



Student Achievement on Mathematics Curriculum Strands

Results from the 2021–2022
Primary- and Junior-Division and Grade 9 Assessments

OCTOBER 2023

INTRODUCTION

This study explores students' achievement on the mathematics curriculum strands as assessed by the mathematics components of the primary- and junior-division EQAO assessments and the Grade 9 Assessment of Mathematics. The purpose of the study was to provide further information on students' strengths and needs in mathematics, and to assist Ontario's education community in understanding how achievement on particular strands relates to meeting overall curriculum expectations. The study focuses particularly on mathematics achievement at Levels 2 and 3 on the assessments, as this distinction represents students meeting curriculum expectations (according to provincial standard, Level 3) and those just below. This report presents the study results and discusses the findings.

METHOD

How results for curriculum strands are generated

For the 2021–2022 administration, EQAO introduced a multi-stage computer adaptive testing (msCAT) model for mathematics that presents assessment modules to students with the overall difficulty adapted to students' individual ability. Each student's ability level is determined in real time by performance as the student progresses through the stages of the assessment.

Because the assessment is adaptive, observed performance is difficult to interpret. This is because the observed percent correct may be similar across msCAT paths, with higher-performing students doing about as well on a set of more difficult questions as lower-performing students do on a set of easier questions. For example, two students of different ability levels may each get 75% of the items on their assessment correct, but 75% correct on a set of more difficult questions indicates a higher level of performance than 75% correct on a set of easier questions.

For this reason, this study reports “expected percent correct” results rather than “observed percent correct” results.¹ Expected percent correct is reported by estimating the percentage of questions each student would get correct if everyone had been administered all the same questions belonging to each curriculum strand. Because we know the difficulty of each question as well as the overall score obtained by each student on the assessment, it is possible to determine what percent of all questions in a curriculum strand are likely (or expected) to be answered correctly by students of varying ability levels.

Population

The responses of all students in Ontario who wrote the adaptive online version of the mathematics components of the primary- and junior-division assessments or the adaptive online Grade 9 Assessment of Mathematics and were provided an achievement level were included in the analysis. Therefore, the data set included 126 660 Grade 3 students, 130 711 Grade 6 students and 72 616 Grade 9 students.²

It is worth noting that the performance of this population of students may look different from that of previous years. The students who wrote the 2021–2022 EQAO assessments had been through COVID-19-related school closures, and students’ in-person learning was interrupted as a result. Because of the new curriculum, instructional time may have been distributed differently than in previous years. Finally, the assessments were online for the first time, and some students may have performed differently due to differential familiarity with the online format.

In addition, this is a single year of data, and it is unknown at this time whether the results for this kind of study will be consistent or differ across years. It is also unknown whether results will be the same across grades when the same students are tracked over time. Similar analyses in future years, and multi-year analyses, will further inform understanding on this topic.

The student populations at English- and French-language boards were combined in this study, except for the Financial Literacy strand (see the Analysis section for detail). This approach was taken because analyses showed that the percentage of correctly answered questions required to achieve Level 3 was generally the same regardless of language, as all students wrote the same assessment. Some differences by board language were observed for the Financial Literacy curriculum strand. Therefore, Financial Literacy results are reported separately.

Table 1 shows the percentage of students who achieved each achievement level. In total, 59% of Grade 3 students achieved or exceeded the provincial standard. In Grade 6 and Grade 9, this proportion was lower (47% and 53% respectively).

Table 1. Percentage of students in the study who achieved each achievement level, by grade

Grade	Below Level 1	Level 1	Level 2	Level 3	Level 4	N
Grade 3	<1%	8%	32%	46%	13%	126 660
Grade 6	<1%	5%	47%	40%	7%	130 711
Grade 9	<1%	10%	37%	47%	6%	72 616

¹ Throughout the remainder of the report, expected percent correct results are simply referred to as “percent correct” for ease of interpretation.

² During the 2021–2022 school year, many school boards were not able to administer the Grade 9 mathematics assessment in January, due to the pandemic, so this cohort size is smaller than in previous and subsequent years.

Curriculum strands

Five curriculum strands are identified in the Ontario mathematics curriculum and assessed on EQAO assessments: Number, Algebra, Data, Spatial Sense/Geometry and Measurement, and Financial Literacy. A sixth strand, known as the Social-Emotional Learning Skills in Mathematics and the Mathematical Processes strand in Grades 3 and 6 and the Social-Emotional Learning Skills in Mathematics and Mathematical Thinking and Making Connections strand in Grade 9, is not directly assessed on EQAO mathematics assessment components. Financial Literacy is a new curriculum strand introduced with the new 2020 (Grades 1–8) and 2021 (Grade 9) mathematics curriculum and was not included in the previous curriculum. This strand is reported separately in the Grade 6 and Grade 9 results but included in the Number strand in the Grade 3 results.³

The number of questions that students receive on their assessment for each curriculum strand is outlined in the assessment frameworks. For the Grade 3 assessment, the [mathematics component of the primary-division Framework](#) specifies that 35% of the 40 assessment questions are allocated to the Number strand, with the remainder relatively evenly distributed across the Algebra, Data and Spatial Sense strands. For the Grade 6 assessment, the [mathematics component of the junior-division Framework](#) specifies a similar breakdown, with 32% of the 44 assessment questions allocated to Number, the rest distributed across Algebra, Data and Spatial Sense and a small share (9%) allocated to Financial Literacy. For the Grade 9 assessment, the [Framework for the Grade 9 Assessment of Mathematics](#) indicates that the weighting shifts, with 36% of the 50 assessment questions mapped to the Algebra strand, 20% to Number and the remainder relatively evenly distributed to Data, Geometry and Measurement, and Financial Literacy. Table 2 shows these distributions.

Table 2. Percentage of questions across curriculum strands, by grade⁴

Curriculum strand	Grade 3	Grade 6	Grade 9
Number	35%	32%	20%
Algebra	20%	20%	36%
Data	20%	18%	16%
Spatial Sense/Geometry and Measurement	25%	20%	16%
Financial Literacy	NA	9%	12%
Total questions	40	44	50

To provide an overview of student achievement on the curriculum strands, Tables 3–5 present the descriptive statistics for Grades 3, 6 and 9 respectively. For example, Grade 3 students answered, on average, 66% of Number questions correctly, Grade 6 students answered 62% of Number questions correctly and Grade 9 students answered 62% of Number questions correctly.

³ Because of its content in the Grade 3 curriculum, the Financial Literacy strand has been combined with the Number strand for Grade 3.

⁴ These are the percentages for operational questions. Operational questions are used to determine a student's results. Students also complete four field-test questions during the assessment, which are embedded in the assessment. These questions do not count towards their results.

However, it is important to understand that the curriculum strands are not equated on EQAO assessments, which means that it is not possible to compare strands and say that, for example, Grade 6 student achievement is higher for Number (62%) than for Data (53%). It could simply have been that there were more “easy” questions in the Number strand than for Data, so the number of correct answers required to achieve Level 3 was higher for Number than for Data. The percent of correct responses required to achieve Level 3 is one of the analyses addressed in this study (see the Analysis section below).

