TRENDS IN INTERNATIONAL MATHEMATICS AND SCIENCE STUDY

Results for Québec Students on the 2011 Mathematics and Science Assessments

TIMSS – 2011

Québec

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Table of Contents

1 Background and goals of the study 1
2 Summary of results 3
3 Mathematics achievement results 6
3.1 Average scale scores of Québec students and trends 6
3.1.1 Elementary 4 mathematics 6
3.1.2 Secondary II mathematics 9
3.2 Achievement by gender 12
3.2.1 Achievement by gender for Elementary 4 mathematics 12
3.2.2 Achievement by gender for Secondary II mathematics 14
3.3 Results at the international benchmarks 16
3.3.1 Trends in percentages of Québec Elementary 4 students who reached or surpassed the international benchmarks of mathematics achievement 17
3.3.2 Trends in percentages of Québec Secondary II students who reached or surpassed the international benchmarks of mathematics achievement 17
3.4 Content domains and cognitive domains 18
3.4.1 Average achievement of Elementary 4 students, by domain 18
3.4.2 Average achievement of Secondary II students, by domain 20
3.5 Achievement by language of instruction 21
4 Science achievement results 22
4.1 Average scale scores of Québec students and trends 22
4.1.1 Elementary 4 science 22
4.1.2 Secondary II science 24
4.2 Achievement by gender 27
4.2.1 Achievement by gender for Elementary 4 science 27
4.2.2 Achievement by gender for Secondary II science 29
4.3 Results at the international benchmarks 31
4.3.1 Trends in percentages of Québec Elementary 4 students who reached or surpassed the international benchmarks of science achievement 32
4.3.2 Trends in percentages of Québec Secondary II students who reached or surpassed the international benchmarks of science achievement 32
4.4 Content domains and cognitive domains 33
4.4.1 Average achievement of Elementary 4 students, by domain 33
4.4.2 Average achievement of Secondary II students, by domain 35
4.5 Achievement by language of instruction 37
5 Behaviours and attitudes: responses to contextual questionnaires 38
5.1 Mathematics 38
5.1.1 School composition by student socioeconomic background 38
5.1.2 Home support for learning 39
5.1.3 Students' attitudes and behaviours with regard to mathematics 41
5.1.4 Mathematics teachers 43
5.1.5 School climate 48
5.2 Science 52
5.2.1 School composition by student socioeconomic background 52
5.2.2 Home support for learning 52
5.2.3 Students' attitudes and behaviours with regard to science 54
5.2.4 Science teachers 57
5.2.5 School climate 61
Conclusion 65

List of Tables

Table 2.1 Trends in achievement and Québec's ranking in TIMSS studies since 1995 5

Table 3.1 Average scale scores in Elementary 4 mathematics, by country 7

Table 3.2 Average scale scores in Elementary 4 mathematics, by benchmarking participant 8

Table 3.3 Average scale scores in Secondary II mathematics, by country 10

Table 3.4 Average scale scores in Secondary II mathematics, by benchmarking participant 11

Table 3.5 Elementary 4 mathematics achievement, by gender and country 13

Table 3.6 Secondary II mathematics achievement, by gender and country 15

Table 3.7 Percentage of Québec students who reached or surpassed the international benchmarks in mathematics 16

Table 3.8 Trends in percentages of Québec Elementary 4 students who reached or surpassed the international benchmarks of mathematics achievement 17

Table 3.9 Trends in the percentages of Québec Secondary II students who reached or surpassed the international benchmarks of mathematics achievement 17

Table 3.10 Average achievement of Elementary 4 students in the mathematics content and cognitive domains, by gender 19

Table 3.11 Trends in the average achievement of Elementary 4 students in the mathematics content and cognitive domains 19

Table 3.12 Average achievement of Secondary II students in the mathematics content and cognitive domains, by gender 20

Table 3.13 Trends in the average achievement of Secondary II students in the mathematics content and cognitive domains 21

Table 3.14 Achievement in mathematics by language of instruction. 21

Table 4.1 Average scale scores in Elementary 4 science, by country 23

Table 4.2 Average scale scores in Elementary 4 science, by benchmarking participant 24

Table 4.3 Average scale scores in Secondary II science, by country 25

Table 4.4 Average scale scores in Secondary II science, by benchmarking participant 26

Table 4.5 Elementary 4 science achievement, by gender and country 28

Table 4.6 Secondary II science achievement, by gender and by country 30

Table 4.7 Percentage of Québec students who reached or surpassed the international benchmarks in science 31

Table 4.8 Trends in percentages of Québec Elementary 4 students who reached or surpassed the international benchmarks of science achievement 32

Table 4.9 Trends in the percentages of Québec Secondary II students who reached or surpassed the international benchmarks in science 33

Table 4.10 Average achievement of Elementary 4 students in the science content and cognitive domains, by gender 34

Table 4.11 Trends in the achievement of Elementary 4 students in the science content and cognitive domains 35

Table 4.12 Average achievement of Secondary II students in the science content and cognitive domains, by gender 36

Table 4.13 Trends in the achievement of Secondary II students in the science content and cognitive domains 36

Table 4.14 Achievement in science by language of instruction. 37

Table 5.1 Elementary school composition by student economic background and average achievement in mathematics (reported by school principals) 38

Table 5.2 Average scale score of Québec Elementary 4 students, by language spoken at home before starting school (reported by students' parents) 39

Table 5.3 Average scale score of Québec Secondary II students, by frequency of use of the test language at home (reported by Secondary II students) 39
Table 5.4 Home resources available for learning (reported by parents of Elementary 4 students and by Secondary II students) 40
Table 5.5 Average scale scores in mathematics in Québec, by parental participation in numeracy-related activities 41
Table 5.6 Average achievement in mathematics in Québec, by attitude to learning mathematics 42
Table 5.7 Average achievement in mathematics in Québec, by student confidence in mathematics 43
Table 5.8 Average achievement in mathematics in Québec, by student engagement in mathematics lessons 43
Table 5.9 Percentage of teachers participating in areas of professional development in mathematics 44
Table 5.10 Working Conditions and Career Satisfaction scales for Québec teachers 45
Table 5.11 Characteristics of students who limit instruction in mathematics in Québec (reported by teachers) 46
Table 5.12 Percentage of students whose teachers use certain resources for basic instruction (reported by teachers) 47
Table 5.13 Instructional approaches in mathematics class (reported by teachers) 48
Table 5.14 Distribution of students on the School Emphasis on Academic Success scale (reported by principals) 49
Table 5.15 Distribution of students on the School Emphasis on Academic Success scale (reported by teachers) 49
Table 5.16 Distribution of students on the Safe and Orderly School scale (reported by teachers) 50
Table 5.17 Distribution of students on the School Discipline and Safety scale (reported by school principals) 50
Table 5.18 Results for the Students Bullied at School scale (reported by students) 51
Table 5.19 Elementary school composition by student economic background (reported by school principals) 52
Table 5.20 Average scale score of Québec Elementary 4 students, by language spoken at home before starting school (reported by students' parents) 53
Table 5.21 Average scale score of Québec Secondary II students, by frequency of use of the test language at home (reported by Secondary II students) 53
Table 5.22 Home resources available for learning (reported by parents of Elementary 4 students and by Secondary II students) 54
Table 5.23 Average achievement in science in Québec, by attitude to learning science 55
Table 5.24 Average achievement in science in Québec, by student confidence in science 56
Table 5.25 Average achievement in science in Québec, by student engagement in science lessons 56
Table 5.26 Percentage of teachers participating in areas of professional development in science 57
Table 5.27 Working Conditions and Career Satisfaction scales for Québec teachers 58
Table 5.28 Instruction affected by science resource shortages in Québec (reported by school principals) 59
Table 5.29 Characteristics of students who limit instruction in science in Québec (reported by teachers) 60
Table 5.30 Percentage of students whose teachers use certain resources for basic instruction in science 60
Table 5.31 Students with teachers who emphasize scientific inquiry (reported by teachers) 61
Table 5.32 Distribution of students on the School Emphasis on Academic Success scale (reported by principals) 62
Table 5.33 Distribution of data on the School Emphasis on Academic Success scale (reported by teachers) 62

Table 5.34 Distribution of students on the Safe and Orderly School scale (reported by teachers) 63
Table 5.35 Distribution of students on the School Discipline and Safety scale (reported by school principals) 63
Table 5.36 Results for the Students Bullied at School scale (reported by students) 64

List of Figures

Figure 3.1 Trend in the average scale scores for Elementary 4 mathematics – Québec 8
Figure 3.2 Trend in the average scale score for Secondary II mathematics – Québec 11
Figure 3.3 Trends in Elementary 4 mathematics achievement, by gender 12
Figure 3.4 Trends in Secondary II mathematics achievement, by gender 14
Figure 3.5 Percentages attributed to each item in the content domains and the cognitive domains in TIMSS 2011 mathematics 18
Figure 4.1 Trend in the average scale scores for Elementary 4 science – Québec 22
Figure 4.2 Trend in the average scale score for Secondary II science – Québec 26
Figure 4.3 Trends in Elementary 4 science achievement, by gender 29
Figure 4.4 Trends in Secondary II science achievement, by gender 31
Figure 4.5 Percentages attributed to each item in the content domains and the cognitive domains in TIMSS 2011 science 33

Trends in International Mathematics and Science Study (TIMSS) 2011

1 Background and goals of the study

Mathematics and science have roles to play in almost every aspect of life and society. Students develop their knowledge and competencies in these domains in order to understand quantitative and technical information and take part in public debates on scientific issues. Mathematics and science also lead to a huge variety of careers.

Like its predecessors, the sixth Trends in International Mathematics and Science Study (TIMSS 2011) was conducted by the International Association for the Evaluation of Educational Achievement (IEA), an independent cooperative of research institutions and government agencies. More than 60 countries are now members.

TIMSS was designed to assess the mathematics and science knowledge of students aged 10 (Elementary 4) and 14 (Secondary II), to compare the performances of participating countries and school jurisdictions and to provide information on school curricula and instructional methods. The 2011 study also gives countries that participated in previous studies the opportunity to track changes that may have occurred during the intervals between the studies, thus bringing to light a wide range of factors that could affect achievement levels in mathematics and science and offering the opportunity to reflect on how they could be improved.

As in 2007, Québec ensured that it had a large enough random sample[1] to allow its results as a benchmarking participant to appear separately in the international report.

Elementary 4

Fifty-two countries and seven benchmarking participants, including Québec, took part in the 2011 study involving Elementary 4 students. Canada did not participate in the study but two other Canadian provinces, Alberta and Ontario, did. The report therefore presents the results of 59 countries and school jurisdictions, 16 more than the previous report.

Québec's sample of Elementary 4 students was composed of students from 190 public and private schools in both the French and English sectors (4235 students). The students all wrote a mathematics assessment and a science assessment, each lasting 36 minutes. They then answered a brief questionnaire on their attitudes toward these two school subjects. Teachers and school principals also filled out a questionnaire and specialists provided information about the mathematics and science curricula.

1 For more information on sampling, please consult the Web site of the Trends in International Mathematics and Science Study (TIMSS) and Progress in International Reading Literacy Study (PIRLS) at **http://timssandpirls.bc.edu/pirls2011/index.html**.

Secondary II

Forty-five countries and fourteen benchmarking participants, including Québec, took part in the 2011 study. Canada did not participate but two other Canadian provinces, Alberta and Ontario, did. The report therefore presents the results of 59 countries and school jurisdictions.

Québec's sample of Secondary II students was composed of students from 189 public and private schools in both the French and English sectors (6149 students). The students all wrote a mathematics assessment and a science assessment, each lasting 45 minutes. They then answered a brief questionnaire on their attitudes toward these two school subjects. Teachers and school principals also filled out a questionnaire and specialists provided information about the mathematics and science curricula.

This report presents the results achieved by Québec students, compares their performance with that of other international and Canadian participants, and highlights any changes observed since the other assessments in which Québec participated. The data are extracted from the international report entitled *TIMSS 2011 Trends in International Mathematics and Science Study at the Fourth and the Eighth Grades*, available on the Boston College Web site at **http://timss.bc.edu/**.

2 Summary of results

The TIMSS 2011 assessments written by Elementary 4 and Secondary II students comprised a series of written questions in mathematics and science. The contextual framework of the assessment and design of the test are available at **http://timssandpirls.bc.edu/timss2011/frameworks.html**.

The TIMSS 2011 average scores in reading are reported on the TIMSS scale, which has a range of 0 to 1000, with a standard deviation of 100. The mean of 500 was set in 1995 and remains constant from one assessment to another.

As the assessments were completed by a sample of students in each participating country or jurisdiction, each result reported contains a sampling error that must be taken into consideration when making comparisons. A difference in average scores is statistically different when there is no overlap of confidence intervals between the measurements being compared. Appendix 1 provides definitions of the terminology used (standard error and confidence interval). Achievement is also expressed as the percentage of students reaching the four international benchmarks, defined in Appendix 2.

Elementary 4 results

Québec's relative overall ranking improved owing to significantly better results in mathematics and the addition of 16 countries and school jurisdictions since 2007.

In mathematics

- The average scale score obtained by Québec students in 2011 (533 points) is significantly better than that of 2007 (519 points), but remains below that of 1995 (550 points).
- Fourteen countries and benchmarking participants obtained a significantly higher result than Québec. The average score of Québec students (533 points) is markedly higher than that of students in Ontario (518 points) and Alberta (507 points).
- Boys significantly outperformed girls and the gender gap has been widening steadily since 1995.

In science

- The average scale score obtained by Québec students was 516 points, equivalent to that of 2007 (517 points), but below that of 1995 (529 points).
- Twenty-one countries and benchmarking participants obtained a significantly higher result than that of Québec. Considering that the six new participants in the study ranked higher than Québec, the province's relative ranking remained virtually the same as its ranking in 2007.
- The average result achieved by students in Québec (516 points) is markedly below that obtained by students in Ontario (528 points) and Alberta (541 points).
- In 2011, Québec boys obtained a statistically higher score than girls (520/512). The boys' results improved during the 2007 to 2011 period, while those of girls dropped.

Secondary II results

Québec's relative overall ranking improved owing to better results in science and the addition of three countries and school jurisdictions since 2007.

In mathematics

- The average scale score obtained by Québec students (532 points) is not significantly higher, but did show a slight improvement of 3 points in comparison with the average result in the last study.
- Only seven countries and benchmarking participants, the same ones as in 2007, scored significantly higher than Québec. The average result obtained by students in Québec (532 points) is significantly higher than that obtained by students in Ontario (512 points) and Alberta (505 points).

In science

- The average scale score obtained by Québec students in 2011 (520 points) is significantly higher than that obtained in 2007 (507 points).
- Fifteen countries and benchmarking participants had an average score that was significantly higher than that of Québec. The average result obtained by students in Québec is statistically equivalent to that obtained by students in Ontario (521 points) and significantly lower than that obtained by students in Alberta (546 points).

Table 2.1 Trends in achievement and Québec's ranking in TIMSS studies since 1995

Year	Québec Results	Québec Results by gender		Rank among participating countries[a]
		Girls	Boys	
Elementary 4 mathematics				
1995	550	548	552	5 out of 27
1999	NA	NA	NA	NA
2003	506	**502**[b]	**509**	14 out of 26
2007	519	**515**	**524**	14 out of 37
2011	533	**527**	**538**	15 out of 52
Secondary II mathematics				
1995	556	560	553	5 out of 41
1999	566	566	565	6 out of 39
2003	543	**540**	**546**	6 out of 46
2007	528	527	529	6 out of 50
2011	532	531	532	6 out of 45
Elementary 4 science				
1995	529	524	532	8 out of 27
1999	NA	NA	NA	NA
2003	500	501	500	17 out of 26
2007	517	516	518	19 out of 36
2011	516	**512**	**520**	21 out of 52
Secondary II science				
1995	510	506	514	14 out of 41
1999	540	537	543	8 out of 39
2003	531	**522**	**540**	9 out of 46
2007	507	503	511	15 out of 50
2011	520	518	522	12 out of 45

a. Does not take benchmarking participants into account.
b. Results in bold type are statistically different.

3 Mathematics achievement results

3.1 Average scale scores of Québec students and trends

3.1.1 Elementary 4 mathematics

Québec's average scale score was 533 points. Fourteen countries and school jurisdictions obtained results that were significantly higher than those of Québec.

Tables 3.1 and 3.2 present the average scale scores of the countries and benchmarking participants, grouping them into three categories: participants with an average scale score significantly higher than Québec, participants with an average scale score not significantly different than that of Québec, and participants whose average scale scores were significantly lower than that of Québec.

Québec has been participating in TIMSS studies since 1995. The average score in mathematics for Québec's Elementary 4 students in 2011 is significantly higher than that of 2007 but remains below the 1995 score. Figure 1 illustrates the evolution of the results since 1995.

Between 2007 and 2011, two countries slipped below Québec in the rankings but none of the 2007 participating countries rose above Québec.

