

Wānangatia te Putanga Taurira  
National Monitoring Study  
of Student Achievement

# Mathematics and Statistics

## Achievement Findings 2022



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National Monitoring Study  
of Student Achievement

# Mathematics and Statistics 2022

## Achievement Findings

Educational Assessment Research Unit  
and  
New Zealand Council for Educational Research



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#### Key reports for Mathematics and Statistics 2022

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- 30: Mathematics and Statistics 2022 – Achievement Findings
- 31: Mathematics and Statistics 2022 – Contextual Findings
- 32: Technical Information 2022



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- the students who participated in the assessments and their parents, whānau and caregivers
- the teachers who administered the assessments to the students
- the teachers and senior initial teacher education students who undertook the marking
- the Ministry of Education Research Team and Steering Committee.

# Student Achievement in Mathematics and Statistics

In 2022, the National Monitoring Study of Student Achievement (NMSSA) assessed achievement in the mathematics and statistics<sup>1</sup> learning area of the New Zealand Curriculum. This document contains a summary of the key achievement findings from the 2022 study<sup>2</sup>. Within this summary, any reported differences in achievement between groups are statistically significant unless stated otherwise<sup>3</sup>.

## 1. The 2022 study

The 2022 NMSSA mathematics study involved two nationally representative samples of students attending English medium state and state-integrated schools—a Year 4 sample and a Year 8 sample. Each sample was made up of about 2,000 students from 100 schools.

The samples were constructed using a two-stage sampling design. In the first stage, a stratified random sampling approach based on school decile, geographical region, and school size was used to select 100 schools at each year level. In the second stage, up to 27 students were randomly selected from each school at the appropriate year level. Table 1 shows the number of students assessed in each sample.

Table 1: Number of schools and students in the 2022 NMSSA Year 4 and Year 8 national samples

Year level	Number of schools	Number of students
Year 4	100	2064
Year 8	100	1960

## The 2022 mathematics and statistics assessment programme

The 2022 assessment programme for mathematics and statistics included a paper-and-pencil assessment and a series of in-depth tasks. Teacher Assessors (TAs) administered the programme as part of a two-and-a-half-day visit to each school. The visit also included the administration of assessments in the health and physical education learning area<sup>4</sup>.

The paper-and-pencil assessment drew on a bank of short constructed response and selected response items. The items were designed to assess how well students understood and could use the ideas and processes described by the achievement objectives that make up the three content strands of the mathematics and statistics learning area within the NZC (number and algebra, geometry and measurement, and statistics). Students completed one of several assessment forms containing items from the bank. To link the forms together, each form contained items used in other forms. Item response theory (IRT) was used to locate scores from the assessment on the Mathematics and Statistics (MS) measurement scale. The MS scale has been used to report results on previous NMSSA assessments of mathematics in 2013 and 2018. The use of common items across the different cycles of NMSSA assessment allowed the same scale to be used to report results for the 2022 study.

<sup>1</sup> For brevity, the word 'mathematics' is used throughout this document when referring to the mathematics and statistics learning area.

<sup>2</sup> More information related to achievement in mathematics is available using the NMSSA data window. This can be found on the NMSSA website ([www.nmssa.otago.ac.nz](http://www.nmssa.otago.ac.nz)).

<sup>3</sup> Some plots use error bars to indicate a 95 percent confidence interval around a plotted statistic, such as a group mean. The intervals provide a range within which we can be fairly sure the population value for the reported statistic lies. The confidence intervals have been adjusted (widened) to account for any design effect associated with NMSSA's sampling approach (i.e., sampling schools and then sampling students).

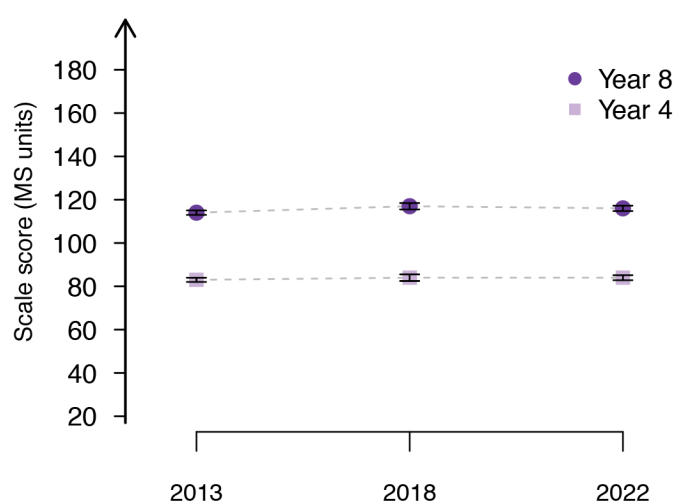
<sup>4</sup> Achievement results associated with the assessments in health and physical education can be found in a separate summary report.

