provincial wise. This has resulted in a decline in all island performance.

A significant finding is that in both 2014 and 2016, skill wise lowest performance has been recorded in test items that demands students working out the sum to find the answer. There appears to be a decline in following the process to find the answer.

Since the items for local TIMSS were selected in comparison with the local curriculum it is recommended that curriculum developers study the item analysis to identify the difficult areas for students in all three cognitive domains in mathematics. Such an analysis is necessary to find out the reasons for the low performance and suggest remedial measures.

Further, school level test papers should include test items similar to TIMSS items.