Table 3.1 Average scale scores in Elementary 4 mathematics, by country[2]

Country	Average score		
Singapore	606	(3.2)	
Korea, Republic of	605	(1.9)	
Hong Kong SAR	602	(3.4)	
Chinese Taipei	591	(2.0)	
Japan	585	(1.7)	***Statistically higher than Québec***
Northern Ireland	562	(2.9)	
Belgium (Flemish)	549	(1.9)	
Finland	545	(2.3)	
England	542	(3.5)	
Russian Federation	542	(3.7)	
United States	541	(1.8)	
Netherlands	540	(1.7)	
Denmark	537	(2.6)	
Lithuania	534	(2.4)	
Canada, Québec	***533***	***(2.4)***	***Statistically equivalent to Québec***
Portugal	532	(3.4)	
Germany	528	(2.2)	
Ireland	527	(2.6)	
Serbia	516	(3.0)	
Australia	516	(2.9)	
Hungary	515	(3.4)	
Slovenia	513	(2.2)	
Czech Republic	511	(2.4)	
Austria	508	(2.6)	
Italy	508	(2.6)	
Slovak Republic	507	(3.8)	
Sweden	504	(2.0)	
Kazakhstan	501	(4.5)	
TIMSS scale centrepoint	**500**		
Malta	496	(1.3)	
Norway	495	(2.8)	
Croatia	490	(1.9)	
New Zealand	486	(2.6)	
Spain	482	(2.9)	***Statistically lower than Québec***
Romania	482	(5.8)	
Poland	481	(2.2)	
Turkey	469	(4.7)	
Azerbaijan	463	(5.8)	
Chile	462	(2.3)	
Thailand	458	(4.8)	
Armenia	452	(3.5)	
Georgia	450	(3.7)	
Bahrain	436	(3.3)	
United Arab Emirates	434	(2.0)	
Iran, Islamic Republic of	431	(3.5)	
Qatar	413	(3.5)	
Saudi Arabia	410	(5.3)	
Oman	385	(2.9)	
Tunisia	359	(3.9)	
Kuwait	342	(3.4)	
Morocco	335	(4.0)	
Yemen	248	(6.0)	

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

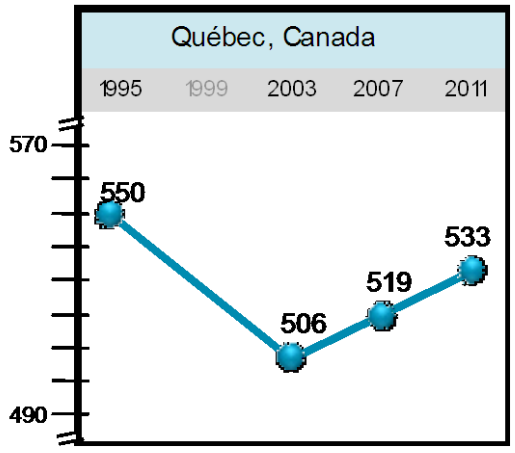
2 The three countries that assessed Elementary 6 students are not included in the table.

Table 3.2 Average scale scores in Elementary 4 mathematics, by benchmarking participant

Benchmarking participants	Average score		
North Carolina, United States	554	(4.2)	***Statistically higher***
Florida, United States	545	(2.9)	
Québec	**533**	**(2.4)**	
Ontario	518	(3.1)	
Alberta	507	(2.5)	***Statistically lower***
Dubai (UAE)	468	(1.6)	
Abu Dhabi (UAE)	417	(4.6)	

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Figure 3.1 Trend in the average scale scores for Elementary 4 mathematics – Québec



Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

3.1.2 Secondary II mathematics

Québec's average scale score was 532 points. Only five countries and one benchmarking participant obtained a score that was significantly higher than that of Québec. Tables 3.3 and 3.4 present the average scale scores of the countries and benchmarking participants, grouping the results into three categories: participants with an average score that is significantly higher than Québec, participants with an average result that is not significantly different than that of Québec and the participants whose scores were significantly lower than that of Québec.

Québec has been participating in TIMSS studies since 1995. The average scale score in mathematics for Québec's Secondary II students in 2011 is statistically equivalent to that of 2007, but remains below the 1999 score. Figure 3.2 illustrates changes in results since 1995.

The trends in the results of the TIMSS studies enabled 17 countries and 3 benchmarking participants to follow a cohort of students from 2007 to 2011. The performance of six countries (Hong Kong SAR, Singapore, Chinese Taipei, Japan, the Russian Federation and the United States) and two Canadian provinces (Ontario and Québec) was above the scale centrepoint in Elementary 4 in 2007 and Secondary II (Grade 8) in 2011. The cohorts of six participants maintained their positions above the scale centrepoint in 2011, while the cohorts of six countries fell below it.

Table 3.3 Average scale scores in Secondary II mathematics, by country[3]

Country	Average score		
Korea, Republic of	613	(2.9)	
Singapore	611	(3.8)	***Statistically***
Chinese Taipei	609	(3.2)	***higher than***
Hong Kong SAR	586	(3.8)	***Québec***
Japan	570	(2.6)	
Russian Federation	539	(3.6)	***Statistically***
Canada, Québec	***532***	***(2.3)***	***equivalent***
Israel	516	(4.1)	
Finland	514	(2.5)	
United States	509	(2.6)	
England	507	(5.5)	
Hungary	505	(3.5)	
Australia	505	(5.1)	
Slovenia	505	(2.2)	
Lithuania	502	(2.5)	
TIMSS scale centrepoint	**500**		
Italy	498	(2.4)	
New Zealand	488	(5.5)	
Kazakhstan	487	(4.0)	
Sweden	484	(1.9)	
Ukraine	479	(3.9)	
Norway	475	(2.4)	
Armenia	467	(2.7)	***Statistically***
Romania	458	(4.0)	***lower than***
United Arab Emirates	456	(2.1)	***Québec***
Turkey	452	(3.9)	
Lebanon	449	(3.7)	
Malaysia	440	(5.4)	
Georgia	431	(3.8)	
Thailand	427	(4.3)	
Macedonia, Republic of	426	(5.2)	
Tunisia	425	(2.8)	
Chile	416	(2.6)	
Iran, Islamic Republic of	415	(4.3)	
Qatar	410	(3.1)	
Bahrain	409	(2.0)	
Jordan	406	(3.7)	
Palestinian National Authority	404	(3.5)	
Saudi Arabia	394	(4.6)	
Indonesia	386	(4.3)	
Syrian Arab Republic	380	(4.5)	
Morocco	371	(2.0)	
Oman	366	(2.8)	
Ghana	331	(4.3)	

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

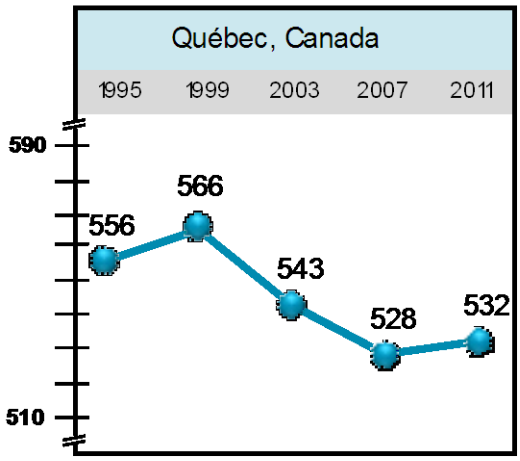
3 The three countries that assessed Secondary III students are not included in the table.

Table 3.4 Average scale scores in Secondary II mathematics, by benchmarking participant

Benchmarking participant	Average score		
Massachusetts (United States)	561	(5.3)	***Statistically higher***
Minnesota (United States)	545	(4.6)	
North Carolina (United States)	537	(6.8)	
Québec	**532**	**(2.3)**	***Statistically equivalent***
Indiana (United States)	522	(5.1)	
Colorado (United States)	518	(4.9)	
Connecticut (United States)	518	(4.8)	
Florida (United States)	513	(6.4)	
Ontario	512	(2.5)	***Statistically lower***
Alberta	505	(2.6)	
California (United States)	493	(4.9)	
Dubai (UAE)	478	(2.1)	
Alabama (United States)	466	(5.9)	
Abu Dhabi (UAE)	449	(3.7)	

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Figure 3.2 Trend in the average scale score for Secondary II mathematics – Québec



Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011

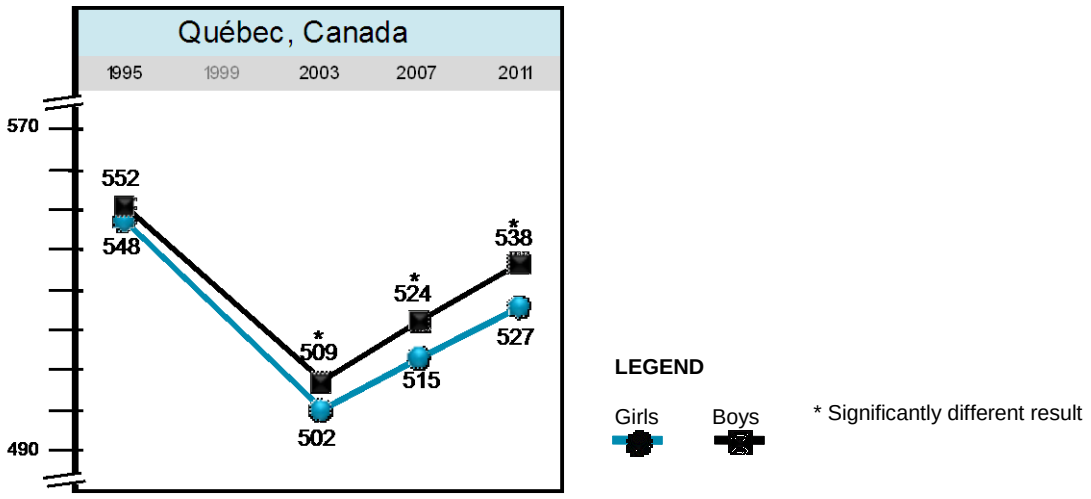
3.2 Achievement by gender

3.2.1 Achievement by gender for Elementary 4 mathematics

Table 3.5 presents the average scale scores obtained for Elementary 4 mathematics, by gender, in the participating countries. Québec boys, like those in Alberta and Ontario, obtained a statistically higher score than the girls (538 and 527 points). Internationally, the gender gap varies from 0 to 35 points depending on the country, with the average gap being 1 point in favour of the boys. Twenty-six participating countries have results that show no significant difference between the genders.

The last three TIMSS studies show that Québec boys are significantly more successful in mathematics than the girls. Although the performances of both genders follow the same trend, the gap has widened since 1995. Figure 3.3 illustrates the trend in the results obtained by boys and girls in Québec. Like Austria, the United States, Italy, the Czech Republic, the Netherlands and Slovenia, Québec has posted a gender gap in performance right from the first TIMSS studies.

Figure 3.3 Trends in Elementary 4 mathematics achievement, by gender



Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Table 3.5 Elementary 4 mathematics achievement, by gender and country

Country	Girls		Boys		Difference (absolute value)
	Percentage of students	Average score	Percentage of students	Average score	
Iran, Islamic Republic of	49 (2.9)	431 (5.2)	51 (2.9)	431 (5.4)	0 (8.0)
New Zealand	49 (0.8)	486 (3.3)	51 (0.8)	486 (2.8)	0 (3.1)
Northern Ireland	49 (1.3)	562 (3.3)	51 (1.3)	563 (3.6)	0 (3.8)
Russian Federation	49 (1.0)	543 (3.7)	51 (1.0)	542 (4.1)	1 (2.4)
Lithuania	48 (0.8)	533 (2.6)	52 (0.8)	534 (2.9)	1 (2.6)
Chinese Taipei	47 (0.6)	592 (2.5)	53 (0.6)	590 (2.4)	2 (2.8)
Turkey	48 (0.6)	470 (5.2)	52 (0.6)	469 (4.8)	2 (3.8)
Hungary	49 (1.0)	514 (3.6)	51 (1.0)	517 (3.9)	2 (3.2)
Romania	48 (0.9)	481 (6.7)	52 (0.9)	484 (5.9)	3 (4.5)
Japan	49 (0.5)	584 (2.0)	51 (0.5)	587 (2.5)	3 (3.0)
England	48 (1.0)	541 (4.2)	52 (1.0)	544 (3.5)	3 (3.4)
Ireland	49 (2.3)	526 (3.7)	51 (2.3)	529 (3.3)	3 (4.6)
Armenia	47 (0.8)	454 (4.1)	53 (0.8)	451 (3.6)	3 (3.0)
Singapore	49 (0.6)	608 (3.6)	51 (0.6)	604 (3.5)	4 (3.0)
Sweden	49 (1.0)	501 (2.5)	51 (1.0)	506 (2.4)	5 (2.7)
Kazakhstan	48 (0.8)	498 (4.4)	52 (0.8)	504 (4.8)	5 (2.6)
Denmark	51 (0.7)	534 (2.9)	49 (0.7)	540 (2.9)	6 (2.8)
Australia	49 (1.0)	513 (3.3)	51 (1.0)	519 (3.6)	6 (3.8)
Portugal	49 (1.1)	529 (4.1)	51 (1.1)	535 (3.4)	6 (3.2)
Serbia	48 (0.9)	513 (3.8)	52 (0.9)	519 (3.5)	6 (4.1)
Hong Kong SAR	46 (1.2)	598 (3.2)	54 (1.2)	604 (3.9)	6 (2.3)
Korea, Republic of	48 (0.4)	601 (2.1)	52 (0.4)	608 (2.2)	7 (2.0)
Azerbaijan	47 (0.8)	466 (6.4)	53 (0.8)	460 (5.9)	7 (3.9)
Morocco	48 (0.8)	338 (4.6)	52 (0.8)	331 (4.3)	7 (3.9)
Tunisia	47 (0.8)	363 (4.5)	53 (0.8)	356 (4.4)	7 (4.4)
Malta	49 (0.5)	492 (1.6)	51 (0.5)	499 (2.1)	7 (2.5)
Norway	51 (1.1)	492 (2.8)	49 (1.1)	499 (3.5)	7 (2.8)
Finland	49 (0.8)	542 (2.5)	51 (0.8)	549 (2.9)	7 (2.8)
Georgia	48 (0.9)	454 (3.2)	52 (0.9)	447 (4.9)	7 (3.9)
Bahrain	50 (1.6)	440 (4.5)	50 (1.6)	432 (4.0)	7 (5.5)
Netherlands	52 (1.0)	536 (2.1)	48 (1.0)	544 (2.1)	8 (2.4)
United Arab Emirates	50 (1.6)	438 (2.8)	50 (1.6)	430 (3.5)	8 (5.0)
Belgium (Flemish)	50 (0.9)	545 (2.2)	50 (0.9)	553 (2.4)	8 (2.5)
Slovak Republic	49 (0.9)	503 (4.0)	51 (0.9)	511 (3.9)	8 (2.6)
Germany	49 (0.8)	523 (2.7)	51 (0.8)	532 (2.6)	8 (2.7)
United States	51 (0.5)	536 (2.1)	49 (0.5)	545 (1.9)	9 (1.7)
Italy	50 (0.7)	503 (3.1)	50 (0.7)	512 (2.9)	9 (3.0)
Poland	48 (0.9)	476 (2.4)	52 (0.9)	486 (2.5)	9 (2.5)
Austria	49 (1.2)	504 (2.7)	51 (1.2)	513 (3.3)	9 (2.8)
Chile	51 (1.4)	457 (2.7)	49 (1.4)	466 (2.8)	9 (3.3)
Slovenia	48 (0.8)	508 (2.2)	52 (0.8)	518 (3.1)	10 (3.2)
Croatia	50 (0.8)	485 (2.4)	50 (0.8)	495 (2.4)	10 (2.8)
Canada, Québec	***50 (1.0)***	***527 (2.8)***	***50 (1.0)***	***538 (2.7)***	***11 (2.6)***
Czech Republic	48 (1.2)	505 (2.8)	52 (1.2)	516 (2.7)	11 (2.7)
Spain	49 (0.8)	477 (3.1)	51 (0.8)	488 (3.4)	11 (3.0)
Yemen	40 (2.8)	255 (7.0)	60 (2.8)	243 (7.0)	12 (7.6)
Qatar	47 (3.4)	420 (4.7)	53 (3.4)	407 (4.2)	13 (5.6)
Thailand	49 (0.9)	465 (4.8)	51 (0.9)	451 (5.6)	14 (4.4)
Saudi Arabia	52 (1.5)	418 (4.6)	48 (1.5)	402 (10.0)	16 (11.2)
Oman	49 (0.7)	398 (3.2)	51 (0.7)	372 (3.4)	26 (3.3)
Kuwait	54 (1.6)	358 (3.6)	46 (1.6)	323 (5.8)	35 (6.8)
International average	49 (0.2)	490 (0.5)	51 (0.2)	491 (0.6)	

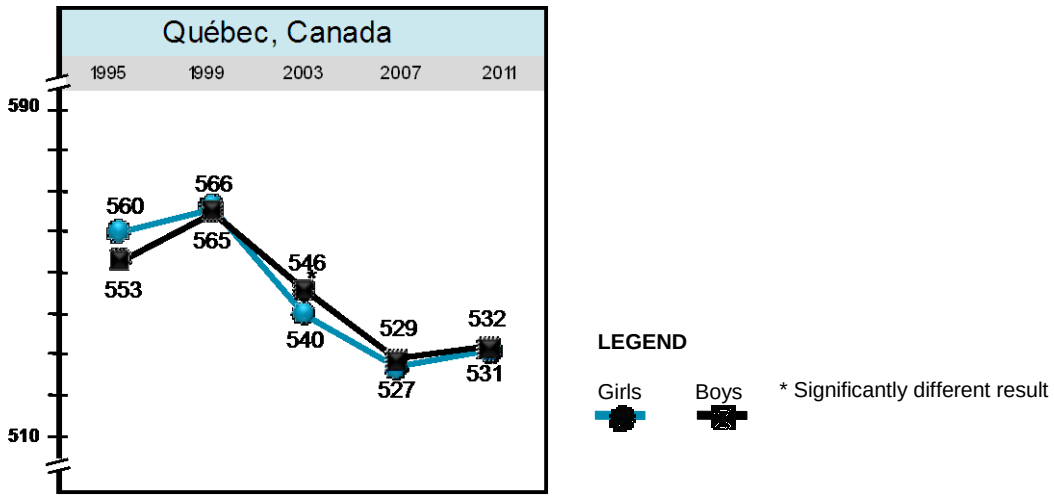
Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

3.2.2 Achievement by gender for Secondary II mathematics

Table 3.6 (see next page) presents the average scale scores for Secondary II mathematics, by gender, in the participating countries. Québec boys and girls obtained equivalent scores (532 and 531 points), as did their counterparts in Alberta and Ontario. The results from 22 participating countries reveal no significant gender gaps. Internationally, the gender gap varies from 0 to 63 points, depending on the country, with the average gap being 4 points in favour of girls.