Appendix 1 provides a description of the knowledge and skills measured using the MS scale. Readers are encouraged to refer to this description when considering the meaning of the MS scale scores provided throughout the report.

In 2022, questionnaires were also used as part of the assessment programme to collect contextual data related to teaching and learning mathematics from students, teachers, and school leaders. Analysis of this material is reported separately.

Tables of results related to reporting in this chapter are available in the appendix. Detailed statistical information related to mathematics achievement in 2022 can be found on a data window available at the NMSSA website.

## 2. Changes in achievement from 2013 to 2022



As noted, NMSSA has assessed achievement in mathematics in 2013, 2018, and 2022. The use of common assessment items across the three cycles of assessment means that achievement can be compared across these time periods. Figure 1 shows the average scale scores for Year 4 and 8 in mathematics over the three cycles of NMSSA assessment in mathematics. Table 2 shows the changes in the average scale score on the mathematics and statistics scale between 2018 and 2022 for all students and across gender, ethnic, and decile band<sup>5</sup> groupings at Year 4 and Year 8.

Figure 1: Change in average achievement in mathematics and statistics from 2013 to 2022

### Overall, average achievement at Year 4 and Year 8 remained constant between 2018 and 2022

In 2022, any change in the average scale score for mathematics at both Year 4 and Year 8 since 2018 was not statistically significant. Overall, achievement in mathematics has remained relatively static over the three cycles of NMSSA assessment. Between 2013 and 2018 there was a statistically significant increase in the average score at Year 8.

### At Year 8, there were statistically significant declines in the average mathematics scores for girls, Māori learners, and Pacific learners between 2018 and 2022.

At Year 8, the changes in the average scores between 2018 and 2022 for Māori learners, Pacific learners, and for girls were statistically significant (see Table 2). In each case, the change indicated a decline in achievement. When interpreting the changes, it is important to consider the confidence intervals. These indicate a plus or minus range within which the ‘true’ difference could reasonably lie.

<sup>5</sup> When the NMSSA samples were drawn for the 2022 study, deciles were used as a stratifying variable. They have therefore been used for reporting purposes. For the purposes of this report, the low decile band comprised students in decile 1 to decile 3 schools, the mid band comprised students in decile 4 to decile 7 schools, and the high band comprised students in decile 8 to decile 10 schools.



Table 2 Change in average score on the Mathematics and Statistics (MS) scale between 2018 and 2022 by year level, gender, ethnicity, and school decile band

	Year 4		Year 8	
	Difference in average scores 2018 to 2022 (MS units)*	95 percent confidence interval (MS units)	Difference in average scores 2018 to 2022 (MS units)*	95 percent confidence interval (MS units)
All students	0.1	(-1.4, 1.7)	All students	-1.3 (-2.9, 0.2)
Girls	-0.1	(-2.1, 1.9)	Girls	-2.8 <b>(-5.0, -0.7)</b>
Boys	0.5	(-1.6, 2.6)	Boys	0.1 (-2.1, 2.4)
NZE	-1.3	(-3.2, 0.6)	NZE	-0.5 (-2.4, 1.5)
Māori	0.1	(-2.7, 2.9)	Māori	-3.2 <b>(-6.1, -0.4)</b>
Pacific	1.8	(-1.7, 5.3)	Pacific	-4.4 <b>(-8.0, -0.8)</b>
Asian	2.6	(-0.8, 6.1)	Asian	2.5 (-1.8, 6.8)
Low decile	1.2	(-1.6, 3.9)	Low decile	-2.6 (-5.5, 0.4)
Mid decile	0.8	(-1.4, 3.0)	Mid decile	-0.5 (-2.8, 1.9)
High decile	-1.4	(-3.6, 0.7)	High decile	0.5 (-2.0, 3.0)

\* Bolded numbers indicate the difference is statistically significant ( $p < 0.05$ )

### 3. Overall achievement on the 2022 mathematics assessment

Figures 2 and 3 show the distribution of achievement on the MS scale in 2022 for Year 4 and Year 8, respectively. The difference in the average scores for the two year levels was 32 units. This represents an annualised difference of 8 units which equates to an effect size of 0.4. The annualised difference indicates the amount of ‘progress’ associated with one year of schooling and can be helpful when interpreting score differences between groups.