Table 3. Descriptive statistics for each curriculum strand, 2021–2022: Grade 3

Curriculum strand	Mean	Standard deviation	Median	Range
Number	65.8	21.22	69	17 to 100
Algebra	62.0	21.37	63	11 to 100
Data	63.8	24.20	67	9 to 100
Spatial Sense	56.8	22.20	57	8 to 100

Number of students = 126 660

Table 4. Descriptive statistics for each curriculum strand, 2021–2022: Grade 6

Curriculum strand	Mean	Standard deviation	Median	Range
Number	62.3	19.30	62	21 to 100
Algebra	60.9	21.90	61	9 to 100
Data	53.3	22.20	51	9 to 100
Spatial Sense	52.5	23.17	52	0 to 100
Financial Literacy (English-language boards)	76.3	22.57	79	0 to 100
Financial Literacy (French-language boards)	63.1	23.96	64	0 to 100

Number of students = 130 711. Number of students in English-language boards: 122 699.
Number of students in French-language boards: 8012.

Table 5. Descriptive statistics for each curriculum strand, 2021–2022: Grade 9

Curriculum strand	Mean	Standard deviation	Median	Range
Number	61.8	21.39	62	12 to 100
Algebra	50.9	20.58	49	11 to 96
Data	58.2	21.32	59	7 to 100
Geometry and Measurement	52.5	25.58	52	0 to 100
Financial Literacy (English boards)	72.4	21.72	75	0 to 100
Financial Literacy (French boards)	66.7	21.90	69	0 to 100

Number of students = 72 616. Number of students in English-language boards: 66 907.
Number of students in French-language boards: 5709.

Analysis

The first step in the study was to explore each curriculum strand to find achievement patterns among students who achieved different levels. The range of achievement was identified for the middle 50% of students at each level. This was determined by calculating, for each curriculum strand, the percent correct score for the 25th and 75th percentile of students at each level. These results were used to understand the trends in achievement patterns across levels.

The second step in the study was to identify what can be considered a “benchmark” result for each curriculum strand. As Level 3 represents having demonstrated the expected ability for a given grade, the definition of a benchmark result was anchored on achieving Level 3. It was decided that if a clear majority of students (i.e., 80% of students) at Level 3 achieved a given score or higher, then it was reasonable to say that this score (i.e., the 20th percentile score among students who received Level 3) is required in order to achieve a Level 3. In this study, this score was labelled “the benchmark score” to signify that this is the score schools should be aiming for their classes to achieve on average.

The benchmark scores were first calculated separately for students in English- and French-language boards, and the differences were checked. The results for the two language groups were the same or negligibly different. An exception was in the Financial Literacy curriculum strand, particularly in Grade 6 but also in Grade 9. To accommodate the substantial observed differences for Financial Literacy, Grade 6 and Grade 9 Financial Literacy analyses have been split by language.

Using the benchmark scores, the percentage of students at other levels (i.e., Level 4, Level 2, Level 1 and Below Level 1) who also achieved this score or higher was calculated.

It was also necessary to know whether achievement of these benchmark scores was required for every skill to achieve Level 3, or just some. To do this, the number of skills where the benchmark score was achieved was calculated for each student. Then the percentage of students who achieved a given number of benchmark scores was reported by level. Profiles for students were also generated to aid in understanding whether there were patterns in their proficiency in different curriculum strands.

RESULTS

Achievement patterns in curriculum strands

The first task in the study was to explore achievement patterns in curriculum strands among students who achieved different EQAO levels in mathematics. The results are reported below for Grade 3, Grade 6 and Grade 9.⁵

Grade 3

A clear finding is that student achievement was similar across all curriculum strands. That is, students who were at beginning levels of achievement in one curriculum strand tended to be at beginning levels across all curriculum strands. Likewise, students who were at the middle or higher levels of achievement in one curriculum strand tended to be at middle or higher levels of achievement across all curriculum strands.

⁵ Due to very large sample sizes, statistical significance testing in this study did not yield meaningful results, as even very small differences were flagged as significant. Therefore, results of statistical significance testing (e.g., for correlation coefficients) are not reported.

These relationships are demonstrated in this correlation table (see Table 6). A correlation value can run from -1 (a perfectly negative relationship) to 0 (no relationship) to 1 (a perfectly positive relationship). A strong relationship is typically over $\pm .40$, and a very strong relationship is typically over $\pm .70$. In the table below, Number, Algebra, Data and Spatial Sense show strong relationships, suggesting that students' ability is consistently higher or lower across them.

Table 6. Correlation values showing relationships between curriculum strands for 2021–2022, Grade 3

Curriculum strand	Number	Algebra	Data	Spatial Sense
Number	1.00			
Algebra	.68	1.00		
Data	.70	.61	1.00	
Spatial Sense	.68	.61	.64	1.00

For each curriculum strand, achievement across levels displayed a concave growth curve (see Figure 1; the percentages are provided in Table 7). Additionally, some curriculum strands required somewhat lower numbers of correct responses than others to achieve Level 3. However, the achievement distribution was consistent across curriculum strands.

Figure 1. Curriculum strand percentage correct range for the middle 50% of Grade 3 students, by achievement level, 2021–2022