With the exception of the 1999 study, there has not been a significant gap between boys' and girls' achievements in Secondary II mathematics in Québec since 2003. Figure 3.4 illustrates the trends in achievement by gender in Québec. Both genders have shown an improved performance in mathematics since the last study.

Figure 3.4 Trends in Secondary II mathematics achievement, by gender



Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Table 3.6 Secondary II mathematics achievement, by gender and country

Country	Girls				Boys				Difference (absolute value)	
	Percentage of students		Average score		Percentage of students		Average score			
Canada, Québec	***51***	***(1.4)***	***531***	***(2.9)***	***49***	***(1.4)***	***532***	***(2.5)***	***0***	***(2.7)***
Morocco	47	(0.8)	371	(2.3)	53	(0.8)	371	(2.7)	0	(3.2)
Russian Federation	49	(0.9)	539	(3.8)	51	(0.9)	539	(3.9)	1	(2.9)
Kazakhstan	49	(0.8)	486	(4.1)	51	(0.8)	488	(4.5)	2	(3.3)
Norway	49	(0.7)	476	(2.9)	51	(0.7)	473	(2.9)	3	(3.1)
England	48	(2.0)	508	(5.7)	52	(2.0)	505	(6.6)	3	(5.6)
Georgia	47	(0.9)	430	(4.1)	53	(0.9)	432	(4.4)	3	(4.0)
Ukraine	50	(1.0)	478	(4.0)	50	(1.0)	481	(4.9)	3	(4.4)
United States	51	(0.6)	508	(2.9)	49	(0.6)	511	(2.8)	4	(2.2)
Sweden	48	(0.9)	486	(2.1)	52	(0.9)	482	(2.4)	4	(2.4)
Finland	48	(1.1)	516	(2.7)	52	(1.1)	512	(2.7)	4	(2.3)
Slovenia	49	(0.9)	502	(2.4)	51	(0.9)	507	(2.8)	5	(2.8)
Hungary	49	(1.1)	502	(3.9)	51	(1.1)	508	(3.9)	6	(3.5)
Hong Kong SAR	49	(1.6)	588	(5.0)	51	(1.6)	583	(4.3)	6	(5.5)
Chinese Taipei	48	(1.0)	613	(3.7)	52	(1.0)	606	(3.8)	6	(4.1)
Korea, Republic of	52	(2.5)	610	(3.5)	48	(2.5)	616	(3.1)	6	(3.1)
Iran, Islamic Republic of	46	(2.3)	411	(5.9)	54	(2.3)	418	(5.9)	7	(8.1)
Macedonia, Republic of	49	(0.9)	430	(5.8)	51	(0.9)	423	(5.6)	7	(4.7)
Japan	49	(1.1)	566	(3.1)	51	(1.1)	574	(3.5)	8	(4.1)
Israel	50	(1.6)	520	(3.9)	50	(1.6)	512	(5.2)	8	(4.4)
Singapore	49	(0.7)	615	(3.7)	51	(0.7)	607	(4.5)	9	(3.5)
Turkey	49	(0.7)	457	(3.8)	51	(0.7)	448	(4.7)	9	(3.5)
Australia	50	(1.6)	500	(4.7)	50	(1.6)	509	(7.3)	9	(6.9)
Lithuania	49	(0.7)	507	(2.6)	51	(0.7)	498	(3.2)	9	(3.0)
Armenia	49	(0.8)	472	(3.1)	51	(0.8)	462	(3.2)	10	(3.1)
Syrian Arab Republic	50	(1.7)	375	(5.3)	50	(1.7)	385	(5.3)	11	(5.7)
Italy	49	(0.9)	493	(2.9)	51	(0.9)	504	(2.8)	11	(2.9)
Romania	48	(0.9)	464	(4.6)	52	(0.9)	453	(4.2)	11	(3.6)
Qatar	50	(3.3)	415	(5.8)	50	(3.3)	404	(5.5)	11	(9.5)
Lebanon	55	(1.9)	444	(4.2)	45	(1.9)	456	(4.7)	12	(4.7)
Indonesia	50	(1.2)	392	(4.9)	50	(1.2)	379	(4.5)	13	(4.0)
Chile	53	(1.5)	409	(3.2)	47	(1.5)	424	(3.0)	14	(3.6)
Saudi Arabia	48	(1.2)	401	(4.1)	52	(1.2)	387	(8.0)	15	(8.9)
Tunisia	52	(0.7)	417	(3.1)	48	(0.7)	433	(3.1)	17	(2.5)
United Arab Emirates	50	(1.7)	464	(2.7)	50	(1.7)	447	(3.1)	17	(4.2)
Thailand	55	(1.6)	435	(4.2)	45	(1.6)	417	(5.3)	18	(4.4)
New Zealand	47	(2.0)	478	(5.5)	53	(2.0)	496	(6.2)	18	(4.7)
Malaysia	51	(1.2)	449	(5.2)	49	(1.2)	430	(6.2)	19	(4.4)
Palestinian National Authority	52	(1.7)	415	(4.2)	48	(1.7)	392	(5.6)	23	(7.0)
Ghana	47	(0.8)	318	(4.8)	53	(0.8)	342	(4.3)	23	(2.9)
Jordan	49	(1.7)	420	(4.3)	51	(1.7)	392	(5.9)	28	(7.4)
Bahrain	50	(0.8)	431	(2.5)	50	(0.8)	388	(3.1)	43	(4.0)
Oman	51	(2.1)	397	(3.1)	49	(2.1)	334	(3.8)	63	(4.6)
International average	50	(0.2)	469	(0.6)	50	(0.2)	465	(0.7)		

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

3.3 Results at the international benchmarks

The percentage of students who reached each of the international benchmarks gives an overall portrait of the competencies in mathematics of Elementary 4 and Secondary II students. Table 3.7 presents the cumulative distributions of Québec students over the four benchmarks in TIMSS 2011. In this table, a student who reached an intermediate, high or advanced benchmark is automatically included in the lower benchmarks.

The international benchmarks for Elementary 4 mathematics are described in Appendix 2 and those for Secondary II mathematics are described in Appendix 3.

Table 3.7 Percentage of Québec students who reached or surpassed the international benchmarks in mathematics

	International benchmarks			
	Advanced (625)	**High (550)**	**Intermediate (475)**	**Low (400)**
Grade	(%)	(%)	(%)	(%)
Elementary 4	6	40	83	99
Secondary II	6	40	82	98

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

In general, the participating countries and school jurisdictions where the average scale score is high have a larger percentage of students who reached the *High* and *Advanced* benchmarks. The participating countries and school jurisdictions whose Elementary 4 students performed best are Singapore (43% at the *Advanced* benchmark), the Republic of Korea (39% at the *Advanced* benchmark), Hong Kong SAR (37% at the *Advanced* benchmark), Chinese Taipei (34% at the *Advanced* benchmark) and Japan (30% at the *Advanced* benchmark). The Secondary II students in these countries and jurisdictions had similar results and remain in the top echelon. Considering the proportion of students who reached or surpassed the *High* benchmark, Québec did very well, right up there with the 14 countries with percentages higher than 40% for Elementary 4 and the 6 countries who obtained similar percentages for Secondary II.

At the Canadian level, Québec performed well. In Elementary 4, Ontario saw 7% of its students reach the *Advanced* benchmark and 34% reach the *High* benchmark, while Alberta saw 3% of its students reach the *Advanced* benchmark and 25% reach the *High* benchmark. In Secondary II, 4% of students in Ontario reached the *Advanced* benchmark and 31% reached the *High* benchmark, while 3% of students in Alberta reached the *Advanced* benchmark and 24% reached the *High* benchmark.

3.3.1 *Trends in percentages of Québec Elementary 4 students who reached or surpassed the international benchmarks of mathematics achievement*

The percentages of Québec students who reached or surpassed the first three international benchmarks (*Low, Intermediate and High*) increased significantly between 2007 and 2011.

Table 3.8 Trends in percentages of Québec Elementary 4 students who reached or surpassed the international benchmarks of mathematics achievement

	International benchmarks			
Studies	**Advanced (625)**	**High (550)**	**Intermediate (475)**	**Low (400)**
Year	(%)	(%)	(%)	(%)
2011	6	40	83	99
2007	5	34	74	96
2003	3	25	69	94
1995	13	50	87	98

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

3.3.2 *Trends in percentages of Québec Secondary II students who reached or surpassed the international benchmarks of mathematics achievement*

The percentages of Québec students who reached or surpassed the four international benchmarks remained statistically stable between 2007 and 2011. With 40% of its students reaching or surpassing the *High* benchmark, Québec is ranked 7th among the participating countries at this level.

Table 3.9 Trends in the percentages of Québec Secondary II students who reached or surpassed the international benchmarks of mathematics achievement

	International benchmarks			
Studies	**Advanced (625)**	**High (550)**	**Intermediate (475)**	**Low (400)**
Year	(%)	(%)	(%)	(%)
2011	6	40	82	98
2007	8	37	78	97
2003	8	45	88	99
1999	18	60	93	99
1995	14	54	90	99

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

3.4 Content domains and cognitive domains

The questions in the TIMSS 2011 study were organized around the content domains and cognitive domains listed in Figure 3.5 below. Each of these domains is defined in the *TIMSS 2011 Framework* (http://timssandpirls.bc.edu/timss2011/frameworks.html).

The assessments consisted of multiple-choice questions, constructed-response questions and problems to be solved. The following figure presents the items in the content and cognitive domains around which the assessments for Elementary 4 and Secondary II were designed.

Figure 3.5 Percentages attributed to each item in the content domains and the cognitive domains in TIMSS 2011 mathematics

CONTENT DOMAINS

Elementary 4		Secondary II	
• Number	50%	• Number	30%
• Geometric shapes and measures	35%	• Algebra	30%
• Data display	15%	• Data and chance	20%
		• Geometry	20%

COGNITIVE DOMAINS

Elementary 4		Secondary II	
• Knowing	40%	• Knowing	35%
• Applying	40%	• Applying	40%
• Reasoning	20%	• Reasoning	25%

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

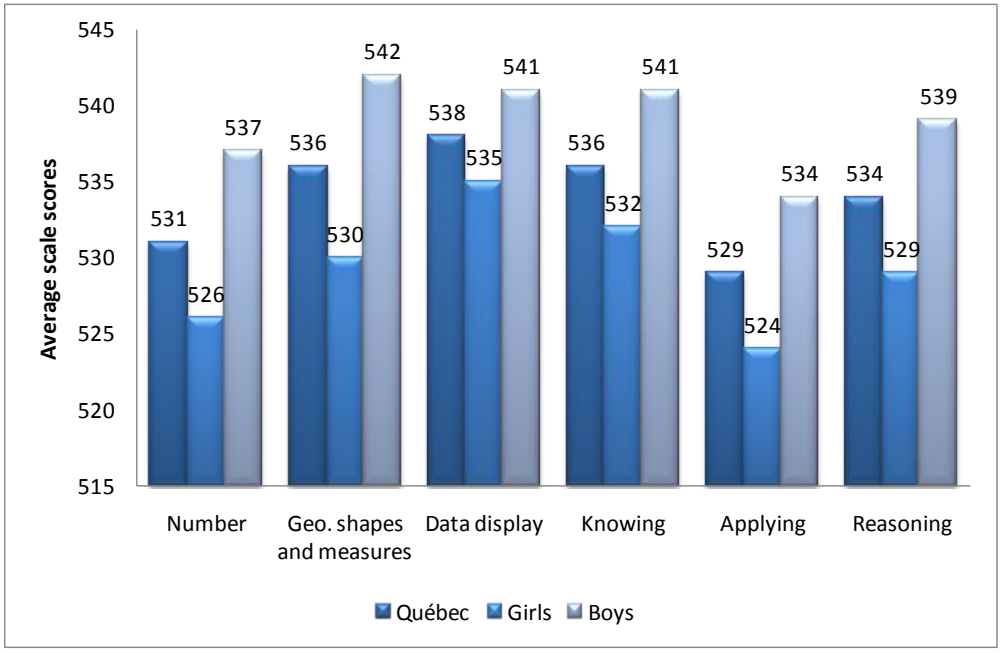
3.4.1 Average achievement of Elementary 4 students, by domain

Table 3.10 presents the average results obtained by Québec Elementary 4 students in the content and cognitive domains, by gender.

The gap is statistically significant in favour of boys in all domains except the content domain *Data display*, where the results are equivalent. The same can be said for the international level, with the exception of the *Data display* domain, where girls achieved significantly higher results than boys.

The results also show that Québec performs well in the *Data display* content domain and not as well in the *Numbers* content domain. Like the majority of participating countries, Québec performs better in the *Knowing* cognitive domain and not as well in the *Applying* cognitive domain.

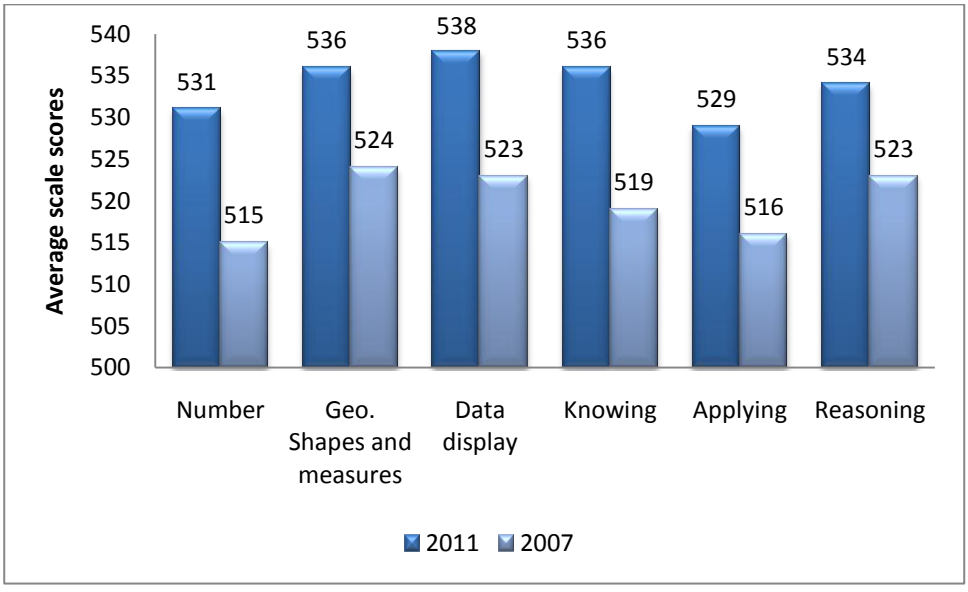
Table 3.10 Average achievement of Elementary 4 students in the mathematics content and cognitive domains, by gender



Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

The following table illustrates the trends in the last two studies. The 2011 results achieved in mathematics by Québec Elementary 4 students are significantly higher than those achieved in 2007 in all domains evaluated.

Table 3.11 Trends in the average achievement of Elementary 4 students in the mathematics content and cognitive domains



Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

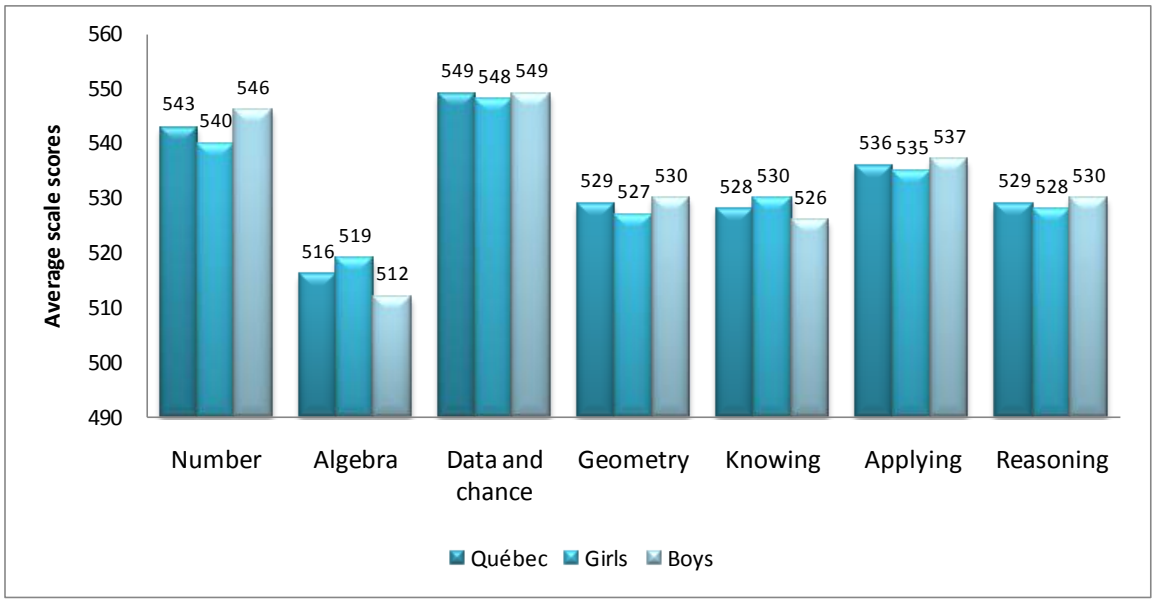
3.4.2 Average achievement of Secondary II students, by domain

Table 3.12 presents the average scale scores obtained by Québec Secondary II students in the content and cognitive domains, by gender.