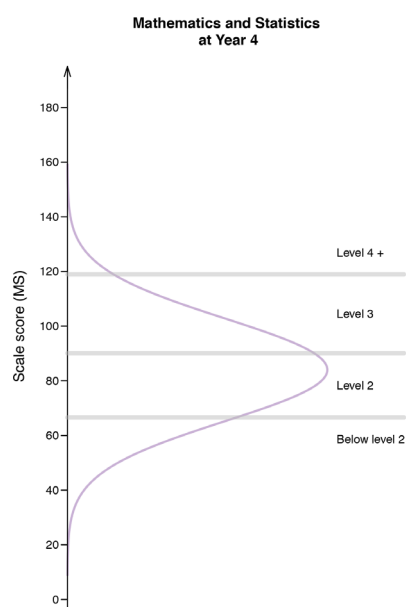


Figure 2: Distribution of scores for Year 4 students on the MS assessment

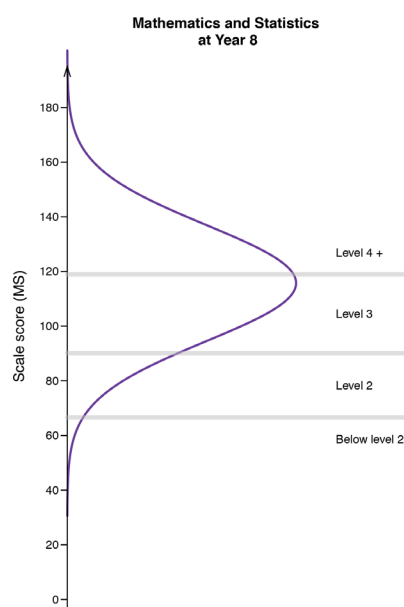


Figure 3: Distribution of scores for Year 8 students on the MS assessment

## 4. Achievement against the curriculum

A curriculum alignment exercise was carried out after the 2013 assessment to link scores on the MS scale with achievement expectations associated with curriculum levels 2 to 4. This allows results from the 2022 mathematics assessment to be interpreted against curriculum expectations. At the end of Year 4, the curriculum expectation is for most students to have achieved at level 2. At the end of Year 8, most students are expected to have achieved at level 4. The expected score gain between level 2 and level 4 is 52 units.

Figure 4 shows the percentage of students at Year 4 and Year 8 who achieved at each curriculum level.

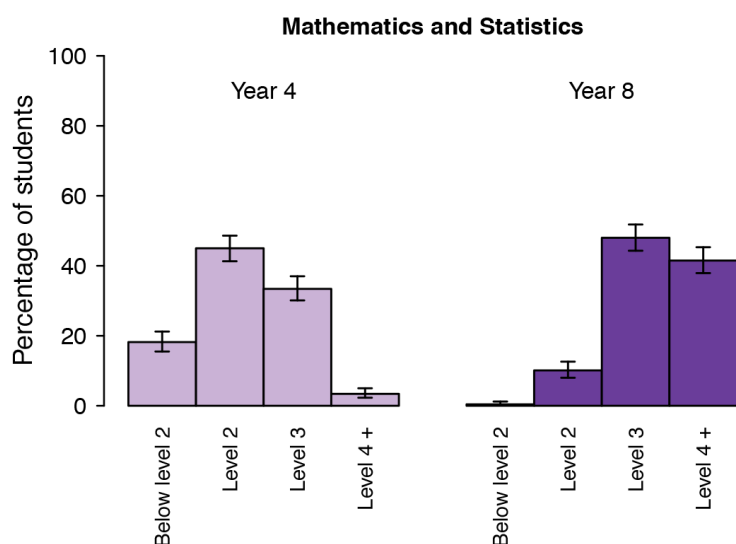


Figure 4: Achievement against the curriculum on the MS assessment, by year level

A smaller proportion of Year 8 students are meeting curriculum expectations compared with Year 4 students.