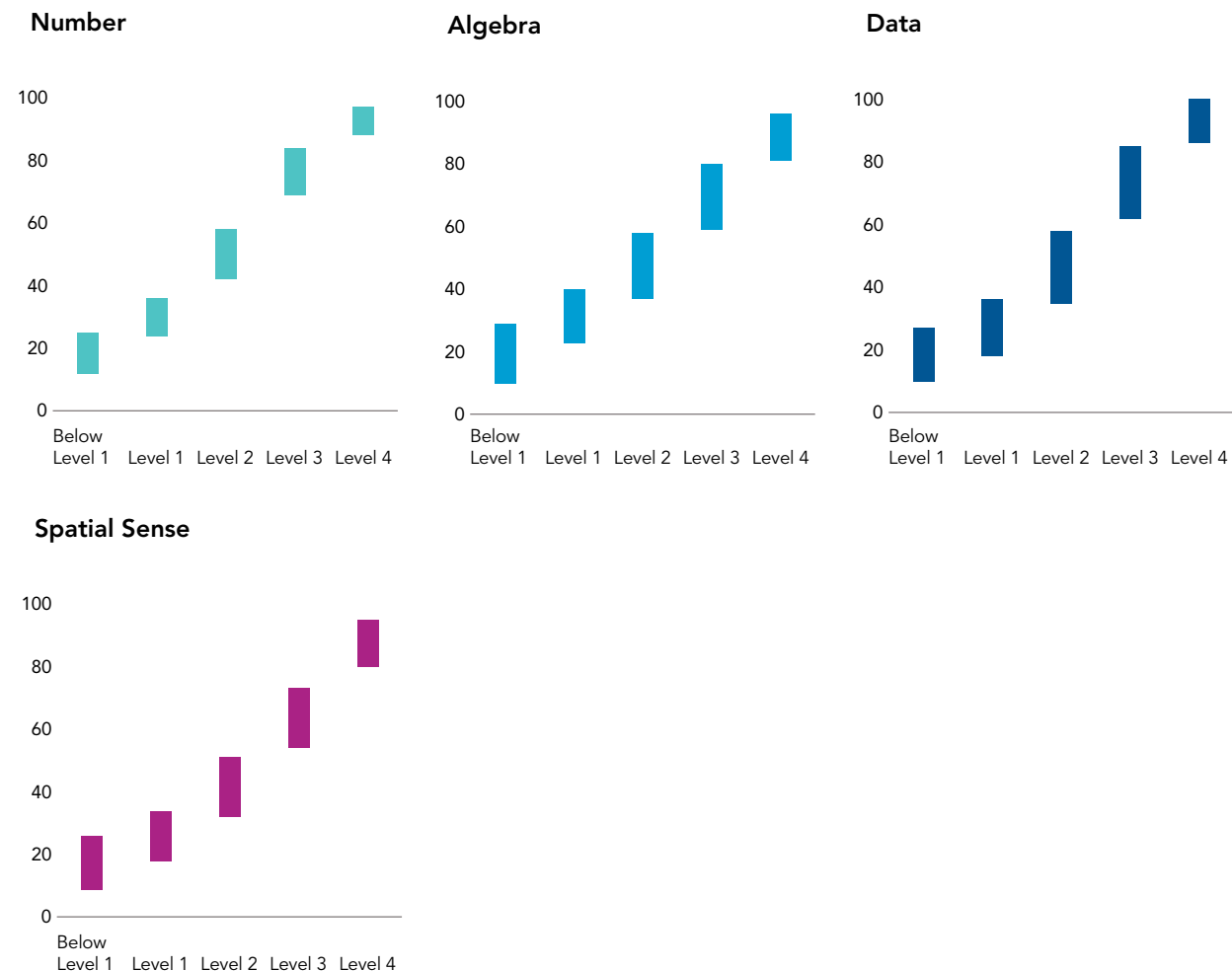


Table 7. Curriculum strand percentage correct range for the middle 50% of Grade 3 students, by achievement level, 2021–2022

Curriculum strand	Achievement level				
	Below Level 1	Level 1	Level 2	Level 3	Level 4
Number	12 to 25	24 to 36	42 to 58	69 to 84	88 to 97
Algebra	10 to 29	23 to 40	37 to 58	59 to 80	81 to 96
Data	10 to 27	18 to 36	35 to 58	62 to 85	86 to 100
Spatial Sense	9 to 26	18 to 34	32 to 51	54 to 73	80 to 95

Grade 6

Similar to Grade 3 student achievement, student achievement in Grade 6 was similar across all curriculum strands (see Figure 2; the percentages are provided in Table 9). That is, students who were at beginning levels of achievement in one curriculum strand tended to be at beginning levels across all curriculum strands. Likewise, students who were at the middle or higher levels of achievement in one curriculum strand tended to be at middle or higher levels of achievement across all curriculum strands. As with Grade 3, some curriculum strands required somewhat lower numbers of correct responses than others to achieve Level 3.

These relationships are demonstrated in this correlation table (see Table 8). In the table below, Number, Algebra, Data and Spatial Sense show strong relationships, while Financial Literacy is less strongly related to other math strands.

Table 8. Correlation values showing relationships between curriculum strands for 2021–2022, Grade 6

Curriculum strand	Number	Algebra	Data	Spatial Sense	Financial Literacy
Number	1.00				
Algebra	.69	1.00			
Data	.63	.60	1.00		
Spatial Sense	.63	.59	.54	1.00	
Financial Literacy	.40	.38	.34	.31	1.00

The achievement distribution was, as in Grade 3, generally consistent across curriculum strands (see Figure 2; the percentages are provided in Table 9). An exception to these trends was in Financial Literacy, which showed a markedly different achievement distribution from the other curriculum strands among students in both English- and French-language boards. For Financial Literacy at English-language school boards, student achievement at each level overlapped significantly and displayed a convex growth curve, possibly because the overall difficulty of questions in this strand was lower and the ceiling of 100% correct was reached by many students who achieved Level 3 and Level 4 on the assessment. However, for Financial Literacy at French-language school boards, student achievement at each level overlapped very significantly and displayed a linear growth curve.

Figure 2. Curriculum strand percentage correct range for the middle 50% of Grade 6 students, by achievement level, 2021–2022

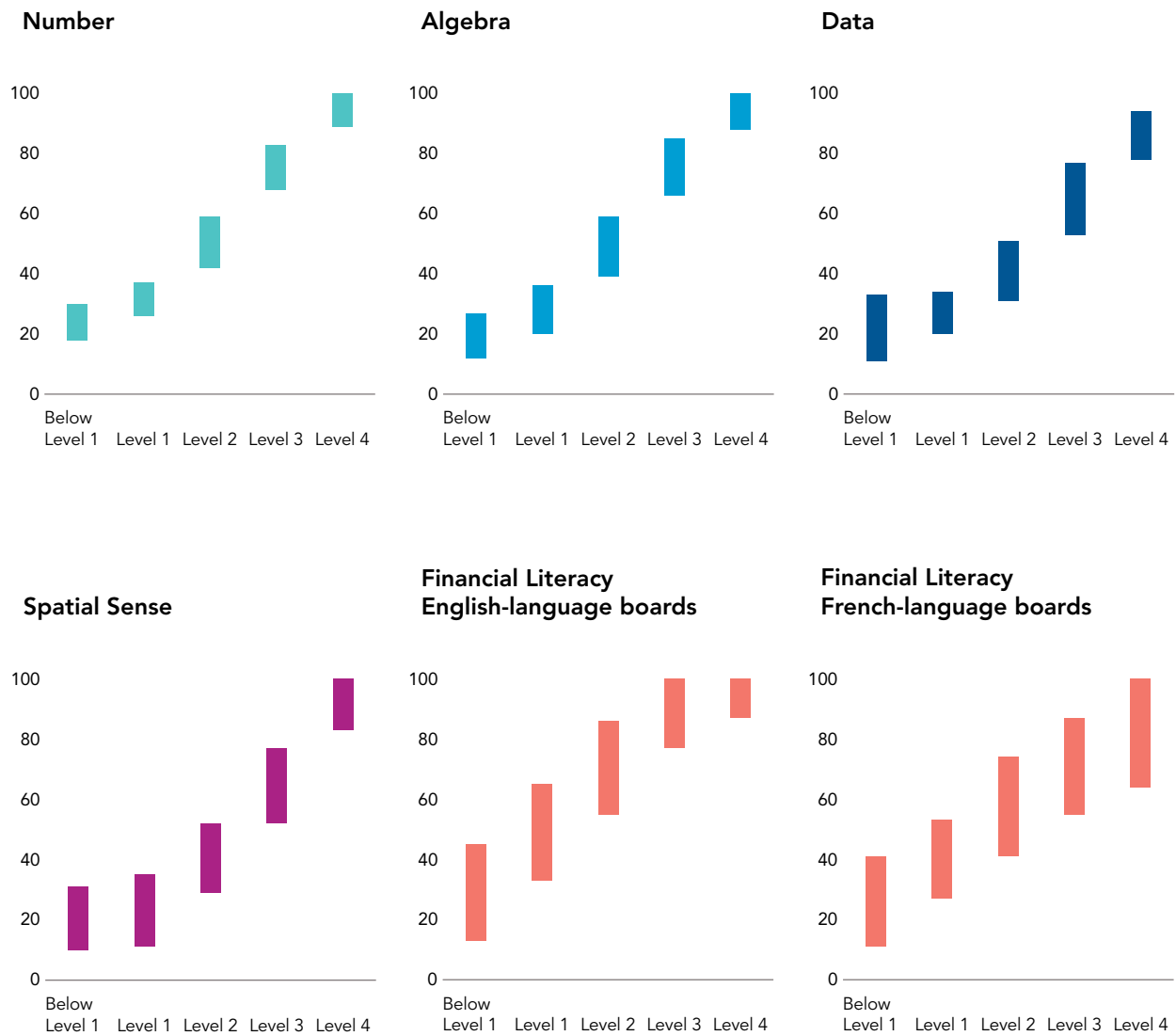


Table 9. Curriculum strand percentage correct range for the middle 50% of Grade 6 students, by achievement level, 2021–2022