Québec boys' results are statistically higher than those of girls in the *Number* content domain. There are no significant gaps between girls and boys in the other domains. On the international level, girls obtained higher scores than boys in the *Algebra* and *Knowing* domains while the boys outperformed the girls in the *Number* and *Applying* domains.

Québec students performed best in the *Data and chance* content domain and not as well in the *Algebra* content domain. On the international level, most countries achieved better results in the *Number* and *Data and chance* content domains. In the cognitive domains, Québec follows the majority trend and performs best in *Knowing*.

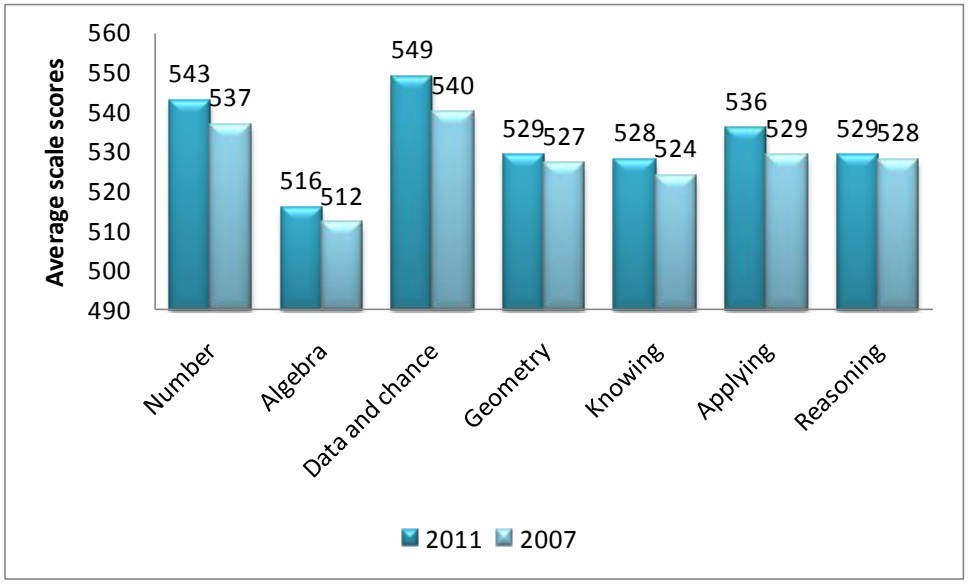
Table 3.12 Average achievement of Secondary II students in the mathematics content and cognitive domains, by gender



Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

The following table illustrates the trends in the last two studies. The 2011 mathematics scores of Secondary II Québec students are slightly higher than the 2007 scores in all domains evaluated, without being statistically higher.

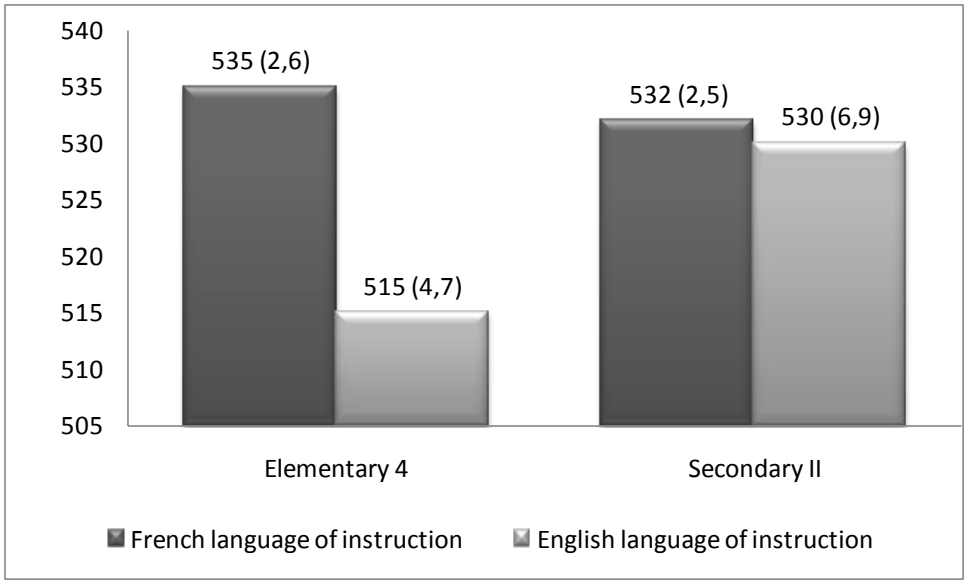
Table 3.13 Trends in the average achievement of Secondary II students in the mathematics content and cognitive domains



Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

3.5 Achievement by language of instruction

Table 3.14 Achievement in mathematics by language of instruction.



4 Science achievement results

4.1 Average scale scores of Québec students and trends

4.1.1 Elementary 4 science

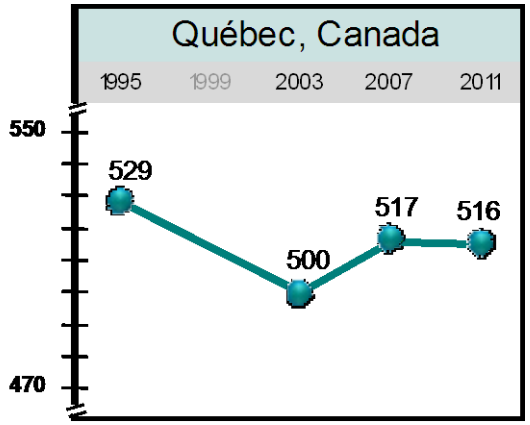
Québec's average scale score was 516 points. In 2011, 21 countries and school jurisdictions obtained results that were significantly higher than those of Québec.

Tables 4.1 and 4.2 present the average scale scores in science of the countries and Canadian provinces that participated in the study, grouping them into three categories: participants with an average scale score significantly higher than Québec; participants with an average scale score not significantly different than that of Québec; and participants whose average scale scores were significantly lower than that of Québec.

The TIMSS 2011 average score in science for Québec's Elementary 4 students is statistically equivalent to that of 2007. Over the last two studies, Québec has maintained its relative position. Between 2007 and 2011, two countries slipped below and two countries rose above Québec in the rankings. Six participants new to the study in 2011 obtained higher scores than Québec.

Québec has participated in TIMSS studies since 1995. Figure 4.1 illustrates the change in results since 1995. Of the 20 countries and benchmarking participants in TIMSS since 1995, nine improved their results during this time; nine maintained their scores and two saw their results decline. Québec's results dropped 13 points during this same period.

Figure 4.1 Trend in the average scale scores for Elementary 4 science – Québec



Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Table 4.1 Average scale scores in Elementary 4 science, by country[4]

Country	Average result		
Korea, Republic of	587	(2.0)	
Singapore	583	(3.4)	
Finland	570	(2.6)	
Japan	559	(1.9)	
Russian Federation	552	(3.5)	
Chinese Taipei	552	(2.2)	
United States	544	(2.1)	
Czech Republic	536	(2.5)	
Hong Kong SAR	535	(3.8)	
Hungary	534	(3.7)	***Statistically higher than Québec***
Sweden	533	(2.7)	
Slovak Republic	532	(3.8)	
Austria	532	(2.8)	
Netherlands	531	(2.2)	
England	529	(2.9)	
Denmark	528	(2.8)	
Germany	528	(2.9)	
Italy	524	(2.7)	
Portugal	522	(3.9)	
Slovenia	520	(2.7)	***Statistically equivalent to Québec***
Northern Ireland	517	(2.6)	
Ireland	516	(3.4)	
Croatia	516	(2.1)	
Québec	***516***	***(2.7)***	
Australia	516	(2.8)	
Serbia	516	(3.1)	
Lithuania	515	(2.4)	
Belgium (Flemish)	509	(2.0)	
Romania	505	(5.9)	
Spain	505	(3.0)	
Poland	505	(2.6)	
TIMSS scale centrepoint	**500**		
New Zealand	497	(2.3)	
Kazakhstan	495	(5.1)	
Norway	494	(2.3)	
Chile	480	(2.4)	
Thailand	472	(5.6)	
Turkey	463	(4.5)	
Georgia	455	(3.8)	
Iran, Islamic Republic of	453	(3.7)	***Statistically lower than Québec***
Bahrain	449	(3.5)	
Malta	446	(1.9)	
Azerbaijan	438	(5.6)	
Saudi Arabia	429	(5.4)	
United Arab Emirates	428	(2.5)	
Armenia	416	(3.8)	
Qatar	394	(4.3)	
Oman	377	(4.3)	
Kuwait	347	(4.7)	
Tunisia	346	(5.3)	
Morocco	264	(4.5)	
Yemen	209	(7.3)	

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

4 The three countries that assessed Elementary 6 students are not included in the table.

Table 4.2 Average scale scores in Elementary 4 science, by benchmarking participant

Benchmarking participants	Average score		
Florida (United States)	545	(3.7)	***Statistically higher***
Alberta	541	(2.4)	
North Carolina (United States)	538	(4.6)	
Ontario	528	(3.0)	
Québec	**516**	**(2.7)**	
Dubai (United Arab Emirates)	461	(2.3)	***Statistically lower***
Abu Dhabi (United Arab Emirates)	411	(4.9)	

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

4.1.2 Secondary II science

Québec's average scale score was 520 points. In 2011, the scores of 15 countries and school jurisdictions were significantly higher than those of Québec. Table 4.2 presents the average scale scores in science of the countries and Canadian provinces that participated in the study, grouping them into three categories: participants with an average scale score significantly higher than Québec; participants with an average scale score that is not significantly different than that of Québec; and participants whose average scale scores were significantly lower than that of Québec.

Québec has been participating in TIMSS studies since 1995. The TIMSS average scale score in science for Québec's Secondary II students is statistically higher than that of 2007, but remains below the 1999 score of 540 points and the 2003 score of 531 points. Figure 4.2 illustrates the change in results since 1995. Of the 20 countries and benchmarking participants that have been involved in TIMSS since 1995, eight, including Québec, have improved their results during this time; nine have maintained their scores and three have seen their results fall. Québec's relative position improved between 2007 and 2011. During this same period, three countries slipped below Québec in the rankings but none of the countries that participated in the 2007 study has risen above Québec.

The trends in the results of the TIMSS studies enabled 17 countries and 3 benchmarking participants to follow a cohort of students from 2007 to 2011. The performance of 12 countries and two Canadian provinces (Ontario and Québec) was above the scale centrepoint for Elementary 4 in 2007 and for Secondary II (Grade 8) in 2011. The cohorts of five participants maintained their positions above the scale centrepoint (500 points) and the cohort of one country that was above the scale centrepoint in 2007 dropped below it in 2011.

Table 4.3 Average scale scores in Secondary II science, by country[5]

Country	Average score		
Singapore	590	(4.3)	
Chinese Taipei	564	(2.3)	
Korea, Republic of	560	(2.0)	***Statistically***
Japan	558	(2.4)	***higher than***
Finland	552	(2.5)	***Québec***
Slovenia	543	(2.7)	
Russian Federation	542	(3.2)	
Hong Kong SAR	535	(3.4)	
England	533	(4.9)	
United States	525	(2.6)	
Hungary	522	(3.1)	
Canada, Québec	***520***	***(2.5)***	***Equivalent to***
Australia	519	(4.8)	***Québec***
Israel	516	(4.0)	
Lithuania	514	(2.6)	
New Zealand	512	(4.6)	
Sweden	509	(2.5)	
Italy	501	(2.5)	
Ukraine	501	(3.4)	
TIMSS scale centrepoint	**500**		
Norway	494	(2.6)	
Kazakhstan	490	(4.3)	
Turkey	483	(3.4)	
Iran, Islamic Republic of	474	(4.0)	
Romania	465	(3.5)	
United Arab Emirates	465	(2.4)	
Chile	461	(2.5)	
Bahrain	452	(2.0)	***Statistically***
Thailand	451	(3.9)	***lower than***
Jordan	449	(4.0)	***Québec***
Tunisia	439	(2.5)	
Armenia	437	(3.1)	
Saudi Arabia	436	(3.9)	
Malaysia	426	(6.3)	
Syrian Arab Republic	426	(3.9)	
Palestinian National Authority	420	(3.2)	
Georgia	420	(3.0)	
Oman	420	(3.2)	
Qatar	419	(3.4)	
Macedonia, Republic of	407	(5.4)	
Lebanon	406	(4.9)	
Indonesia	406	(4.5)	
Morocco	376	(2.2)	
Ghana	306	(5.2)	

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

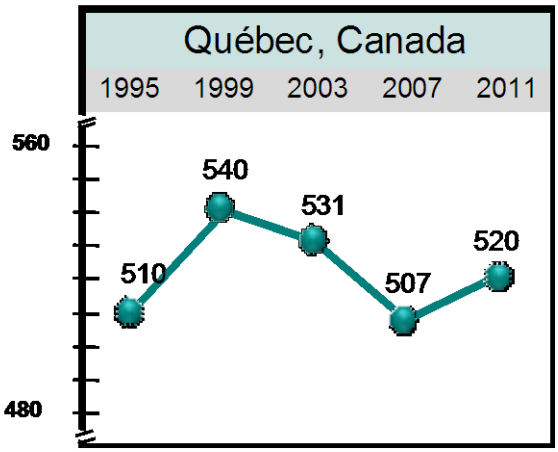
5 The three countries that assessed Secondary III students are not included in the table.

Table 4.4 Average scale scores in Secondary II science, by benchmarking participant

Country	Average score		
Massachusetts (United States)	567	(5.1)	
Minnesota (United States)	553	(4.6)	
Alberta (Canada)	546	(2.4)	***Statistically higher***
Colorado (United States)	542	(4.4)	
Indiana (United States)	533	(4.8)	
Connecticut (United States)	532	(4.6)	
North Carolina (United States)	532	(6.3)	
Florida (United States)	530	(7.3)	***Statistically equivalent***
Ontario (Canada)	521	(2.5)	
Québec (Canada)	**520**	**(2.5)**	
California (United States)	499	(4.6)	
Alabama (United States)	485	(6.2)	***Statistically lower***
Dubai (United Arab Emirates)	485	(2.5)	
Abu Dhabi (UAE)	461	(4.0)	

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Figure 4.2 Trend in the average scale score for Secondary II science – Québec



Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

4.2 Achievement by gender

4.2.1 Achievement by gender for Elementary 4 science

Table 4.5 presents the average scale scores for Elementary 4 science, by gender, in the participating countries. Québec boys obtained a statistically higher score than the girls (520 and 512 points). Twenty-three participating countries show no significant difference between the genders; 16 countries and Québec show a slight gap in favour of boys, while three countries show a slight gap in favour of girls and eight countries show a large gap in favour of girls. Internationally, the gender gap varies from 0 to 53 points depending on the country, with the average international gap being 2 points in favour of the girls.

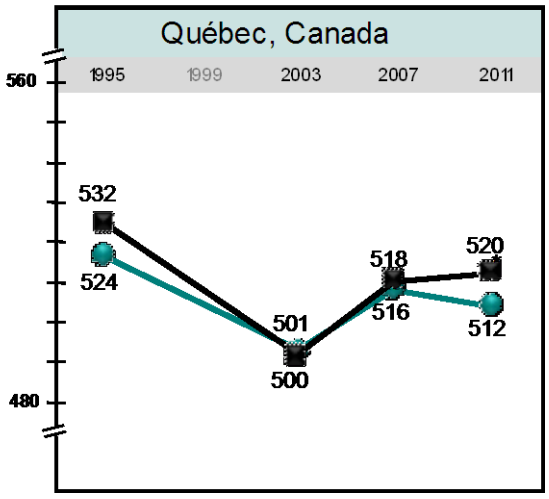
In the three previous TIMSS studies, there was no significant difference between the results obtained by boys and those obtained by girls in Québec. Figure 4.3 illustrates the trend in the results for each gender in Québec. The boys' average scale score improved between 2007 and 2011, while that of the girls declined. Like Québec, Alberta had no gender gap in the 1995 and 2007 studies and, in the 2011 study, shows a significant gap in favour of boys. Ontario has had no significant gender gap since 1995.