At Year 4, 82 percent of students achieved at or above the minimum score on the MS scale associated with achieving at curriculum level 2. At Year 8, 42 percent of students achieved at or above the minimum score on the MS scale associated with achieving at level 4.

## 5. Achievement by student-level variables

Figures 5 and 6 show the score distributions for all students, and by gender and ethnic group on the MS scale at Year 4 and Year 8, respectively.

On average, boys scored higher than girls at both year levels.

On average, boys scored higher than girls by 3 scale score units at Year 4 and 5 scale score units at Year 8. The score distributions for girls were also less spread out than for boys. One impact of this, is that a smaller proportion of girls than boys scored at the higher levels of the scale.

There were differences in mathematics achievement related to ethnic group.

On average, non-Māori students scored higher than Māori students by 11 scale score units at Year 4 and 14 units at Year 8. Non-Pacific students scored higher, on average, than Pacific students by 13 scale score units at Year 4 and 17 units at Year 8. On average, Asian students scored higher than non-Asian students by 13 scale score units at Year 4 and 16 units at Year 8.

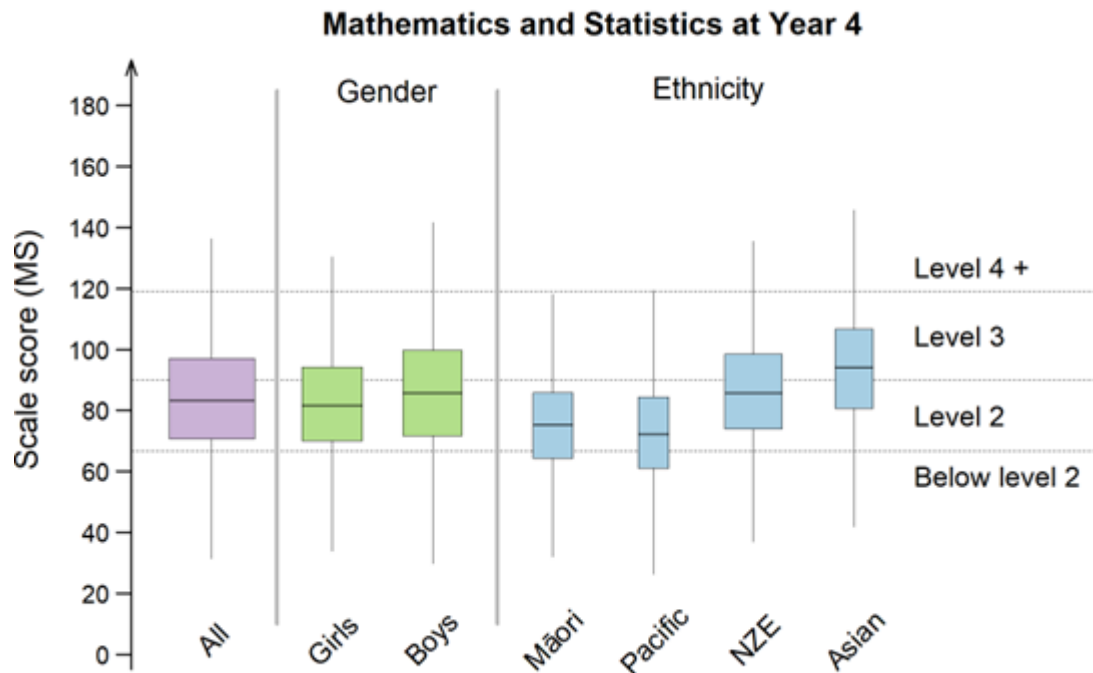


Figure 5: Distribution of scores for Year 4 students on the MS scale, by gender and ethnicity  
 Note: NZE=New Zealand European