Curriculum strand	Achievement level				
	Below Level 1	Level 1	Level 2	Level 3	Level 4
Number	18 to 30	26 to 37	42 to 59	68 to 83	89 to 100
Algebra	12 to 27	20 to 36	39 to 59	66 to 85	88 to 100
Data	11 to 33	20 to 34	31 to 51	53 to 77	78 to 94
Spatial Sense	10 to 31	11 to 35	29 to 52	52 to 77	83 to 100
Financial Literacy (English)	13 to 45	33 to 65	55 to 86	77 to 100	87 to 100
Financial Literacy (French)	11 to 41	27 to 53	41 to 74	55 to 87	64 to 100

Grade 9

As with Grade 3 and Grade 6 student achievement, student achievement in Grade 9 was mostly consistent across all curriculum strands. That is, students with lower levels of achievement in one curriculum strand tended to have lower achievement across all curriculum strands. Likewise, students with higher levels of achievement in one curriculum strand tended to have higher achievement across all curriculum strands. As with Grade 3 and Grade 6, some curriculum strands required somewhat lower numbers of correct responses than others to achieve Level 3.

These relationships are demonstrated in Table 10. All five curriculum strands (Number, Algebra, Data, Geometry and Measurement and Financial Literacy) show strong relationships.

Table 10. Correlation values showing relationships between curriculum strands for 2021–2022, Grade 9

Curriculum strand	Number	Algebra	Data	Geometry and Measurement	Financial Literacy
Number	1.00				
Algebra	.67	1.00			
Data	.50	.57	1.00		
Geometry and Measurement	.61	.70	.52	1.00	
Financial Literacy	.80	.84	.62	.72	1.00

The achievement distribution was, as in Grade 3 and Grade 6, generally consistent across curriculum strands (see Figure 3; the percentages are provided in Table 11). As with Grade 6, an exception to these trends was Financial Literacy, which showed a markedly different achievement distribution among students by language. For Financial Literacy at English-language boards, student achievement at each level somewhat overlapped and displayed a convex growth curve, and the ceiling of 100% correct was reached by many students. However, for Financial Literacy at French-language boards, student achievement at each level overlapped significantly and displayed a linear growth curve.

Figure 3. Curriculum strand percentage correct range for the middle 50% of Grade 9 students, by achievement level, 2021–2022

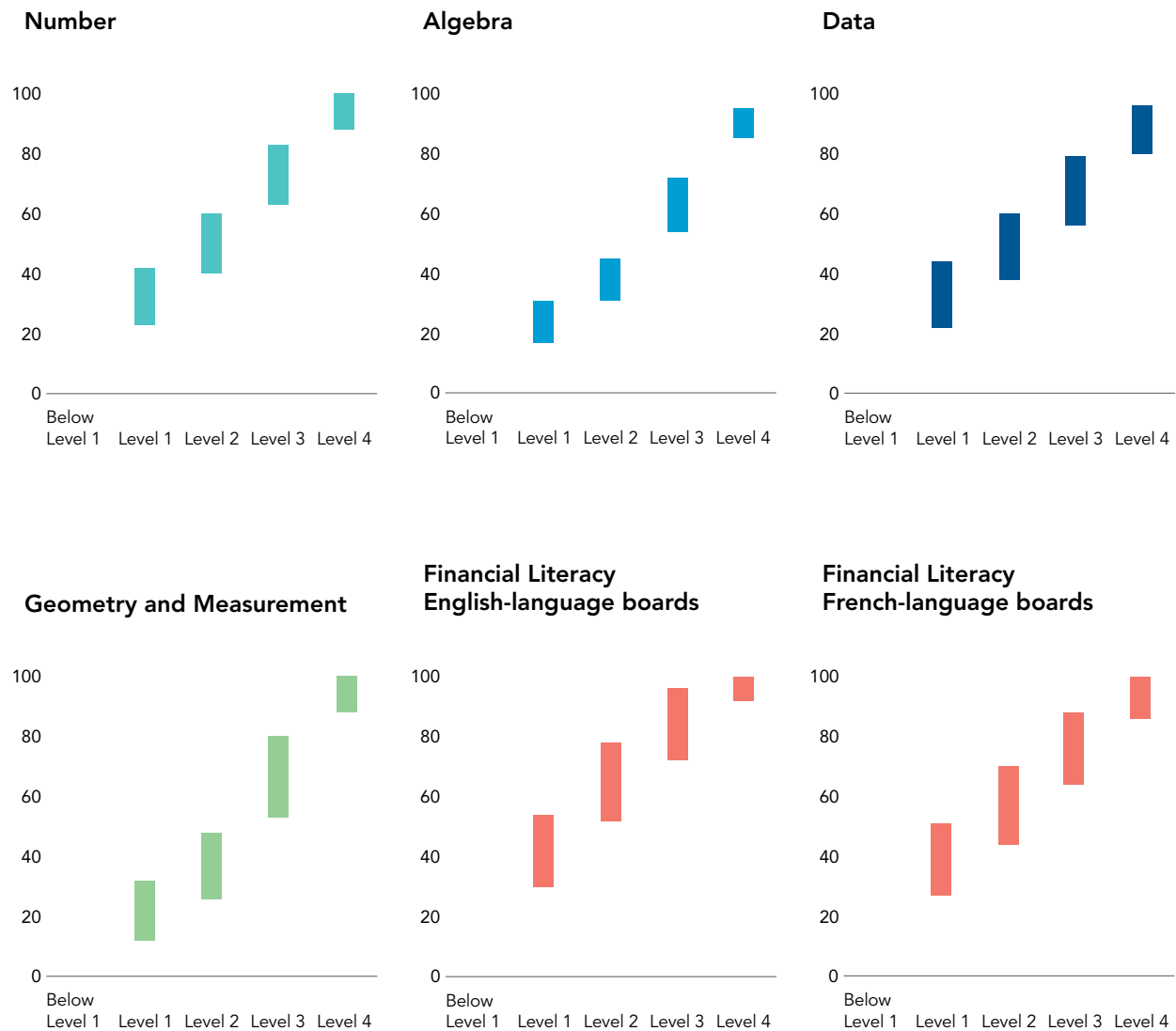


Table 11. Curriculum strand percentage correct range for the middle 50% of Grade 9 students, by achievement level, 2021–2022

Curriculum strand	Achievement level				
	Below Level 1	Level 1	Level 2	Level 3	Level 4
Number	*NEI	23 to 42	40 to 60	63 to 83	88 to 100
Algebra	NEI	17 to 31	31 to 45	54 to 72	85 to 95
Data	NEI	22 to 44	38 to 60	56 to 79	80 to 96
Geometry and Measurement	NEI	12 to 32	26 to 48	53 to 80	88 to 100
Financial Literacy (English)	NEI	30 to 54	52 to 78	72 to 96	92 to 100
Financial Literacy (French)	NEI	27 to 51	44 to 70	64 to 88	86 to 100

* NEI = Not enough information to draw conclusions, typically due to a small sample size

What was a benchmark result?