Table 4.5 Elementary 4 science achievement, by gender and country

Country	Girls				Boys				Difference (absolute value)	
	Percentage of students		Average score		Percentage of students		Average score			
Australia	49	(1.0)	516	(3.1)	51	(1.0)	516	(3.7)	0	(3.9)
Romania	48	(0.9)	505	(6.9)	52	(0.9)	506	(5.7)	0	(4.7)
Finland	49	(0.8)	570	(2.9)	51	(0.8)	570	(3.0)	0	(3.0)
Ireland	49	(2.3)	516	(4.0)	51	(2.3)	516	(4.6)	1	(5.5)
New Zealand	49	(0.8)	496	(3.0)	51	(0.8)	497	(2.6)	1	(3.2)
England	48	(1.0)	529	(3.3)	52	(1.0)	528	(3.3)	1	(3.1)
Lithuania	48	(0.8)	514	(2.4)	52	(0.8)	515	(3.0)	1	(2.6)
Russian Federation	49	(1.0)	553	(3.5)	51	(1.0)	552	(3.8)	1	(2.4)
Northern Ireland	49	(1.3)	517	(3.2)	51	(1.3)	516	(3.2)	1	(3.8)
Denmark	51	(0.7)	527	(3.3)	49	(0.7)	529	(3.1)	2	(3.0)
Iran, Islamic Republic of	49	(2.9)	452	(5.8)	51	(2.9)	454	(5.7)	2	(8.8)
Serbia	48	(0.9)	514	(3.6)	52	(0.9)	517	(3.7)	3	(3.9)
Sweden	49	(1.0)	532	(3.0)	51	(1.0)	535	(3.2)	4	(3.0)
Norway	51	(1.1)	492	(2.5)	49	(1.1)	496	(3.2)	4	(3.1)
Singapore	49	(0.6)	581	(3.7)	51	(0.6)	585	(3.7)	4	(2.7)
Turkey	48	(0.6)	465	(5.0)	52	(0.6)	461	(4.7)	4	(3.8)
Hungary	49	(1.0)	532	(4.0)	51	(1.0)	537	(3.9)	5	(2.9)
Croatia	50	(0.8)	514	(2.5)	50	(0.8)	518	(2.5)	5	(2.7)
Portugal	49	(1.1)	519	(4.6)	51	(1.1)	524	(3.8)	5	(3.2)
Armenia	47	(0.8)	419	(4.0)	53	(0.8)	414	(4.3)	5	(3.4)
Japan	49	(0.5)	556	(2.7)	51	(0.5)	561	(2.1)	5	(2.8)
Slovenia	48	(0.8)	517	(2.8)	52	(0.8)	523	(3.4)	6	(3.2)
Hong Kong SAR	46	(1.2)	532	(3.6)	54	(1.2)	538	(4.3)	6	(2.5)
Poland	48	(0.9)	502	(3.0)	52	(0.9)	508	(2.9)	6	(2.8)
Malta	49	(0.5)	443	(2.2)	51	(0.5)	449	(2.8)	6	(3.3)
Chinese Taipei	47	(0.6)	548	(2.6)	53	(0.6)	555	(2.4)	7	(2.3)
Italy	50	(0.7)	520	(3.2)	50	(0.7)	528	(3.0)	7	(2.9)
Korea, Republic of	48	(0.4)	583	(2.4)	52	(0.4)	590	(2.3)	8	(2.3)
Kazakhstan	48	(0.8)	490	(5.1)	52	(0.8)	498	(5.5)	8	(3.0)
Azerbaijan	47	(0.8)	442	(6.3)	53	(0.8)	434	(5.7)	8	(4.0)
Slovak Republic	49	(0.9)	528	(4.3)	51	(0.9)	536	(3.6)	8	(2.7)
Canada, Québec	***50***	***(1.0)***	***512***	***(3.0)***	***50***	***(1.0)***	***520***	***(3.0)***	***8***	***(2.4)***
Georgia	48	(0.9)	459	(3.2)	52	(0.9)	451	(5.1)	9	(3.9)
Morocco	48	(0.8)	268	(5.1)	52	(0.8)	259	(4.9)	9	(4.4)
Spain	49	(0.8)	500	(2.8)	51	(0.8)	510	(3.7)	10	(2.8)
Thailand	49	(0.9)	476	(5.7)	51	(0.9)	467	(6.6)	10	(5.0)
United States	51	(0.5)	539	(2.3)	49	(0.5)	549	(2.1)	10	(1.5)
Netherlands	52	(1.0)	526	(2.4)	48	(1.0)	537	(2.6)	10	(2.1)
Belgium (Flemish)	50	(0.9)	503	(2.6)	50	(0.9)	514	(2.3)	11	(2.9)
Chile	51	(1.4)	474	(2.8)	49	(1.4)	486	(2.8)	12	(2.9)
Germany	49	(0.8)	522	(3.0)	51	(0.8)	534	(3.2)	12	(2.5)
Austria	49	(1.2)	525	(2.8)	51	(1.2)	538	(3.6)	12	(2.9)
Czech Republic	48	(1.2)	529	(2.9)	52	(1.2)	544	(2.7)	15	(2.6)
United Arab Emirates	50	(1.6)	437	(3.4)	50	(1.6)	419	(3.8)	18	(5.3)
Bahrain	50	(1.6)	461	(5.5)	50	(1.6)	438	(4.6)	23	(7.0)
Tunisia	47	(0.8)	359	(5.6)	53	(0.8)	334	(5.6)	25	(4.3)
Qatar	47	(3.4)	408	(5.1)	53	(3.4)	382	(5.7)	26	(6.5)
Yemen	40	(2.8)	225	(7.3)	60	(2.8)	198	(8.8)	27	(8.0)
Oman	49	(0.7)	394	(4.7)	51	(0.7)	360	(4.6)	34	(3.8)
Saudi Arabia	52	(1.5)	453	(4.7)	48	(1.5)	405	(9.9)	48	(11.0)
Kuwait	54	(1.6)	371	(5.5)	46	(1.6)	319	(7.1)	53	(8.6)
International average	49	(0.2)	487	(0.6)	51	(0.2)	485	(0.6)		

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Figure 4.3 Trends in Elementary 4 science achievement, by gender



* Significantly different result

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

4.2.2 Achievement by gender for Secondary II science

Table 4.6 presents the average scale scores for Secondary II science, by gender, in the participating countries. Québec boys and girls obtained statistically equivalent scores (522 and 518 points), just like 17 participating countries. Internationally, the gender gap varies from 0 to 78 points, depending on the country, with the average international gap being 6 points in favour of girls.

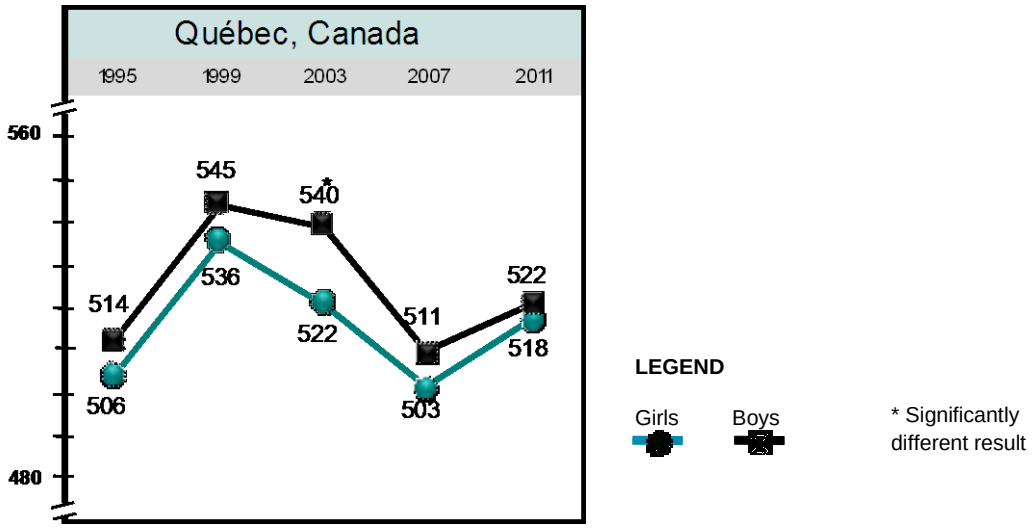
With the exception of the 2003 study, there has been no significant gap between boys' and girls' achievements in Secondary II science since 1995. Figure 4.4 illustrates the trends in achievement by Québec boys and girls. Both genders have shown an improved performance in science since the last study.

Table 4.6 Secondary II science achievement, by gender and by country

Country	Girls				Boys				Difference (absolute value)	
	Percentage of students		Average score		Percentage of students		Average score			
Chinese Taipei	48	(1.0)	564	(2.7)	52	(1.0)	564	(2.8)	0	(3.0)
Norway	49	(0.7)	495	(3.2)	51	(0.7)	494	(3.0)	1	(3.4)
Singapore	49	(0.7)	589	(4.2)	51	(0.7)	591	(5.3)	1	(4.1)
Hong Kong SAR	49	(1.6)	536	(4.5)	51	(1.6)	534	(3.7)	2	(4.6)
Romania	48	(0.9)	466	(3.8)	52	(0.9)	464	(4.0)	2	(3.4)
England	48	(2.0)	534	(5.0)	52	(2.0)	532	(6.2)	2	(5.6)
Sweden	48	(0.9)	511	(2.7)	52	(0.9)	508	(3.1)	3	(3.0)
Canada, Québec	***51***	***(1.4)***	***518***	***(3.0)***	***49***	***(1.4)***	***522***	***(3.0)***	***4***	***(3.0)***
Morocco	47	(0.8)	378	(2.6)	53	(0.8)	374	(2.7)	4	(3.0)
Kazakhstan	49	(0.8)	492	(4.6)	51	(0.8)	488	(4.6)	4	(3.6)
Lebanon	55	(1.9)	404	(5.4)	45	(1.9)	408	(6.5)	4	(6.7)
Slovenia	49	(0.9)	541	(3.0)	51	(0.9)	545	(3.4)	4	(3.4)
Ukraine	50	(1.0)	499	(3.7)	50	(1.0)	503	(4.3)	4	(4.1)
Korea, Republic of	52	(2.5)	558	(2.6)	48	(2.5)	563	(2.4)	5	(3.1)
Finland	48	(1.1)	555	(2.4)	52	(1.1)	550	(3.1)	5	(2.7)
Iran, Islamic Republic of	46	(2.3)	477	(5.3)	54	(2.3)	472	(5.3)	5	(7.0)
Syrian Arab Republic	50	(1.7)	424	(4.4)	50	(1.7)	429	(4.9)	6	(5.2)
Russian Federation	49	(0.9)	539	(3.6)	51	(0.9)	546	(3.5)	7	(2.9)
Israel	50	(1.6)	519	(3.7)	50	(1.6)	512	(5.2)	7	(4.2)
Indonesia	50	(1.2)	409	(5.1)	50	(1.2)	402	(4.5)	7	(3.6)
Japan	49	(1.1)	554	(2.9)	51	(1.1)	562	(2.9)	8	(3.3)
Lithuania	49	(0.7)	518	(3.0)	51	(0.7)	510	(3.1)	8	(3.3)
Georgia	47	(0.9)	425	(3.3)	53	(0.9)	415	(3.5)	10	(3.4)
United States	51	(0.6)	519	(2.8)	49	(0.6)	530	(2.9)	11	(2.4)
Malaysia	51	(1.2)	434	(6.3)	49	(1.2)	419	(7.3)	15	(5.5)
Thailand	55	(1.6)	458	(3.9)	45	(1.6)	443	(5.2)	15	(4.9)
Italy	49	(0.9)	493	(3.1)	51	(0.9)	508	(2.6)	15	(2.8)
Chile	53	(1.5)	454	(3.2)	47	(1.5)	470	(2.9)	16	(3.6)
Turkey	49	(0.7)	491	(3.2)	51	(0.7)	475	(4.3)	16	(3.2)
Australia	50	(1.6)	511	(4.5)	50	(1.6)	527	(6.5)	16	(5.9)
Tunisia	52	(0.7)	431	(2.6)	48	(0.7)	447	(2.9)	17	(2.6)
Macedonia, Republic of	49	(0.9)	417	(5.6)	51	(0.9)	399	(6.1)	18	(4.7)
Hungary	49	(1.1)	513	(3.5)	51	(1.1)	531	(3.7)	18	(3.7)
Armenia	49	(0.8)	446	(3.5)	51	(0.8)	428	(3.6)	18	(3.4)
New Zealand	47	(2.0)	501	(4.6)	53	(2.0)	522	(5.1)	20	(3.9)
United Arab Emirates	50	(1.7)	477	(2.9)	50	(1.7)	452	(3.3)	25	(4.2)
Qatar	50	(3.3)	432	(7.0)	50	(3.3)	406	(5.4)	26	(10.7)
Saudi Arabia	48	(1.2)	450	(3.5)	52	(1.2)	424	(6.4)	26	(7.2)
Palestinian National Authority	52	(1.7)	434	(3.8)	48	(1.7)	406	(5.4)	27	(6.8)
Ghana	47	(0.8)	290	(5.7)	53	(0.8)	320	(5.4)	30	(4.0)
Jordan	49	(1.7)	471	(4.3)	51	(1.7)	428	(6.4)	43	(7.6)
Bahrain	50	(0.8)	482	(2.2)	50	(0.8)	423	(3.6)	59	(4.4)
Oman	51	(2.1)	458	(2.9)	49	(2.1)	380	(4.4)	78	(4.9)
International average	50	(0.2)	480	(0.6)	50	(0.2)	474	(0.7)		

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Figure 4.4 Trends in Secondary II science achievement, by gender



Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

4.3 Results at the international benchmarks

The percentage of students who reached each of the international benchmarks gives an overall portrait of the competencies in science of Elementary 4 and Secondary II students. Table 4.7 presents the cumulative distributions of Québec students over the four benchmarks in TIMSS 2011. In this table, a student who reached an intermediate, high or advanced benchmark is automatically included in the lower benchmarks.

The international benchmarks for Elementary 4 science are described in Appendix 4 and those for Secondary II science are described in Appendix 5.

Table 4.7 Percentage of Québec students who reached or surpassed the international benchmarks in science

	International benchmarks			
	Advanced (625)	**High (550)**	**Intermediate (475)**	**Low (400)**
Grade	(%)	(%)	(%)	(%)
Elementary 4	3	29	76	97
Secondary II	5	34	76	96

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

In general, the participating countries and school jurisdictions where the average scale score is high have a larger percentage of students who reached the *High* and *Advanced* benchmarks. In Elementary 4, 11% and 9% of Alberta and Ontario students, respectively, reached the *Advanced* benchmark, and 47% and 40%, respectively, reached the *High* benchmark. In Secondary II, 12% and 6% of Alberta and Ontario students, respectively, reached the *Advanced* benchmark, and 48% and 35%, respectively, reached the *High* benchmark.

4.3.1 Trends in percentages of Québec Elementary 4 students who reached or surpassed the international benchmarks of science achievement

The percentages of Québec students who reached or surpassed the first three international benchmarks (*Low*, *Intermediate* and *High*) did not change significantly between 2007 and 2011. The percentage of students who reached or surpassed the *Advanced* benchmark (3%) is statistically lower than the percentage in 2007 (5%).

Table 4.8 Trends in percentages of Québec Elementary 4 students who reached or surpassed the international benchmarks of science achievement

	International benchmarks			
Studies	**Advanced (625)**	**High (550)**	**Intermediate (475)**	**Low (400)**
Year	(%)	(%)	(%)	(%)
2011	3	29	76	97
2007	5	32	74	96
2003	3	25	66	91
1995	9	40	77	94

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

4.3.2 Trends in percentages of Québec Secondary II students who reached or surpassed the international benchmarks of science achievement

The percentages of Québec students who reached or surpassed the *High* and *Intermediate* benchmarks in 2011 are statistically higher than in 2007. The percentages in each of the 2011 benchmarks are lower than those of 1999.

Table 4.9 Trends in the percentages of Québec Secondary II students who reached or surpassed the international benchmarks in science

	International benchmarks			
Studies	**Advanced (625)**	**High (550)**	**Intermediate (475)**	**Low (400)**
Year	(%)	(%)	(%)	(%)
2011	5	34	76	96
2007	4	27	68	94
2003	6	39	82	98
1999	10	43	83	98
1995	7	30	69	92

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

4.4 Content domains and cognitive domains

The questions on science in the TIMSS 2011 study were organized around the content domains and cognitive domains. The assessments consisted of multiple-choice questions, constructed-response questions and problems to be solved. The following figure presents the items in the content and cognitive domains around which the assessments for Elementary 4 and Secondary II were designed.

Figure 4.5 Percentages attributed to each item in the content domains and the cognitive domains in TIMSS 2011 science

CONTENT DOMAINS

Elementary 4		Secondary II	
• Life science	45%	• Biology	35%
• Physical science	35%	• Chemistry	20%
• Earth science	20%	• Physics	25%
		• Earth science	20%

COGNITIVE DOMAINS

Elementary 4		Secondary II	
• Knowing	40%	• Knowing	35%
• Applying	40%	• Applying	35%
• Reasoning	20%	• Reasoning	30%

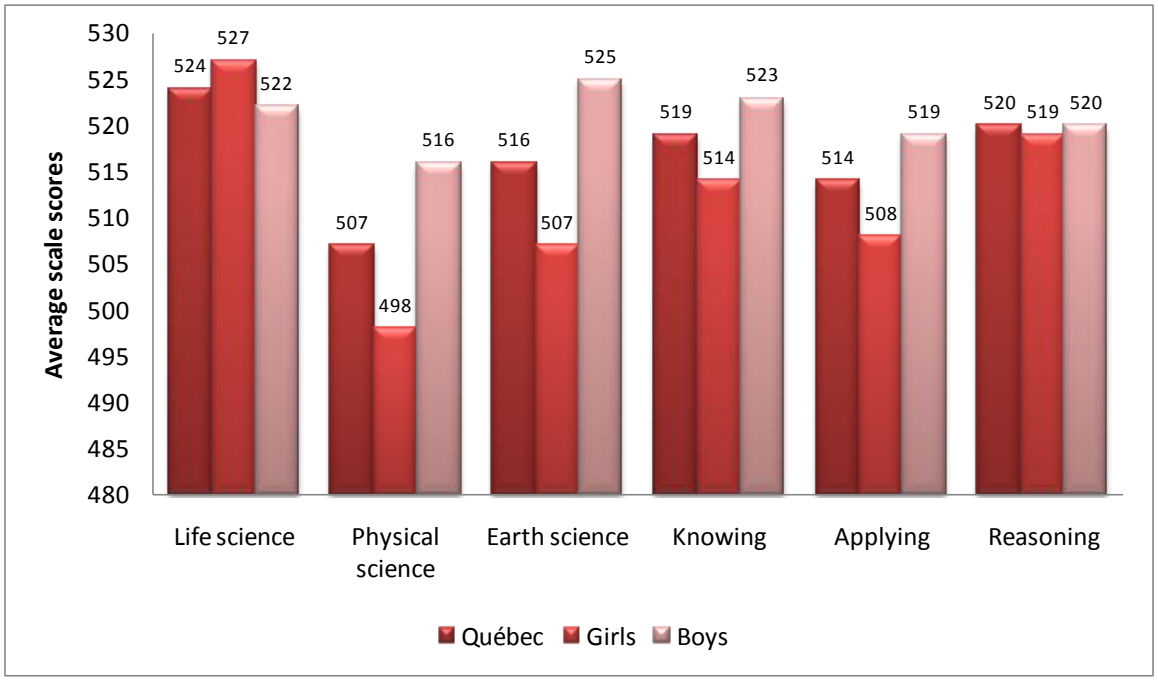
Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

4.4.1 Average achievement of Elementary 4 students, by domain

In TIMSS 2011, four countries and one benchmarking participant did equally well in all three content domains (Finland, Denmark, Ireland, Romania and Alberta). The results show Québec students performed better in the *Life science* domain. Four countries and three benchmarking participants, including Québec, did equally well in the three cognitive domains.