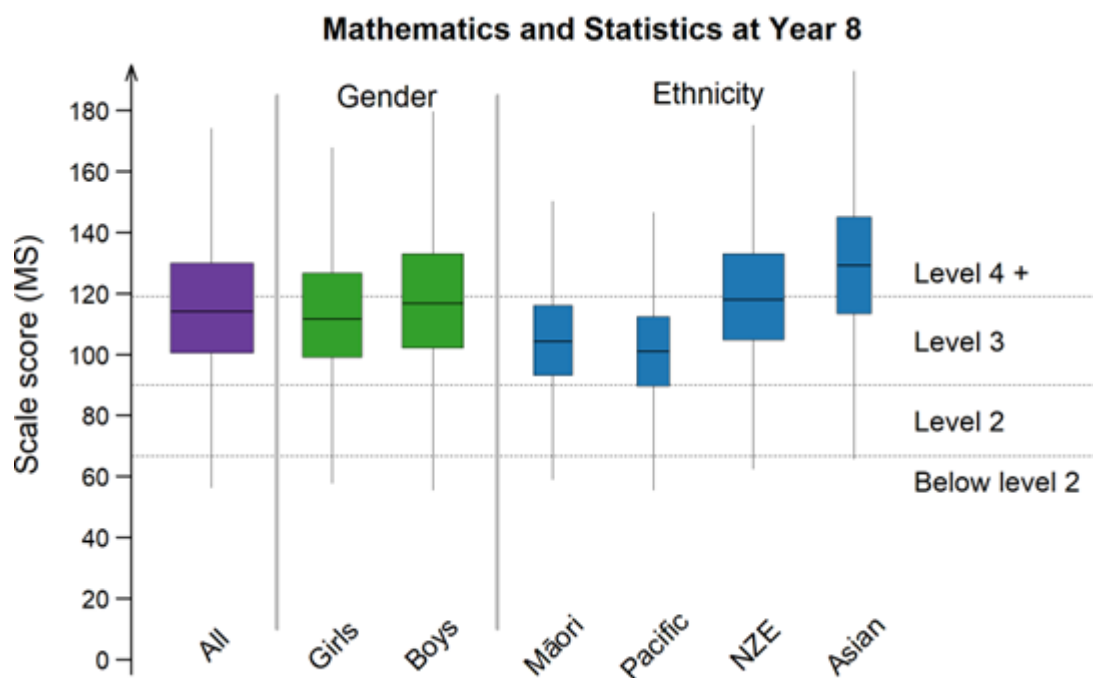


Figure 6: Distribution of scores for Year 8 students on the MS scale, by gender and ethnicity  
 Note: NZE=New Zealand European

## 6. Achievement by school-level variables

Figures 7 and 8 show the achievement of students according to school decile band and school type.

Students attending high decile schools scored higher, on average, than those attending mid or low decile schools.

At both year levels, students from high decile schools scored higher, on average, than those from mid and low decile schools. At Year 4, the difference in average scores for students from high and low decile schools was 17 units. At Year 8, the corresponding difference was 21 units. The difference at Year 8 is equivalent to two and a half years of 'progress'. It means, that on average, students from low decile schools were achieving at one curriculum level below their counterparts in high decile schools.

There were small, statistically significant differences in average achievement between contributing schools and full primaries at Year 4 and full primaries and intermediate schools at Year 8

At Year 4, students attending contributing schools scored lower, on average, than students who were attending full primary schools. At Year 8, students at full primary schools scored higher, on average, than those attending intermediate schools. At both year levels, the difference was about 2 scale score units.

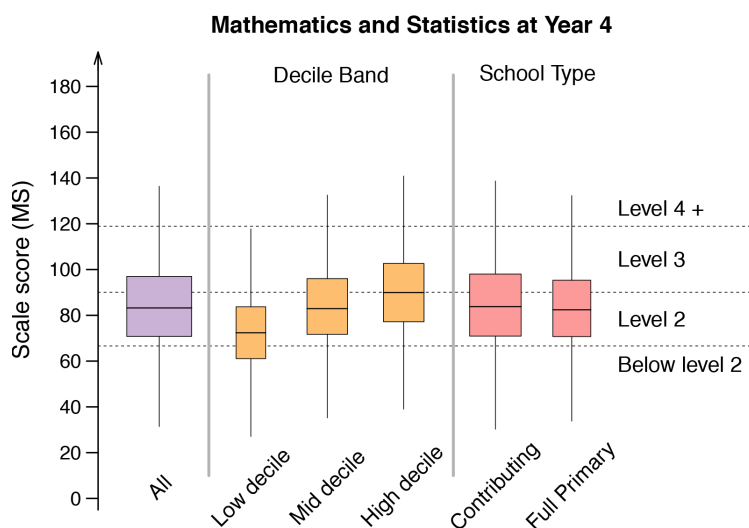


Figure 7: Distribution of scores for Year 4 students on the MS scale, by school decile band and school type