The second task in the study was to identify what can be considered a benchmark result for each curriculum strand. The results are reported below for Grade 3, Grade 6 and Grade 9.

Grade 3

Regarding the definition of a benchmark result, the analysis found that when the benchmark score was set at the percent correct achieved by 80% of students who achieved Level 3 (i.e., a clear majority), a clear difference in achievement emerged between Grade 3 students who achieved Level 2 and those who achieved Level 3.

As shown in Table 12, for example, while 80% of students who achieved Level 3 answered 58% or more of Algebra questions correctly, only 27% of students who achieved Level 2 answered this many Algebra questions correctly.

This gap persisted for Spatial Sense, with 80% of students who achieved Level 3 answering 52% or more questions correctly, but only 24% of students who achieved Level 2 answering this many questions correctly. Likewise, 80% of students who achieved Level 3 answered 61% or more of Data questions correctly, but only 21% of students who achieved Level 2 answered this many Data questions correctly.

The largest gap observed was for Number. For this curriculum strand, 80% of students who achieved Level 3 answered 67% or more of Number questions correctly. However, only 9% of students who achieved Level 2 answered this many Number questions correctly.

Table 12. Percentage of Grade 3 students who achieved each benchmark score, by achievement level, 2021–2022

Curriculum strand	Benchmark percent correct	Achievement level				
		Below Level 1	Level 1	Level 2	Level 3	Level 4
Number	67	0%	<1%	9%	80%	>99%
Algebra	58	<1%	4%	27%	80%	99%
Data	61	<1%	1%	21%	80%	>99%
Spatial Sense	52	<1%	3%	24%	80%	>99%

Grade 6

For Grade 6, the analysis also found that when the benchmark score was set at the percent correct achieved by 80% of students who achieved Level 3 (i.e., a clear majority), a clear difference in achievement emerged between Grade 6 students who achieved Level 2 and those who achieved Level 3. The results are summarized in Table 13.

Firstly, Financial Literacy is reported separately for the first time in Grade 6. Uniquely among the curriculum strands, differences in benchmark scores between students in French- and English-language boards were observed. Specifically, 80% of students in English-language boards who achieved Level 3 could answer 72% or more of Financial Literacy questions correctly. However, in French-language boards, 80% of students who achieved Level 3 could answer only 52% or more questions correctly. As these were the same questions, it appears that Financial Literacy questions were more difficult for students in French-language boards than for students in English-language boards.

However, once the benchmark score was established for Financial Literacy, the percentage of students who achieved Level 2 and reached the benchmark score was similar across the two language groups, and it was a very high percentage. Specifically, 53% of students in English-language boards who achieved Level 2 also achieved the English board benchmark score or higher. In French-language boards, among students who achieved Level 2, 56% of students also achieved the French board benchmark score or higher. Considering 80% of students who achieved Level 3 reached these benchmarks, there was clearly a large overlap between the two groups for Financial Literacy.

For the other curriculum strands, compared to Grade 3, there were also differences in the percentages of students who achieved Level 2 and Level 3 and reached the benchmark score, but the differences were smaller. For example, while 80% of students who achieved Level 3 answered 50% or more of Spatial Sense questions correctly, only 29% of students who achieved Level 2 answered this many Spatial Sense questions correctly. This gap persisted for Data, with 80% of students who achieved Level 3 answering 51% or more of Data questions correctly, but only 26% of students who achieved Level 2 answering this many (or more) Data questions correctly.

Moreover, 80% of students who achieved Level 3 answered 63% or more of Algebra questions correctly, but only 16% of students who achieved Level 2 answered this many Algebra questions correctly. Finally, while 80% of students who achieved Level 3 answered 66% or more of Number questions correctly, only 12% of students who achieved Level 2 answered this many Number questions correctly.

Table 13. Percentage of Grade 6 students who achieved each benchmark score, by achievement level, 2021–2022

Curriculum strand	Benchmark percent correct	Achievement level				
		Below Level 1	Level 1	Level 2	Level 3	Level 4
Number	66	0%	0%	12%	80%	100%
Algebra	63	<1%	<1%	16%	80%	>99%
Data	51	2%	5%	26%	80%	>99%
Spatial Sense	50	4%	7%	29%	80%	>99%
Financial Literacy (English)	72	5%	17%	53%	80%	93%
Financial Literacy (French)	52	5%	29%	56%	80%	93%

Grade 9

At Grade 9, the analysis found, as in Grade 3 and Grade 6, that when the benchmark score was set at the percent correct achieved by 80% of students who achieved Level 3 (i.e., a clear majority), a clear difference in achievement emerged between students who achieved Level 2 and students who achieved Level 3. However, compared to Grade 3 and Grade 6, there were different patterns among curriculum strands in the percentages of students who achieved Level 2 and reached the benchmark score. Specifically, by Grade 9, Algebra became the strand with the largest gap, followed by Geometry and Measurement (previously Spatial Sense in Grade 3 and Grade 6). The results are described in Table 14.

At Grade 9, 80% of students in English-language boards who achieved Level 3 answered 70% or more of Financial Literacy questions correctly, while 41% of students who achieved Level 2 answered this many Financial Literacy questions correctly. This smaller gap was similar to that in Grade 6 Financial Literacy. Similarly, 80% of students in French-language boards who achieved Level 3 answered 62% or more of Financial Literacy questions correctly, while 41% of students who achieved Level 2 answered this many Financial Literacy questions correctly. However, note that the benchmark percent correct for Financial Literacy at Grade 9 was somewhat lower for students in French-language boards than for students in English-language boards (62 versus 70).

Unlike at Grade 6, a similar overlap was also observed for Data at Grade 9. Specifically, 80% of students who achieved Level 3 answered 54% or more of Data correctly, and 39% of students who achieved Level 2 answered this many questions correctly. This was very different from the Grade 6 Data strand outcomes, where the percentage of students who reached the benchmark score was much higher among students who achieved Level 3 than among students who achieved Level 2 (80% and 26% respectively).

Regarding other curriculum strands at Grade 9, 80% of students who achieved Level 3 answered 61% or more of Number questions correctly compared to the 24% of students who achieved Level 2 and achieved this benchmark score. For Geometry and Measurement, 80% of students who achieved Level 3 answered 52% or more of the questions correctly compared to the 17% of students who achieved Level 2 and achieved this benchmark score. Finally, the largest gap was for Algebra, where 80% of students who achieved Level 3 answered 51% or more of the questions correctly compared to the only 9% of students who achieved Level 2 and achieved this benchmark score.