Table 4.10 presents the average results obtained by Québec Elementary 4 students in the content and cognitive domains, by gender. The differences are statistically significant in favour of boys in all domains except *Life science* and *Reasoning*, where the scores are equivalent. Internationally, in the majority of countries, girls outperformed boys in the *Life science* content domain and in the *Reasoning* cognitive domain, while boys performed better in the *Physical science* and *Earth science* content domains and in the *Knowing* cognitive domain.

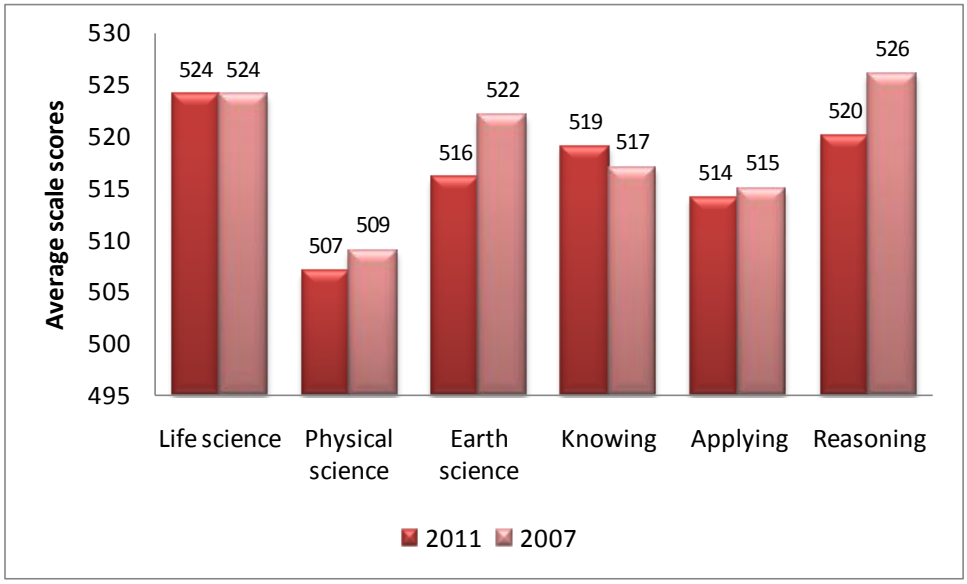
Table 4.10 Average achievement of Elementary 4 students in the science content and cognitive domains, by gender



Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

The science scores for Québec Elementary 4 students in the 2007 and 2011 studies are statistically equivalent in all domains evaluated.

Table 4.11 Trends in the achievement of Elementary 4 students in the science content and cognitive domains



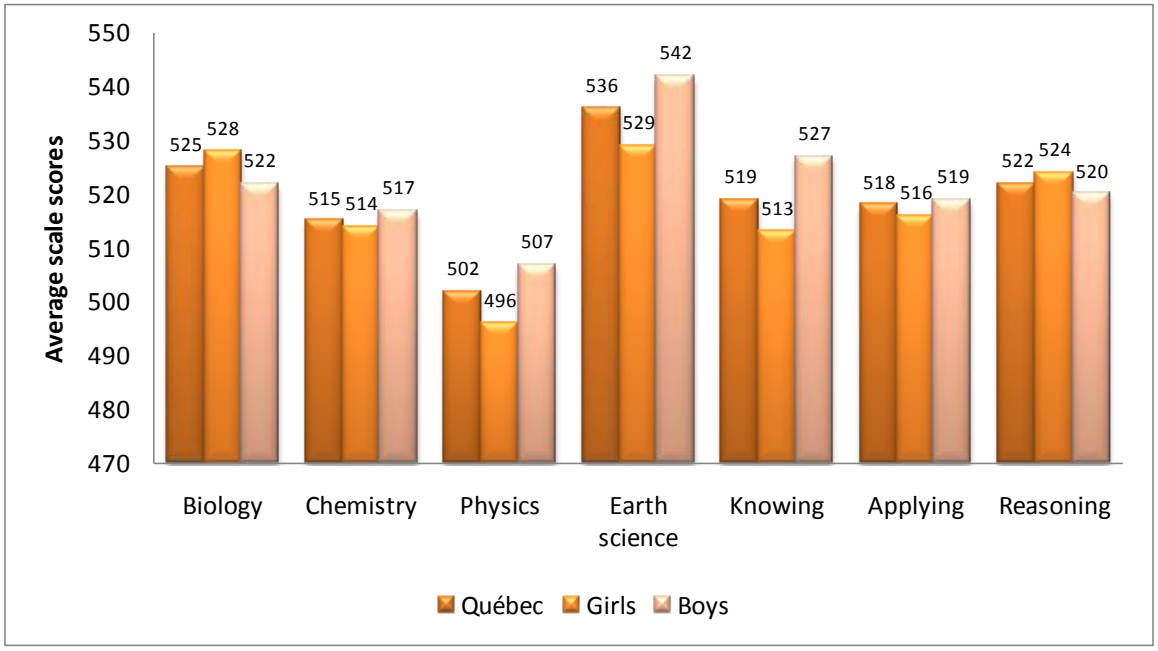
Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

4.4.2 Average achievement of Secondary II students, by domain

In TIMSS 2011, the results of only one benchmarking participant, Abu Dhabi, in all four items of the content domain were comparable to the average results in science. Québec students performed better in the *Life science* and *Earth science* domains. Two countries and three benchmarking participants, including Québec, performed equally well in all three of the cognitive domains.

Table 4.12 presents the average scale scores obtained by Québec Secondary II students in the content and cognitive domains, by gender. Québec boys obtained statistically higher results than the girls in the domains of *Physics, Earth science* and *Knowing.* There are no significant gender gaps in performance in the other domains. Internationally, girls obtained better results than boys in the domains of *Biology, Chemistry, Knowing, Applying* and *Reasoning*, and boys performed better than girls in the domain of *Earth science.*

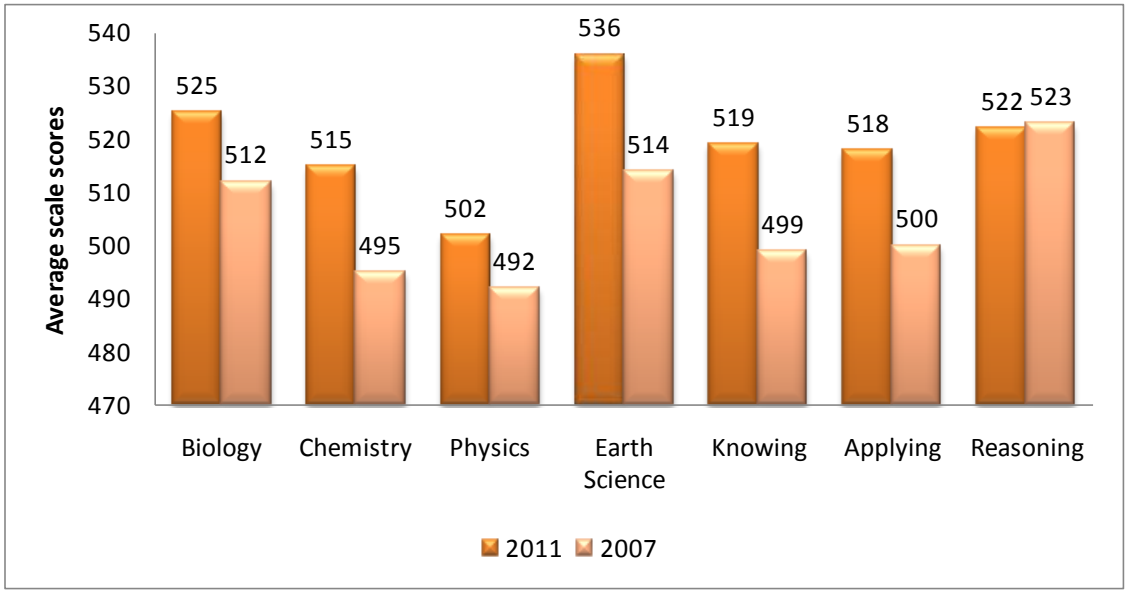
Table 4.12 Average achievement of Secondary II students in the science content and cognitive domains, by gender



Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

The results in mathematics for Secondary II Québec students in 2011 are statistically higher than the 2007 scores, except for *Reasoning*.

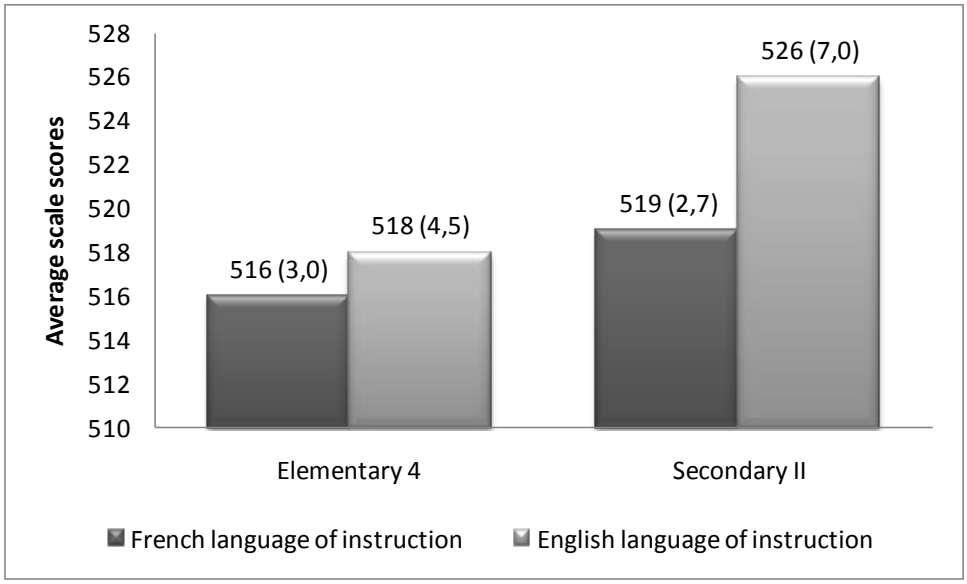
Table 4.13 Trends in the achievement of Secondary II students in the science content and cognitive domains



Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

4.5 Achievement by language of instruction

Table 4.14 Achievement in science by language of instruction.



5 Behaviours and attitudes: responses to contextual questionnaires

The *Student Questionnaire* and the questionnaires for students' parents, teachers and school principals were designed to gather all necessary information about students' home and school experiences in developing their competencies in mathematics and in science.

5.1 Mathematics

5.1.1 School composition by student socioeconomic background

In the *School Questionnaire*, school principals had to indicate the percentage of students in their schools coming from economically disadvantaged homes and the percentage of students coming from economically affluent homes. The table below provides this information.

Table 5.1 Elementary school composition by student economic background and average achievement in mathematics (reported by school principals)

	Schools with more affluent than disadvantaged students		Schools with neither more affluent nor more disadvantaged students		Schools with more disadvantaged than affluent students	
	Percentage of students	Average achievement	Percentage of students	Average achievement	Percentage of students	Average achievement
	Elementary 4					
Québec	60 (4.1)	538 (2.8)	25 (4.0)	525 (6.3)	15 (2.7)	522 (6.0)
International	36 (0.5)	508 (1.0)	35 (0.6)	494 (1.0)	30 (0.5)	470 (1.2)
	Secondary II/Grade 8					
Québec	51 (4.1)	542 (4.3)	32 (3.8)	523 (5.2)	17 (3.5)	514 (6.3)
International	32 (0.5)	494 (1.4)	33 (0.6)	471 (1.2)	36 (0.5)	448 (1.3)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Québec students attending schools with more affluent than disadvantaged students performed better than students attending schools with more disadvantaged students than affluent students, with an advantage of 16 points in mathematics in elementary school and 28 points in secondary school. In comparison, the international average shows that schools with more affluent students had an advantage of 38 points in elementary school and 46 points in Secondary II.

5.1.2 Home support for learning

The home environment can create a climate that encourages children and adolescents to explore and experiment with learning. The answers to the *Learning Survey* completed by parents of Elementary 4 students were correlated with the performance in mathematics in elementary school. The answers provided by Secondary II students were also correlated with their performance in mathematics. The main results are presented below.

Languages spoken at home

According to parents who responded to the TIMSS 2011 *Learning Survey*, 94% of Québec **Elementary 4** students spoke the test language (French or English) before they started school. This proportion is similar to the international average of 91%. However, 6% of Québec students also spoke a language other than French or English before they started school.

Table 5.2 Average scale score of Québec Elementary 4 students, by language spoken at home before starting school (reported by students' parents)

	Spoke the test language before starting school	Did not speak the test language before starting school
Average score in mathematics	535 (2.6)	525 (5.1)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

According to the data gathered from the *Student Survey*, 89% of Secondary II students always or almost always speak the test language (French or English) at home, 8% sometimes speak it at home and 3% never speak it at home. The table below presents the average scores associated with each of these groups.

Table 5.3 Average scale score of Québec Secondary II students, by frequency of use of the test language at home (reported by Secondary II students)

	Always or almost always speak the test language at home	Sometimes speak the test language at home	Never speak the test language at home
Average score in mathematics	532 (2.4)	522 (4.9)	552 (9.1)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Home resources

The Home Resources scale is based on data gathered on parental level of education, the number of books in the home and the number of home-study supports (e.g. students having their own room and an Internet connection). On this scale, which varies on the international level from 7.1 to 11.5 for Elementary 4 and from 7.9 to 11.6 for Secondary II, Québec is among the countries with the most home resources (11.1). Although Québec students with *many resources* (see Table 5.4) had average scores in mathematics that were higher than those of students with *some resources*, this achievement difference remains one of the smallest among the TIMSS 2011 participants.

Table 5.4 Home resources available for learning (reported by parents of Elementary 4 students and by Secondary II students)

	Many resources		Some resources		Few resources	
	Percentage of students	Average achievement	Percentage of students	Average achievement	Percentage of students	Average achievement
	Elementary 4					
Québec	29 (1.6)	559 (2.8)	71 (1.6)	526 (2.5)	0 (0.1)	~ ~[6]
International	17 (0.2)	555 (0.9)	74 (0.2)	497 (0.6)	9 (0.1)	436 (1.8)
	Secondary II/Grade 8					
Québec	19 (0.8)	563 (3.5)	80 (0.8)	525 (2.3)	1 (0.2)	~ ~
International	12 (0.1)	530 (1.2)	67 (0.2)	470 (0.6)	21 (0.2)	415 (1.0)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Engagement of parents and their attitudes toward mathematics

Parents of Elementary 4 students were asked how often they participated in a certain number of numeracy-related activities[7] with their child before he or she started school, and an Early Numeracy Activities scale was created. A large percentage of Québec parents indicated that they often participated in numeracy-related activities and the resulting average scale score places Québec 13th among participating countries.

6 Insufficient data to establish an average

7 Parents were asked about the following nine activities: saying counting rhymes or singing counting songs; playing with construction toys; playing games involving numbers and shapes; counting different things; playing card games.

Table 5.5 Average scale scores in mathematics in Québec, by parental participation in numeracy-related activities

	Often participated in numeracy-related activities		Sometimes participated in numeracy-related activities		Never or almost never participated in numeracy-related activities	
	Percentage of students	Average achievement	Percentage of students	Average achievement	Percentage of students	Average achievement
Elementary 4	57 (1.1)	539 (2.6)	41 (1.1)	530 (3.0)	2 (0.4)	~ ~
International	49 (0.2)	510 (0.7)	45 (0.2)	493 (0.7)	6 (0.1)	460 (1.8)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Homework

A total of 48% of Secondary II students spent between 45 minutes and 3 hours a week on mathematics homework. These students' average score in mathematics was 539 points, 37 points higher than the average score of students who spent less than 45 minutes a week (35%) and 15 points higher than the average score of students who spent more than 3 hours a week on mathematics homework (16%).

5.1.3 Students' attitudes and behaviours with regard to mathematics

TIMSS explores student motivation using scales designed to measure the intrinsic value and the utility value that students place on mathematics and their perception of their abilities in mathematics. There is a positive link between liking mathematics, having confidence in one's mathematical abilities, engagement in mathematics lessons and the scores obtained in mathematics.

Students' attitude to learning mathematics

Five questions[8] were used to assess the degree to which students enjoyed learning mathematics. In Québec, 42% of Elementary 4 students enjoyed learning mathematics, a percentage below the international average of 48% but higher than the averages for Alberta (36%) and Ontario (35%). Internationally, the average scale score varies between 9.0 and 11.3.

In Secondary II, 44% of students stated that they did not enjoy learning mathematics, compared with 31% internationally, 34% in Ontario and 40% in Alberta. Internationally, the average scale score varies from 8.6 to 11.2.

8 Students were asked how much they agreed with the following five statements: I enjoy learning mathematics; I wish I did not have to study mathematics; Mathematics is boring; I learn many interesting things in mathematics; and I like mathematics.