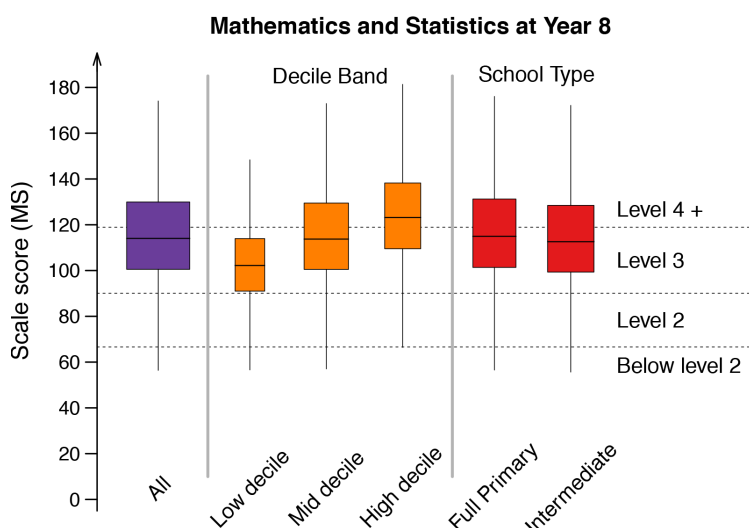


Figure 8: Distribution of scores for Year 8 students on the MS scale, by school decile band and school type

## Appendix 1: The scale description

Figure A1.1. provides a description of the mathematics knowledge and skills measured by the MS scale. The descriptors provide examples of the kinds of skills that students, who achieved at different parts of the scale, were typically able to display. The descriptors are organised according to the content strands of the mathematics and statistics learning area.

To create the scale description, each question used in the assessment was located on the scale where students achieving at that part of the scale answered the question correctly about 70 percent of the time. The questions themselves were then examined to identify the knowledge and skills they required. By working from the questions located at the bottom of the scale to the ones at the top the assessment developers were able to identify how the demands of the questions increased as the scale locations changed. The result was a scale description outlining what students typically know and can do in mathematics when achieving at different places on the scale.

NMSSA • Mathematics and Statistics scale descriptors



Figure A1.1. Description of the Mathematics and Statistics (MS) scale

## Appendix 2: Summary Statistics

### *Tables:*

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### **Reporting of statistics**

The following tables report a range of statistics associated with the 2022 NMSSA mathematics and statistics study.

### **95 percent confidence intervals**

The tables show the 95 percent confidence intervals associated with the mean scores and percentages of students scoring at or above curriculum benchmarks reported in the tables. The intervals provide a range within which we can be fairly sure the population value for the reported statistic lies. The confidence intervals have been adjusted (widened) to account for any design effect associated with NMSSA's sampling approach (i.e., sampling schools and then sampling students).

### **Decile band**

For the purposes of this report, the low decile band comprised students in decile 1 to decile 3 schools, the mid band comprised students in decile 4 to decile 7 schools, and the high band comprised students in decile 8 to decile 10 schools.

### **School type**

A composite school combines students from different year levels that are typically found in separate primary or secondary schools. A restricted composite, sometimes known as a middle school, caters for Years 7 to 10. A contributing school caters for Years 1 to 6 of schooling. A full primary school caters for Years 1 to 8 of schooling. Secondary schools cater for Years 7 to 15 of schooling, although many cater for Years 9 to 15 only. An intermediate school caters for Years 7 and 8 of schooling. Please note, the numbers of students in the study representing school types other than those classified as either contributing, full primary or intermediate are low. Care should be taken when interpreting the statistics for these school types.