Table 14. Percentage of Grade 9 students who achieved each benchmark score, by achievement level, 2021–2022

Curriculum strand	Benchmark percent correct	Achievement level				
		Below Level 1	Level 1	Level 2	Level 3	Level 4
Number	61	NEI	3%	24%	80%	>99%
Algebra	51	NEI	<1%	9%	80%	100%
Data	54	NEI	10%	39%	80%	>99%
Geometry and Measurement	52	NEI	2%	17%	80%	>99%
Financial Literacy (English)	70	NEI	7%	41%	80%	99%
Financial Literacy (French)	62	NEI	11%	41%	80%	99%

Achievement profiles

A third goal of the study was to understand whether there were patterns in achievement profiles. For example, did students who achieved the benchmark score in Spatial Sense/Geometry and Measurement also typically achieve the benchmark scores for other curriculum strands? How many benchmark scores needed to be met in order for students to have a good chance of achieving Level 3?

Grade 3

An analysis of Grade 3 students' achievement profiles showed that students who achieved Level 3 were very likely to achieve three or four of the benchmark scores, while students who achieved Level 2 were very unlikely to achieve three or four benchmark scores (see Table 15). For example, 33% of students who achieved Level 3 also achieved three benchmark scores, and 45% of students who achieved Level 3 achieved all four benchmark scores. Meanwhile, only 4% of students who achieved Level 3 did not achieve any curriculum strand benchmark scores or achieved only one.

In contrast, only 2% of students who achieved Level 2 also achieved three or four curriculum strand benchmark scores. Meanwhile, 81% of students who achieved Level 2 did not achieve any curriculum strand benchmark scores or achieved only one.

Table 15. Percentage of Grade 3 students who achieved each number of benchmark scores, by achievement level, 2021–2022

Number of curriculum strand benchmark scores achieved	Achievement level				
	Below Level 1	Level 1	Level 2	Level 3	Level 4
No strands	98%	91%	40%	<1%	
1 strand	2%	9%	41%	4%	
2 strands		<1%	18%	18%	
3 strands			2%	33%	1%
4 strands			<1%	45%	99%

Grade 6

An analysis of Grade 6 students' achievement profiles showed that when only the first four curriculum strands were considered (comparable to Grade 3: Number, Algebra, Data and Spatial Sense), students who achieved Level 3 were very likely to achieve three or four of the benchmark scores, while students who achieved Level 2 were very unlikely to achieve three or four benchmark scores (see Table 16). For example, 35% of students who achieved Level 3 also achieved three benchmark scores, and 44% of students who achieved Level 3 achieved all four benchmark scores. Meanwhile, only 3% of students who achieved Level 3 did not achieve any curriculum strand benchmark scores or achieved only one.

In contrast, only 3% of students who achieved Level 2 also achieved three or four curriculum strand benchmark scores. Meanwhile, 79% of students who achieved Level 2 did not achieve any curriculum strand benchmark scores or achieved only one.

Table 16. Percentage of Grade 6 students who achieved each number of benchmark scores, by achievement level, 2021–2022, excluding Financial Literacy (comparable with Grade 3)

Number of curriculum strand benchmark scores achieved	Achievement level				
	Below Level 1	Level 1	Level 2	Level 3	Level 4
No strands	93%	88%	41%	<1%	
1 strand	7%	12%	38%	3%	
2 strands		<1%	18%	18%	
3 strands			3%	35%	1%
4 strands			<1%	44%	99%

However, when Financial Literacy was included as the fifth curriculum strand (making results comparable to Grade 9), the distinction became less clearly defined due to the weak relationship between high Financial Literacy achievement and Level 3 or Level 4 achievement (see Table 17). The difference was in the number of students who achieved Level 2 and did not achieve any curriculum strand benchmark scores or achieved only one. While this percentage was 79% when only the first four curriculum strands were considered, when Financial Literacy was included, this percentage decreased to only 59%. That is, 20% of students at Level 2 achieved the benchmark score for only Financial Literacy or only Financial Literacy and one other curriculum strand.

Table 17. Percentage of Grade 6 students who achieved each number of benchmark scores, by achievement level, 2021–2022: all five strands (comparable with Grade 9)

Number of curriculum strand benchmark scores achieved	Achievement level				
	Below Level 1	Level 1	Level 2	Level 3	Level 4
No strands	88%	73%	22%	<1%	
1 strand	11%	25%	37%	<1%	
2 strands	<1%	2%	28%	6%	
3 strands		<1%	12%	22%	<1%
4 strands			1%	36%	8%
5 strands			<1%	36%	92%

Grade 9

An analysis of Grade 9 students' achievement profiles showed strikingly similar trends to those for Grade 6.

When only the first four curriculum strands were considered (comparable to Grade 3 and Grade 6: Number, Algebra, Data and Spatial Sense), students who achieved Level 3 were very likely to achieve three or four of the benchmark scores, while students who achieved Level 2 were very unlikely to achieve three or four benchmark scores (see Table 18). For example, 32% of students who achieved Level 3 also achieved three benchmark scores, and 46% of students who achieved Level 3 achieved all four benchmark scores. Meanwhile, only 4% of students who achieved Level 3 did not achieve any curriculum strand benchmark scores or achieved only one.

In contrast, only 3% of students who achieved Level 2 also achieved three or four curriculum strand benchmark scores. Meanwhile, 78% of students who achieved Level 2 did not achieve any curriculum strand benchmark scores or achieved only one.

Table 18. Percentage of Grade 9 students who achieved each number of benchmark scores, by achievement level, 2021–2022: excluding Financial Literacy (comparable with Grade 3 and Grade 6)

Number of curriculum strand benchmark scores achieved	Achievement level				
	Below Level 1	Level 1	Level 2	Level 3	Level 4
No strands	NEI	85%	35%	<1%	
1 strand	NEI	14%	43%	4%	
2 strands	NEI	<1%	19%	17%	
3 strands	NEI	<1%	3%	32%	<1%
4 strands	NEI		<1%	46%	>99%

As for Grade 6, when Financial Literacy was included as a fifth curriculum strand, the distinction became less clearly defined, due to the weak relationship between high Financial Literacy achievement and Level 3 or Level 4 achievement (see Table 19). The difference was again among the number of students who achieved Level 2 and did not achieve any curriculum strand benchmark scores or achieved only one. While this percentage was 78% when only the first four curriculum strands were considered, when Financial Literacy was included this percentage decreased to only 60%. That is, 18% of students at Level 2 achieved the benchmark score for only Financial Literacy or only Financial Literacy and one other curriculum strand.

Table 19. Percentage of Grade 9 students who achieved each number of benchmark scores, by achievement level, 2021–2022: five strands (not comparable with Grade 3, but comparable with Grade 6)

Number of curriculum strand benchmark scores achieved	Achievement level				
	Below Level 1	Level 1	Level 2	Level 3	Level 4
No strands	NEI	78%	21%	<1%	
1 strand	NEI	20%	39%	1%	
2 strands	NEI	1%	29%	8%	
3 strands	NEI	<1%	10%	21%	
4 strands	NEI		1%	31%	1%
5 strands	NEI		<1%	40%	99%

DISCUSSION

Connectedness of curriculum strands

The analysis findings for achievement patterns and achievement profiles clearly show that at Grades 3, 6 and 9, as achievement increases, achievement in all curriculum strands rises at approximately the same rate. Therefore, the conclusion is that achievement among the mathematics curriculum strands is highly connected, and improving math achievement requires attention to all curriculum strands. The instructional approach of spiralling is one that increases math achievement through attention to all curriculum strands (Ontario Ministry of Education, 2020).