Table 5.6 Average achievement in mathematics in Québec, by attitude to learning mathematics

	Students enjoy learning mathematics		Students somewhat enjoy learning mathematics		Students do not enjoy learning mathematics		Average scale score
	Percentage of students	Average achievement	Percentage of students	Average achievement	Percentage of students	Average achievement	
Elementary 4	42 (1.2)	547 (2.5)	37 (0.9)	532 (3.1)	22 (1.2)	510 (3.9)	9.7 (0.05)
Secondary II	12 (0.7)	557 (3.9)	43 (0.9)	540 (2.4)	44 (1.2)	517 (2.6)	9.3 (0.05)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Student confidence in mathematical abilities

In Québec, 37% of Elementary 4 students said that they were very confident about their abilities in mathematics.[9] This proportion is higher than the international average (34%) and the proportion for Ontario (33%), and is equivalent to the proportion for Alberta (35%).

In Québec, the percentage of students who say that they are *not confident* in mathematics is lower in in Secondary II than Elementary 4, just as it is at the international level, where the proportion is 21% in Elementary 4 and 41% in Secondary II.

9 Students were asked to indicate how much they agreed with the following seven statements: I usually do well in mathematics; I find mathematics easy; Mathematics is harder for me than for many of my classmates; I am just not good at mathematics; I am good at working out difficult mathematics problems; My teacher tells me I am good at mathematics; and Mathematics is harder for me than any other subject.

Table 5.7 Average achievement in mathematics in Québec, by student confidence in mathematics

	Very confident		Somewhat confident		Not confident	
	Percentage of students	Average achievement	Percentage of students	Average achievement	Percentage of students	Average achievement
Elementary 4	37 (1.0)	562 (2.5)	44 (1.1)	527 (2.9)	19 (1.0)	490 (3.7)
Secondary II	21 (0.9)	574 (2.8)	47 (0.9)	540 (2.3)	32 (1.1)	492 (2.8)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Engagement in mathematics lessons

For most of the countries, there is a positive linear relationship between student engagement in mathematics lessons and achievement in mathematics.[10] In Québec, 39% of Elementary 4 students considered themselves engaged in mathematics lessons, as compared with 42% internationally, 45% in Alberta and 43% in Ontario. In Secondary II, the proportion of students who consider themselves engaged in mathematics lessons plummets. In Québec, 13% stated that they were engaged, as compared with 25% internationally, 14% in Alberta and 24% in Ontario.

Table 5.8 Average achievement in mathematics in Québec, by student engagement in mathematics lessons

	Very engaged		Somewhat engaged		Not engaged	
	Percentage of students	Average achievement	Percentage of students	Average achievement	Percentage of students	Average achievement
Elementary 4	39 (1.1)	545 (2.6)	52 (1.0)	528 (3.1)	8 (0.6)	514 (5.0)
Secondary II	13 (0.8)	542 (4.1)	60 (1.0)	536 (2.4)	27 (1.4)	519 (2.7)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

10 Students were asked how much they agreed with the following statements: I know what my teacher expects me to do; I think about things not related to the lesson; My teacher is easy to understand; I am interested in what my teacher says; and My teacher gives me interesting things to do.

5.1.4 Mathematics teachers

Professional development

Professional development is one of the variables measured by the *Teachers' Questionnaire*. Table 5.9 presents the Québec data in relation to the international data. As stated in the international report (Mullis et al., 2012), past studies have not been conclusive about the impact of teachers' professional development on the numeracy performance of students. Professional development could be linked to collaborative working habits and teachers' confidence with respect to mathematics content.

Table 5.9 Percentage of teachers participating in areas of professional development in mathematics

	Mathematics content	Mathematics instruction	Mathematics curriculum	Integrating information and communications technologies	Improving students' critical thinking or problem solving skills	Mathematics assessment
	Elementary 4					
Québec	58 (4.1)	55 (4.2)	35 (4.2)	18 (3.4)		57 (4.7)
International	44 (0.5)	46 (0.5)	41 (0.5)	33 (0.5)		37 (0.5)
	Secondary II/Grade 8					
Québec	53 (4.3)	46 (4.2)	49 (4.0)	43 (4.0)	17 (2.8)	63 (3.9)
International	55 (0.5)	58 (0.6)	52 (0.5)	48 (0.5)	43 (0.6)	47 (0.5)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Elementary 4 and Secondary II teachers consider themselves very well prepared to teach the content found in the TIMSS study and 90% of Elementary 4 and Secondary II students are taught by teachers who state that they are very well prepared to teach the overall content of TIMSS 2011. More specifically, among the four content domains of Secondary II, *Data and chance* stands out with the lowest percentage (69%) of students taught by teachers who consider themselves very well prepared to teach this subject.

In the area of collaboration to improve teaching, 21% of Québec Elementary 4 and 11% of Secondary II students in Québec are taught by teachers whose practices are very collaborative[11] (discussion about a particular topic, planning and preparing common instructional materials, etc.). Internationally, 36% of Elementary 4 and 28% of Secondary II students are taught by teachers whose practices are just as collaborative.

11 Scores were calculated based on teachers' answers with respect to the following areas: discussion about how to teach a particular topic; collaboration in planning and preparing instructional materials; sharing their teaching experiences; visiting another classroom; and working together to try out new ideas.

Perceptions of working conditions and career satisfaction

In the TIMSS 2011 *Teachers' Questionnaire*, teachers were asked to share their perceptions of their working conditions.[12] In Elementary 4, the scale scores vary from 7.6 (Morocco) to 11.8 (Florida). In Secondary II, they vary from 8.7 (Ghana) to 12.5 (Florida). In correlation with working conditions, TIMSS examined teachers' level of career satisfaction.[13] In Elementary 4, the scale scores vary from 8.3 (Republic of Korea) to 11.3 (Georgia). In Secondary II, they vary from 8.2 (Republic of Korea) to 11.2 (Chile). Table 5.10 presents the results of the study of these two aspects.

Table 5.10 Working Conditions and Career Satisfaction scales for Québec teachers

	Teacher Working Conditions scale	Teacher Career Satisfaction scale
	Average scale score	Average scale score
Elementary 4 teachers	10.5 (0.16)	9.5
Secondary II teachers	11.0 (0.17)	10.0

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

The proportion of Elementary 4 students who are taught by teachers who are satisfied with their careers is 40%, one of the lowest percentages of all the TIMSS 2011 participating countries, the international average being 54%. At the secondary level, 46% of students are taught by teachers who are satisfied with their careers, a percentage that is within the international average of 47%.

The TIMSS study asked school principals about the impact of the availability of material resources on classroom instruction. In Québec, this factor has very little bearing on achievement in mathematics. The study also points out that 40% of Elementary 4 and 66% of Secondary II students in Québec attend schools where the principals report that classroom instruction is not at all affected by a lack of resources. The latter percentage is one of the highest among the participating countries.

School principals were also asked about the availability of human resources. According to the data gathered from secondary school principals, 34% of students attend schools where all the mathematics teaching positions are filled, which is one of the lowest percentages among the participating countries, and 5% of students attend schools that have a lot of difficulty filling these positions, with the international average being 4%.

12 A scale was designed based on the answers given concerning the following five areas: school building requiring repairs, overcrowded classrooms, teaching hours, teacher workspace, access to instructional materials and supplies.

13 This satisfaction scale was based on the following six statements: I am content with my profession as a teacher; I am satisfied with being a teacher at this school; I had more enthusiasm when I began teaching than I have now; I do important work as a teacher; I plan to continue as a teacher for as long as I can; and I am frustrated as a teacher.

Characteristics of students in the class and mathematics instruction

Students' characteristics and classroom management also affect the classroom climate and therefore learning. The lack of prerequisite knowledge or skills in Secondary II limits teaching *a lot* to a greater extent in Québec (34%) than internationally (28%) or in the other two Canadian provinces (18% in Ontario and 17% in Alberta). Students' lack of sleep limits the teaching of mathematics for the majority of Québec teachers at the elementary and secondary levels. In addition, the presence of disruptive students seems to limit teaching to a larger extent in Québec (23% in Elementary 4 and 25% in Secondary II) than internationally (13% in Elementary 4 and 17% in Secondary II) or in the other two Canadian provinces (16% and 15% in Alberta; 19% and 10% in Ontario).

Table 5.11 Characteristics of students who limit instruction in mathematics in Québec (reported by teachers)

	Lack of prerequisite knowledge or skills			Lack of nutrition		Lack of sleep		Disruptive		Uninterested	
	Not applicable or not at all	Some	A lot	Not applicable or not at all	Some or a lot	Not applicable or not at all	Some or a lot	Not applicable or some	A lot	Not applicable or some	A lot
Elementary 4	28 (4.0)	57 (5.0)	15 (3.0)	73 (3.5)	27 (3.5)	35 (3.8)	66 (3.8)	77 (3.8)	23 (3.8)	90 (2.8)	10 (2.8)
Secondary II	21 (3.6)	45 (4.2)	34 (3.8)	76 (3.0)	24 (3.0)	29 (3.7)	71 (3.7)	75 (3.2)	25 (3.2)	79 (3.2)	21 (3.2)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Resources for basic instruction

The resources used are varied and Québec sets itself apart from the other Canadian provinces by its higher percentage of teachers using workbooks as a favoured resource (see Table 5.12).

Table 5.12 Percentage of students whose teachers use certain resources for basic instruction (reported by teachers)

	Percentage of students whose teachers use:			
	Textbooks	**Workbooks or worksheets**	**Concrete objects or materials that help students understand quantities or procedures**	**Mathematics software**
	Elementary 4			
Québec	55 (4.6)	48 (4.7)	28 (4.1)	3 (1.3)
International	75 (0.4)	46 (0.5)	37 (0.5)	9 (0.3)
	Secondary II/Grade 8			
Québec	45 (4.2)	54 (4.7)	17 (3.2)	6 (1.1)
International	77 (0.4)	34 (0.5)	23 (0.5)	7 (0.3)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Evaluation practices and follow-up of learning

Most Secondary II students are taught by teachers who test learning in mathematics at least once every two weeks (71%). Internationally, 45% of students are tested at a similar frequency.

During mathematics tests, Québec Secondary II students are almost always asked questions that involve applications of mathematical procedures (93%). The frequency of questions involving the application of mathematical procedures is significantly higher in Québec than it is internationally (77%), in Alberta (77%) or in Ontario (85%).

Instructional activities in mathematics

There are many instructional approaches that can be used in teaching mathematics. TIMSS asked teachers how often they used various approaches and the following table presents the percentage of students taught by teachers who confirm that they *always* or *almost always* use these approaches.

Table 5.13 Instructional approaches in mathematics class (reported by teachers)

	Percentage of students doing the following pedagogical activity for every lesson or almost every lesson					
	Work on problems (individually or with peers), with teacher guidance	Work on problems together as a class with direct teacher guidance	Work on problems (individually or with peers) while teacher occupied by other tasks	Memorize rules, procedures and facts	Explain their answers	Apply facts, concepts and procedures
	Elementary 4					
Québec	37 (4.7)	35 (4.9)	14 (3.1)	29 (3.9)	49 (4.5)	
International	55 (0.5)	45 (0.5)	16 (0.4)	37 (0.5)	62 (0.5)	
	Secondary II/Grade 8					
Québec	56 (4.3)	54 (4.5)	18 (3.2)	34 (4.0)	45 (3.9)	40 (3.7)
International	55 (0.6)	48 (0.6)	14 (0.4)	45 (0.5)	60 (0.5)	49 (0.6)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

5.1.5 School climate

Emphasis on academic success

The emphasis placed by the school on academic success was evaluated using a series of five questions concerning academic optimism.[14] The responses were used to create the School Emphasis on Academic Success scale (see Table 5.14). Based on this scale, students were grouped into three categories of school, as perceived by the principal and teachers.

14 The questions related to teachers' understanding of the school's curricular goals; teachers' degree of success in implementing the school's curriculum; teachers' expectations for student achievement; parental support for student achievement; and students' desire to do well in school.

Table 5.14 Distribution of students on the School Emphasis on Academic Success scale (reported by principals)

	Very high emphasis (%)	High emphasis (%)	Medium emphasis (%)
Québec – Elementary 4	5 (1.6)	75 (3.6)	21 (3.4)
Québec – Secondary II	**7 (1.8)**	**62 (4.1)**	**31 (3.7)**

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

in Québec, the impact of the emphasis placed by the school on academic success is particularly pronounced, with a gap of 44 points between Elementary 4 students attending schools where the emphasis placed on academic success is *very high* (563 points) and those attending schools where the emphasis is *medium* (519 points). In secondary school, there is an even wider gap, with 64 points between *very high* (576 points) and *medium* (512 points).

Teachers were asked the same questions and the results are presented below. A difference of 32 points (26 points internationally) separates Elementary 4 students attending schools where, according to the teachers, the emphasis placed on academic success is *very high* (555 points) and those attending schools where the emphasis is *medium* (523 points). The difference, 48 points for Québec and 54 points internationally, is even more pronounced for secondary schools.

Table 5.15 Distribution of students on the School Emphasis on Academic Success scale (reported by teachers)

	Very high emphasis (%)	High emphasis (%)	Medium emphasis (%)
Québec – Elementary 4	5 (1.9)	67 (4.1)	28 (4.1)
Québec – Secondary II	4 (1.7)	46 (4.2)	50 (4.1)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Safety and discipline at school

The school climate was evaluated using a series of five statements concerning safety and orderliness[15] with which teachers had to indicate their degree of agreement or disagreement. The results are presented in Table 5.16.

15 The statements were: This school is located in a safe neighbourhood; I feel safe at this school; This school's security policy and practices are sufficient; The students behave in an orderly manner; and The students are respectful of teachers.

Table 5.16 Distribution of students on the Safe and Orderly School scale (reported by teachers)

	Safe and orderly (%)	Somewhat safe and orderly (%)	Not safe and orderly (%)
Québec – Elementary 4	45 (4.5)	50 (4.4)	5 (1.9)
Québec – Secondary II	38 (3.8)	59 (6.2)	3 (1.2)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS). 2011.

The percentage of Québec students attending schools that teachers consider *safe and orderly* is among the lowest of the participating countries. The achievement gap between students at schools perceived as *safe and orderly* and students at schools seen as *not safe and orderly* is 14 points for Elementary 4 (32 points internationally). In Secondary II, the difference between these two categories of school is 19 points (34 points internationally).

Problems with discipline in the classroom and school can interfere with learning. Table 5.17 presents the perceptions of school principals regarding the extent of 10 disciplinary and safety problems in their schools.[16]

Table 5.17 Distribution of students on the School Discipline and Safety scale (reported by school principals)

	Hardly any problems (%)	Minor problems (%)	Moderate problems (%)
Québec – Elementary 4	56 (4.3)	40 (4.1)	4 (1.9)
Québec – Secondary II	14 (2.6)	73 (3.9)	13 (2.8)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

The distributions for Québec are quite similar to the international average distributions.

The difference in achievement between Québec Elementary 4 students at schools with *hardly any problems* and those with *moderate problems* is 29 points. Internationally, this difference is 45 points. The difference in achievement between Secondary II students at schools with *hardly any problems* and those with *moderate problems* is 39 points in Québec and 46 points internationally.

[16] The statements about student behaviour related to arriving late at school; absenteeism (unjustified absences); classroom disturbance; cheating; rudeness; vandalism; theft; bullying or verbal abuse among students (including texting, e-mailing); fighting among students; bullying or verbal abuse of teachers or staff (including texting, e-mailing).

Bullying

Québec students were asked about how often they were bullied.[17] Nineteen percent of Elementary 4 students and 5% of Secondary II students stated that they had *often* experienced bullying. At the elementary school level, the Québec distributions were quite similar to the international ones. At the Secondary II level, the percentage of students who said that they were often victims of bullying is one of the lowest on the international scale.

Elementary 4 students who stated that they were *often* bullied have an average score that is 25 points lower than that of students reporting that they were *almost never* bullied (515 and 540 points). In Secondary II, the gap is 12 points (521 and 533 points).

Table 5.18 Results for the Students Bullied at School scale (reported by students)

	Almost never (%)	Sometimes (%)	Often (%)
Québec – Elementary 4	44 (1.4)	37 (1.1)	19 (1.1)
Québec – Secondary II	73 (0.9)	22 (0.7)	5 (0.4)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

[17] Students were asked how often they had experienced the following: I was made fun of or called names; I was left out of games or activities by other students; Someone spread lies about me; Something was stolen from me; I was hit or hurt by other students; and I was made to do things I didn't want to do by other students.

5.2 Science

5.2.1 School composition by student socioeconomic background

In the *School Questionnaire*, school principals had to indicate the percentage of students in their schools coming from economically disadvantaged homes and the percentage of students coming from affluent homes. The table below provides this information.

Table 5.19 Elementary school composition by student economic background (reported by school principals)

	Schools with more affluent than disadvantaged students		Schools with neither more affluent nor more disadvantaged students		Schools with more disadvantaged than affluent students	
	Percentage of students	Average achievement	Percentage of students	Average achievement	Percentage of students	Average achievement
	Elementary 4					
Québec	60 (4.1)	521 (2.9)	25 (4.0)	512 (6.2)	15 (2.7)	502 (6.2)
International	36 (0.5)	505 (1.0)	35 (0.6)	489 (1.0)	30 (0.5)	463 (1.3)
	Secondary II/Grade 8					
Québec	51 (4.1)	529 (4.4)	32 (3.8)	515 (5.7)	17 (3.5)	501 (6.14)
International	32 (0.5)	501 (1.3)	33 (0.6)	481 (1.2)	36 (0.5)	458 (1.3)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Québec students attending schools with more affluent than disadvantaged students performed better in science than students attending schools with more disadvantaged than affluent students, with an advantage of 19 points in science in elementary school and 28 points in secondary school. In comparison, the international average shows that schools with more affluent students had an advantage of 42 points in elementary school and 46 points in Secondary II.