## Achievement in the mathematics and statistics learning area

Table A2.1. Achievement on the MS scale: Summary statistics for Year 4 students

Group	Sample size	Mean	Confidence interval for the mean	Standard deviation
All	2064	84	(83.0, 85.0)	18.8
<b>Gender</b>				
Girls	1060	82.4	(81.1, 83.7)	18
Boys	1004	85.7	(84.3, 87.1)	19.4
<b>Ethnicity</b>				
Māori	448	75.3	(73.5, 77.1)	16.3
Pacific	269	72.9	(70.6, 75.2)	16.3
Asian	413	94	(91.8, 96.2)	18.6
NZE	955	86.2	(84.9, 87.5)	17.5
<b>SEN (combined)</b>				
<b>Decile band</b>				
Low decile	437	72.8	(70.9, 74.7)	16.6
Mid decile	817	84.1	(82.6, 85.6)	17.9
High decile	810	89.9	(88.4, 91.4)	18.1
<b>School type</b>				
Contributing	1327	84.6	(83.4, 85.8)	19.2
Full primary	725	83.1	(81.5, 84.7)	17.9
Composite (Year 1-15)	12	75	(58.8, 91.2)	19.9

Table A2.2. Achievement on the MS scale: Summary statistics for Year 8 students

Group	Sample size	Mean	Confidence interval for the mean	Standard deviation
All	1960	115.8	(114.7, 116.9)	21.3
<b>Gender</b>				
Girls	955	113.3	(111.8, 114.8)	20.3
Boys	1005	118.1	(116.5, 119.7)	21.9
<b>Ethnicity</b>				
Māori	423	105	(103.0, 107.0)	17.1
Pacific	283	101.2	(98.9, 103.5)	16.6
Asian	308	129.5	(126.6, 132.4)	21.8
NZE	1025	119	(117.6, 120.4)	19.7
<b>SEN (combined)</b>				
<b>Decile band</b>				
Low decile	409	103.1	(101.0, 105.2)	17.8
Mid decile	930	115.5	(113.9, 117.1)	20.7
High decile	621	124.5	(122.6, 126.4)	20
<b>School type</b>				
Composite	5	129.5	(67.6, 191.4)	26.9
Full primary	867	116.7	(115.0, 118.4)	21.1
Intermediate	1021	114.5	(112.9, 116.1)	21.5
Restricted composite	19	114.9	(107.0, 122.8)	13.2
Secondary	48	124.8	(118.5, 131.1)	18

Table A2.3. Curriculum levels for MS: Year 4 and Year 8 students

Group	Year 4			Year 8		
	Sample size	Level 2+ (%)	Confidence interval	Sample size	Level 4+ (%)	Confidence interval
All	2064	81.8%	(79.7, 83.7)	1960	41.5%	(38.9, 44.1)
<b>Gender</b>						
Girls	1060	81.1%	(78.1, 83.7)	955	36.7%	(33.1, 40.4)
Boys	1004	82.6%	(79.6, 85.2)	1005	46.1%	(42.5, 49.8)
<b>Ethnicity</b>						
Māori	448	70.4%	(65.1, 75.1)	423	20.5%	(16.3, 25.5)
Pacific	269	62.9%	(55.8, 69.5)	283	14.5%	(10.3, 20.1)
Asian	413	93.2%	(89.7, 95.5)	308	67.0%	(60.5, 72.9)
NZE	955	86.5%	(83.7, 88.9)	1025	48.1%	(44.4, 51.7)
<b>Decile band</b>						
Low decile	437	63.0%	(57.5, 68.2)	409	17.3%	(13.4, 22.1)
Mid decile	817	83.8%	(80.6, 86.6)	930	41.0%	(37.3, 44.9)
High decile	810	89.9%	(87.1, 92.1)	621	58.1%	(53.4, 62.7)
<b>School type</b>						
Contributing	1327	82.0%	(79.4, 84.3)			
Full primary	725	81.7%	(78.1, 84.8)	867	43.1%	(39.3, 47.1)
Composite (Year 1-15)	12	64.5%	(32.8, 87.1)	5	60.4%	(19.2, 90.8)
Intermediate				1021	39.3%	(35.8, 42.9)
Restricted composite				19	36.5%	(16.6, 62.5)
Secondary (Year 7-15)				48	59.3%	(42.5, 74.1)