A benchmark result

The following is a summary of the study findings regarding the definition of a benchmark result:

To have a good chance of achieving a Level 3 in math in Grade 3 (in 2021–2022), students needed three out of four of the scores below:

- At least 67% in Number
- At least 58% in Algebra
- At least 61% in Data
- At least 52% in Spatial Sense

For Grade 6 math, students needed three out of four of the scores below, plus 70% in Financial Literacy:

- At least 66% in Number
- At least 63% in Algebra
- At least 51% in Data
- At least 50% in Spatial Sense

Finally, for Grade 9 math, students needed three out of four of the scores below, plus 69% in Financial Literacy:

- At least 61% in Number
- At least 51% in Algebra
- At least 54% in Data
- At least 52% in Geometry and Measurement

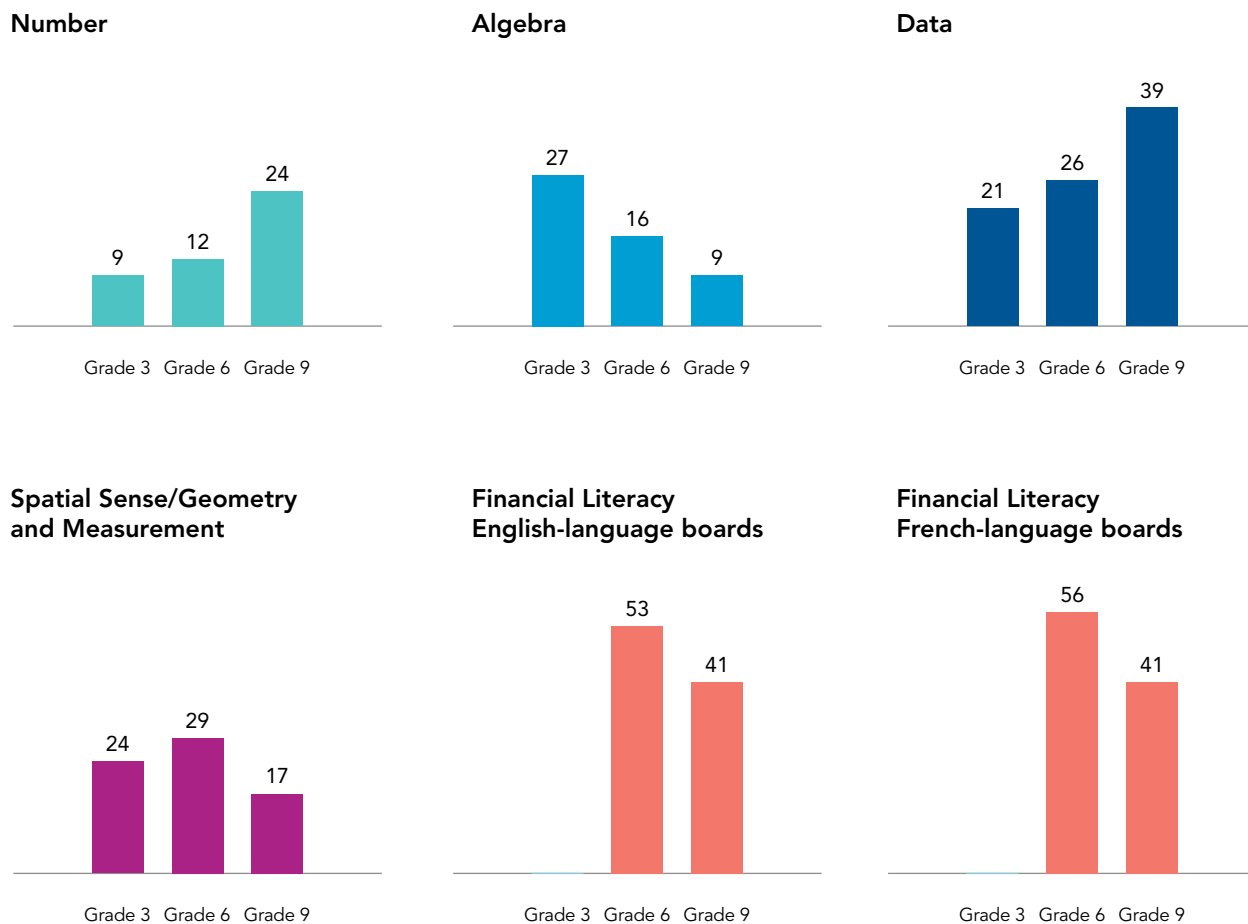
It is worth emphasizing that student achievement across the curriculum strands was reasonably similar for a given EQAO level. However, the analysis results above achieve the goal of defining a 2021–2022 benchmark result in terms of percentage of questions correct.

Differences in achievement of benchmark scores, by EQAO level achieved

The analyses demonstrated that there were clear differences in the percentage of students who achieved Level 2 and also reached benchmark scores and students who achieved Level 3. It appears that a smaller overlap between the two groups for a curriculum strand—that is, a lower percentage of students who achieved Level 2 who also met the benchmark score for that strand—means the strand contributes more strongly to meeting the overall curriculum expectations. This phenomenon is likely related to the number of questions devoted to a given curriculum strand, reflecting its importance in meeting curriculum expectations.

Figure 4 shows, for each grade and curriculum strand, the percentage of students who achieved Level 2 who also achieved each curriculum strand benchmark score. Recall that among students who achieved Level 3, 80% of students achieved each benchmark score.

Figure 4. Percentage of students who achieved Level 2 who achieved each curriculum strand benchmark score, by grade, 2021–2022



Foundational role of Number

Due to the differences in achievement of benchmark scores, the study yielded the observation that Number plays a foundational role in achievement at Grade 3. This conclusion was made because most Grade 3 students who achieved Level 3 (80%) achieved the benchmark score in Number, while very few students who achieved Level 2 (only 9%) achieved the Grade 3 benchmark score for Number. This contrast was not as starkly observed for Algebra, Data or Spatial Sense, where 21% to 27% of students who achieved Level 2 achieved the benchmark score for these curriculum strands, compared to the 80% of students who achieved Level 3. It is also worth highlighting that 35% of questions on the Grade 3 assessment are Number compared to 20–25% for the other curriculum strands, which likely increased the clarity with which students achieving Level 2 and Level 3 were identified for that strand. Thus, it is clear that Number plays a foundational role in achievement at Grade 3.

Moreover, the importance of Number in determining the ability of students to meet grade-level expectations appears to decrease through Grade 6 and Grade 9. For example, in Grade 3, only 9% of students who achieved Level 2 met the benchmark score that 80% of students who achieved Level 3 met. By Grade 6, 12% of students who achieved Level 2 met the benchmark score that 80% of students who achieved Level 3 met. And by Grade 9, 24% of students who achieved Level 2 met the benchmark score that 80% of students who achieved Level 3 met. Again, these changes are likely related to the number of Number strand questions on the assessments, which range from 35% of all questions in Grade 3, to 32% in Grade 6, down to 20% in Grade 9.

Furthermore, as will be shown, a low percentage of Level 2 students meeting the benchmark score indicates that meeting grade-level expectations in Number remains important for being able to develop grade-appropriate math ability across curriculum strands. However, the Number strand was increasingly less difficult for students who achieved Level 2 to keep up with as the curriculum progressed from Grade 3 to Grade 6 to Grade 9. This is a reflection of a decrease in the proportion of the curriculum given to Number, as the time given to Algebra increases, as discussed below.

Critical role of Algebra

From Grade 3 to Grade 6 to Grade 9, achievement in Algebra becomes increasingly critical to meeting grade-level expectations. For example, 27% of Grade 3 students who achieved Level 2 were able to meet the same benchmark score in Algebra that 80% of students who achieved Level 3 met. In Grade 6, 16% of students who achieved Level 2 were able to meet the same benchmark score that 80% of students who achieved Level 3 met. By Grade 9, only 9% of students who achieved Level 2 were able to meet the same benchmark score that 80% of students who achieved Level 3 met.

Once again, there is a relationship between the percentage of students achieving Level 2 who also met the benchmark score and the percentage of the assessment, and thus the curriculum, given to the Algebra strand. In Grade 3 and Grade 6, 20% of questions are about the Algebra strand, compared to the 36% of questions in Grade 9.

This finding likely represents the increasingly critical role of developing abilities in Algebra as students progress in math studies, the increasing amount of the curriculum that involves the Algebra strand, and the increasing probability that students who do not grasp key Algebra concepts will be unable to progress at grade level.

Shifts in Data and Spatial Sense/Geometry and Measurement curriculum expectations

The Data and Spatial Sense/Geometry and Measurement curriculum strands exhibited more moderate and varying changes across grades among students who achieved Level 2. These changes appear to reflect changes in which aspects of Data and Spatial Sense/Geometry and Measurement abilities are emphasized at different grade levels.

For example, in Grade 3, 21% of students who achieved Level 2 met the Data benchmark score that 80% of students who achieved Level 3 met. In Grade 6, 26% of students who achieved Level 2 met the Data benchmark score that 80% of students who achieved Level 3 met. By Grade 9, 39% of students who achieved Level 2 met the Data benchmark score that 80% of students who achieved Level 3 met. The overlap at Grade 9 is a large overlap and indicates that Data curriculum expectations at Grade 9 are often concepts that can be grasped by students who are not demonstrating mastery of the overall Grade 9 math curriculum expectations.

However, the overlaps at Grades 3 and 6 are moderate overlaps and indicate that Data curriculum expectations are more challenging to meet if students have not mastered Grade 3 or Grade 6 curriculum expectations in general. This finding is particularly notable given that the number of assessment questions on the Data strand is similar across grades: 20% in Grade 3, 18% in Grade 6 and 16% in Grade 9.

In contrast, the Spatial Sense/Geometry and Measurement curriculum strand exhibited a different pattern than any other curriculum strand. For example, 24% of Grade 3 students who achieved Level 2 were able to meet the benchmark score that 80% of Grade 3 students who achieved Level 3 met. At Grade 6, 29% of students who achieved Level 2 were able to meet the benchmark score that 80% of students who achieved Level 3 met. However, by Grade 9, only 17% of students who achieved Level 2 were able to meet the benchmark score that 80% of students who achieved Level 3 met. Again, these findings are particularly notable given that the number of assessment questions on the Spatial Sense/Geometry and Measurement strand decreases across grades: 25% in Grade 3, 20% in Grade 6 and 16% in Grade 9.

This finding indicates that Grade 6 curriculum expectations for Spatial Sense may have progressed relatively slowly from Grade 3, so that nearly a third of Grade 6 students were able to meet the benchmark score that 80% of students who achieved Level 3 met. However, mastering Grade 9 curriculum expectations for Geometry and Measurement appear important to being able to demonstrate curriculum expectations in general for Grade 9 math. This may be because Geometry and Measurement at Grade 9 utilizes algebraic abilities, which would again demonstrate that mastery of algebraic concepts is critical to the growth of students' math ability.

Financial Literacy

The Financial Literacy curriculum strand appears to function differently from the other curriculum strands. At Grade 3, the single Financial Literacy curriculum expectation is included in Number. At both Grade 6 and Grade 9, where it is assessed as its own curriculum strand, there was a high overlap for meeting the benchmark score between students achieving Level 3 and those achieving Level 2. For example, at Grade 6, 52% of students in English-language boards who achieved Level 2 were able to meet the benchmark score that 80% of Grade 3 students who achieved Level 3 met. At Grade 9, 41% of students in English-language boards who achieved Level 2 were able to meet the benchmark score that 80% of Grade 3 students who achieved Level 3 met.

Reasons for the overlaps can be observed in the curricula. At Grade 6 and Grade 9, curriculum expectations for Financial Literacy are less focused on numeracy and challenging concepts such as algebraic or abstract thinking. Curriculum expectations for Financial Literacy focus on logical thinking, knowledge of daily financial tasks and deductive reasoning. These skills are important in daily life, and it is good news that they appear to be mastered at grade level by many students who are still working on mastering key math abilities such as numeracy, algebraic thinking and abstract mathematical concepts at grade level. The overlap is also likely related to the small number of questions given to Financial Literacy on the assessments (9% of total questions at Grade 6 and 12% of total questions at Grade 9).

In addition, the benchmark score for Financial Literacy for Grade 6 students in English-language boards is 72% correct compared to the 52% correct for students in French-language boards. Similarly, the benchmark score for Financial Literacy for Grade 9 students in English-language boards is 70% correct compared to the 62% correct for students in French-language boards.

It is proposed that this difference indicates a language-specific difference in performance. For example, the language required to meet curriculum expectations may be less commonly encountered in French than in English.

CONCLUSION

This study explored students' performance in Grade 3, Grade 6 and Grade 9 EQAO mathematics assessment components. The study found that achievement among the mathematics curriculum strands is highly connected, and improving math achievement requires attention to all curriculum strands. The analyses also demonstrated that there were clear differences between the percentage of students who achieved Level 2 and also reached benchmark scores and that of students who achieved Level 3. It appears that a lower percentage of students who achieved Level 2 who also met the benchmark score for that strand means the strand contributes more strongly to meeting the overall curriculum expectations.

Key strands at different grade levels:

- At Grade 3 Number is critical, although it remains foundational across grades.
- At Grade 6 both Number and Algebra are key to success.
- At Grade 9 Algebra is critical for success, and Geometry and Measurement (which includes much algebraic thinking) is also key.

REFERENCES

Ontario Ministry of Education. (2020). *High-Impact Instructional Practices in Mathematics: Resource and Supports*. Website accessible at <https://www.dcp.edu.gov.on.ca/resources/en/subjects/mathematics/high-impact-instructional-practices-in-mathematics-resource-and-supports>