5.2.2 Home support for learning

The home environment can create a climate that encourages children and adolescents to explore and experiment with learning. The answers to the *Learning Survey* completed by parents of Elementary 4 students were correlated with students' performance in science in elementary school. The answers provided by Secondary II students were also correlated with their performance in science. The main results are presented below.

Languages spoken at home

According to parents who responded to the TIMSS 2011 *Learning Survey*, 94% of Québec Elementary 4 students spoke the test language (French or English) before they started school. This proportion is similar to the international average of 91%. However, 6% of Québec students spoke a language other than French or English before they started school. The gap between the average scores of the two groups is 17 points in Québec and 40 points internationally.

Table 5.20 Average scale score of Québec Elementary 4 students, by language spoken at home before starting school (reported by students' parents)

	Spoke the test language before starting school	Did not speak the test language before starting school
Average score in science	520 (2.7)	503 (6.7)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

According to the data gathered from the *Student Survey*, 89% of Secondary II students always or almost always speak the test language (French or English) at home, 8% sometimes speak it at home and 3% never speak it at home. The table below presents the average scores associated with each of these groups. In Québec, the frequency of use of the test language at home does not appear to be linked to the average score in science. Internationally, students who always speak the test language at home had an average score that was 57 points higher than the average score obtained by students who never spoke the test language at home.

Table 5.21 Average scale score of Québec Secondary II students, by frequency of use of the test language at home (reported by Secondary II students)

	Always or almost always speak the test language at home	Sometimes speak the test language at home	Never speak the test language at home
Average score in science	522 (2.6)	501 (5.6)	522 (10.2)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Home resources

The Home Resources scale is based on data gathered on parental level of education, the number of books in the home and the number of home-study supports (e.g. students having their own room and an Internet connection). On this scale, which varies on the international level from 7.1 to 11.5 for Elementary 4 and from 7.9 to 11.6 for Secondary II, Québec is among the countries with the most home resources (11.1). Although Québec students with *many resources* (see Table 5.22) had average scores in science that were higher than those of students with *some resources*, this achievement difference remains one of the smallest among the TIMSS 2011 participants.

Table 5.22 Home resources available for learning (reported by parents of Elementary 4 students and by Secondary II students)

	Many resources		Some resources		Few resources	
	Percentage of students	Average achievement	Percentage of students	Average achievement	Percentage of students	Average achievement
	Elementary 4					
Québec	29 (1.6)	546 (3.0)	71 (1.6)	508 (2.8)	0 (0.1)	~ ~[18]
International	17 (0.2)	559 (0.9)	74 (0.2)	495 (0.6)	9 (0.1)	428 (2.0)
	Secondary II/Grade 8					
Québec	19 (0.8)	560 (3.0)	80 (0.8)	512 (2.6)	1 (0.2)	~ ~
International	12 (0.1)	540 (1.1)	67 (0.2)	480 (0.6)	21 (0.2)	424 (1.0)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Homework

The time spent on science homework does not seem to affect the average score in science. With regard to Secondary II students, 13% of them devote between 45 minutes and three hours a week to science homework and 86% spend less than 45 minutes a week.

5.2.3 Students' attitudes and behaviours with regard to science

TIMSS explores student motivation using scales designed to measure the intrinsic value and the utility value that students place on science and their perception of their abilities in science. There is a positive link between liking to learn science, confidence with science, engagement in science lessons and the scores obtained in science.

Students' attitude to learning science

Five questions[19] were used to assess the degree to which students enjoy learning science. In Québec, 52% of Elementary 4 students enjoyed learning science, which is equivalent to the international average of (53%).

In Secondary II, 24% of students stated that they enjoyed learning science, compared with 35% internationally. These proportions appear fairly consistent with the results on the Students Value Science scale.[20] In Québec, 27% of Secondary II students valued science (41% internationally) and 34% did not value science (26% internationally).

18 Insufficient data to report an average

19 Students were asked how much they agreed with the following five statements: I enjoy learning science; I wish I did not have to study science; Science is boring; I learn many interesting things in science; and I like science.

20 Students were asked how much they agreed with the following statements: I think learning science will help me in my daily life; I need science to learn other school subjects; I need to do well in science to get into the university of my choice; I need to do well in science to get the job I want; I would like a job that involves using science; and It is important to do well in science.

Table 5.23 Average achievement in science in Québec, by attitude to learning science

	Students enjoy learning science		Students somewhat enjoy learning science		Students do not enjoy learning science	
	Percentage of students	Average achievement	Percentage of students	Average achievement	Percentage of students	Average achievement
Elementary 4	52 (1.4)	524 (3.0)	34 (1.0)	511 (3.7)	14 (1.0)	502 (4.8)
Secondary II	24 (1.2)	547 (3.6)	48 (0.9)	522 (2.7)	29 (1.2)	496 (3.6)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Student confidence in science abilities

Forty-seven percent of Québec Elementary 4 students said that they were very confident about their abilities in science.[21] This proportion is higher than the international average of 43%. In Secondary II, the percentage of students who stated that they were confident about their abilities in science (19%) is lower than for Elementary 4 but similar to the international average of 20%.

21 Students were asked how much they agreed with the following six statements: I usually do well in science; Science is harder for me than for many of my classmates; I am just not good at science; I learn things quickly in science; My teacher tells me I am good at science; and Science is harder for me than any other subject.

Table 5.24 Average achievement in science in Québec, by student confidence in science

	Very confident		Somewhat confident		Not confident	
	Percentage of students	Average achievement	Percentage of students	Average achievement	Percentage of students	Average achievement
Elementary 4	47 (1.3)	528 (2.9)	38 (1.0)	512 (3.2)	15 (0.9)	491 (4.5)
Secondary II	19 (1.0)	550 (3.7)	60 (0.8)	521 (2.7)	21 (1.0)	491 (3.7)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Engagement in science lessons

In most countries, there is a positive linear relationship between student engagement in science lessons and achievement in science.[22] In Québec, 48% of Elementary 4 students consider themselves to be engaged in science lessons, slightly more than the international average of 45%. In Secondary II in Québec, the percentage of students who say that they are engaged in science lessons drops to 21%, compared with 29% internationally.

Table 5.25 Average achievement in science in Québec, by student engagement in science lessons

	Very engaged		Somewhat engaged		Not engaged	
	Percentage of students	Average score	Percentage of students	Average score	Percentage of students	Average score
Elementary 4	48 (1.2)	525 (2.5)	44 (1.2)	508 (3.5)	8 (0.5)	507 (5.5)
Secondary II	21 (0.9)	533 (3.8)	56 (1.0)	523 (2.5)	23 (1.4)	504 (4.4)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

22 Students were asked how much they agreed with the following statements: I know what my teacher expects me to do; I think about things not related to the lesson; My teacher is easy to understand; I am interested in what my teacher says; and My teacher gives me interesting things to do.

5.2.4 Science teachers

In Québec, the number of years of experience does not have a significant influence on the average score in science of either Elementary 4 or Secondary II students.

Professional development

Professional development is one of the variables measured by the *Teachers' Questionnaire*. Table 5.26 presents Québec data in relation to the international data.

Table 5.26 Percentage of teachers participating in areas of professional development in science

	Science content	Science instruction	Science curriculum	Integrating information and communications technologies	Improving students' critical thinking or inquiry skills	Science assessment
	Elementary 4					
Québec	23 (3.9)	23 (4.1)	12 (2.1)	16 (3.6)		13 (3.3)
International	35 (0.5)	34 (0.5)	34 (0.5)	28 (0.5)		27 (0.4)
	Secondary II/Grade 8					
Québec	50 (4.5)	49 (4.2)	40 (3.8)	39 (3.9)	11 (2.5)	43 (3.6)
International	55 (0.5)	58 (0.5)	53 (0.5)	49 (0.5)	43 (0.5)	48 (0.5)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

The feeling of being well prepared to teach the science subjects covered in the TIMSS study varies a lot between elementary and secondary school. Forty-one percent of Elementary 4 students are taught by teachers who state that they are very well prepared to teach the three content domains covered by TIMSS (*Life science*, *Physical science* and *Earth science*). This is one of the lowest percentages among the participating countries, with the international average being 62%. TIMSS also prepared a scale on the confidence of teachers in teaching science.[23] On this scale, the average scores for Elementary 4 students in the participating countries varied between 7.8 and 11.9. Québec (Elementary 4) posted an average score of 8.4 and only Japan posted a lower score (7.8).

Corresponding to the international average, 71% of Secondary II students are taught by teachers who consider themselves very well prepared to teach the overall content of TIMSS (*Biology*, *Chemistry*, *Physics* and *Earth science*). In Secondary II, the *Earth science* domain stands apart from the others, with the lowest percentage (63%) of students being taught by teachers who consider themselves very well prepared with respect to this subject. For Secondary II, the average scale scores of participating

23 A scale was designed based on the responses to items regarding answering students' questions about science; explaining science concepts or principles by doing science experiments; providing challenging tasks for capable students; adapting teaching to engage students' interest; and helping students appreciate the value of learning science.

countries on the Confidence in Teaching Science scale varied between 7.9 and 11.7, with Québec posting a 10.6.

In the area of collaboration to improve teaching, 20% of Elementary 4 and 14% of Secondary II students are taught by teachers whose practices are considered to be *very collaborative.*[24] In Québec, 58% of Elementary 4 and 62% of Secondary II students have teachers who use *collaborative* practices to improve the teaching of science. This factor is not, however, associated with any significant differences between the average science scores obtained by students.

Perceptions of working conditions and career satisfaction

In the TIMSS 2011 *Teachers' Questionnaire*, teachers were asked to share their perceptions of their working conditions.[25] In correlation with working conditions, TIMSS examined teachers' level of career satisfaction.[26] Table 5.27 presents the results of the study of these two aspects.

Table 5.27 Working Conditions and Career Satisfaction scales for Québec teachers

	Teacher Working Conditions scale	Teacher Career Satisfaction scale
	Average scale score	Average scale score
Elementary 4 teachers	10.6 (0.17)	9.6 (0.15)
Secondary II teachers	10.7 (0.12)	9.9 (0.15)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

The proportion of Elementary 4 and Secondary II students in Québec who have teachers who are satisfied with their careers is 45%. Internationally, the average percentage of students taught by teachers who are satisfied with their working conditions is 54% for Elementary 4 and 47% for Secondary II.

The TIMSS study asked school principals about the impact of the availability of material resources on classroom instruction. In Québec, this factor appears to have a direct bearing on the average scores obtained in science, unlike mathematics where the opposite is true. In Elementary 4, the gap between the average scores of students for whom instruction is *somewhat affected* by resource shortages and those for whom instruction is *not affected* by resource shortages is 12 points in Québec, with the international average being 10 points. In Secondary II, this gap is also 12 points in Québec, but an average of 20 points internationally. In Secondary II, however, Québec

24 Scores were calculated based on teachers' answers with respect to the following areas: discussion about how to teach a particular topic; collaboration in planning and preparing instructional materials; sharing their teaching experiences; visiting another classroom; and working together to try out new ideas.

25 A scale was designed based on the answers given concerning the following five areas: school building requiring repairs, overcrowded classrooms, teaching hours, teacher workspace, access to instructional materials and supplies.

26 This satisfaction scale was based on the following six statements: I am content with my profession as a teacher; I am satisfied with being a teacher at this school; I had more enthusiasm when I began teaching than I have now; I do important work as a teacher; I plan to continue as a teacher for as long as I can; and I am frustrated as a teacher.

has the largest percentage of students who are *not affected* by science resource shortages among the countries participating in TIMSS for Secondary II.

Table 5.28 Instruction affected by science resource shortages in Québec (reported by school principals)

	Not affected		Somewhat affected		Affected a lot		Average scale score
	Percentage of students	Average score	Percentage of students	Average score	Percentage of students	Average score	
Elementary 4	30 (4.4)	525 (3.9)	69 (4.3)	513 (3.3)	1 (0.7)	~ ~[27]	10.7 (0.15)
Secondary II	65 (3.4)	526 (3.5)	35 (3.4)	510 (4.3)	0 (0.0)	~ ~	12.0 (0.13)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

School principals also reported on the availability of a laboratory for science instruction. In Elementary 4,14% of students attend schools that have a science laboratory (36% internationally) and their average score is significantly higher than that of students whose school does not have a laboratory. In Secondary II, almost all of the students (99%) attend schools that have a science laboratory (80% internationally, 85% in Alberta and 52% in Ontario). In addition, 93% of Secondary II students have technical assistance when they work in the laboratory (20% internationally, 23% in Alberta and 13% in Ontario).

School principals were also asked about the availability of human resources. According to the data gathered from secondary school principals, 32% of students attend schools where all the science teaching positions are filled. The corresponding percentages for Alberta and Québec are 59% and 71% respectively, while the international average is 56%.

Characteristics of students in the class and science instruction

Students' characteristics and classroom management also affect the classroom climate and therefore learning. It is the students' lack of sleep that limits science instruction for the majority of Québec teachers at the elementary and secondary levels. In addition, the presence of disruptive students seems to limit teaching to a greater extent in Québec (22% in elementary and 29% in secondary) than internationally (13% in elementary and 17% in Secondary II). In the other Canadian provinces, the percentage is 15% for both Elementary 4 and Secondary II in Alberta, and 19% for Elementary 4 and 15% for Secondary II in Ontario.

27 Insufficient data to report an average

Table 5.29 Characteristics of students who limit instruction in science in Québec (reported by teachers)

	Lack of prerequisite knowledge or skills			Lack of nutrition		Lack of sleep		Disruptive		Uninterested	
	Not appli-cable or not at all	Some	A lot	Not appli-cable or not at all	Some or a lot	Not appli-cable or not at all	Some or a lot	Not appli-cable or some	A lot	Not appli-cable or some	A lot
Elemen-tary 4	29 (4.3)	57 (4.8)	13 (2.8)	74 (3.8)	26 (3.8)	38 (3.8)	62 (3.8)	78 (4.1)	22 (4.1)	91 (2.5)	9 (2.5)
Second-ary II	29 (3.7)	53 (4.1)	18 (3.4)	72 (3.7)	28 (3.7)	40 (4.3)	60 (4.3)	71 (3.5)	29 (3.5)	80 (3.1)	20 (3.1)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Resources for basic instruction

In Québec, the resources used are varied and workbooks are used by a larger percentage of teachers.

Table 5.30 Percentage of students whose teachers use certain resources for basic instruction in science

	Percentage of students whose teachers use:			
	Textbooks	**Workbooks or worksheets**	**Concrete objects or materials that help students understand quantities and processes**	**Mathematics software**
	Elementary 4			
Québec	23 (3.7)	42 (4.3)	31 (4.0)	2 (1.2)
International	70 (0.4)	41 (0.5)	36 (0.5)	11 (0.3)
	Secondary II /Grade 8			
Québec	41 (4.4)	44 (4.3)	46 (4.2)	6 (1.9)
International	74 (0.4)	35 (0.5)	43 (0.5)	16 (0.4)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Evaluation practices and follow-up of learning

Data gathered from teachers give a picture of the kinds of questions favoured for evaluating science.

Most Secondary II students (59%) are taught by teachers who evaluate learning in science monthly by means of tests or examinations, and 27% of students are tested this

way at least every two weeks. Internationally, the average percentages are 41% and 35% respectively.

During tests or examinations, 73% of Québec Secondary II students are almost always asked questions that involve the application of knowledge and understanding, and 60% must almost always produce an explanation or justification. Questions involving the development of hypotheses and investigative procedures are asked less frequently, with 66% of students having teachers who do this a few times during the year.

Emphasis on scientific inquiry

Several countries place special emphasis on the process of scientific inquiry in their science curricula. TIMSS asked teachers how frequently they engaged students in activities linked to the investigative process (observation and description of a natural phenomenon, demonstration, directed experiment, planning an experiment, etc.). In elementary school, the percentages of students associated with the different frequencies of scientific inquiry activities are comparable to the international averages. In secondary school, the Québec data are comparable to findings for the other two Canadian provinces but differ significantly from the international data, which show that 48% of students are taught by teachers who claim they emphasize scientific inquiry in more than half the lessons.

Table 5.31 Students with teachers who emphasize scientific inquiry (reported by teachers)

	About half the lessons or more emphasized scientific inquiry (%)		Less than half the lessons emphasized scientific inquiry (%)	
	Percent of students	Average achievement	Percent of students	Average achievement
Québec Elementary 4	36 (4,6)	522 (3,8)	64 (4,6)	513 (3,0)
Québec Secondary II	27 (3,4)	518 (5,4)	73 (3,4)	521 (3,5)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

5.2.5 School climate

Emphasis on academic success

The emphasis placed by the school on academic success was evaluated using a series of five questions concerning academic optimism.[28] The responses were used to create the School Emphasis on Academic Success scale. Based on this scale, students were grouped into three categories of school, as perceived by the principal and teachers.

28 These questions were related to teachers' understanding of the school's curricular goals; teachers' degree of success in implementing the school's curriculum; teachers' expectations for student achievement; parental support for student achievement; and students' desire to do well in school.

Table 5.32 Distribution of students on the School Emphasis on Academic Success scale (reported by principals)

	Very high emphasis (%)	High emphasis (%)	Medium emphasis (%)
Québec – Elementary 4	5 (1.6)	75 (3.6)	21 (3.4)
Québec – Secondary II	7 (1.8)	62 (4.1)	31 (3.7)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

In Québec, the correlation between the emphasis placed by the school on academic success and the average score in science is particularly strong. Elementary 4 students attending schools where the emphasis placed on academic success is *very high* scored an average of 549 points and those attending schools where the emphasis placed on academic success is *medium* had an average score of 503 points. This 46-point gap is wider than the 37-point gap observed in the international averages. In secondary school, the gap is even more pronounced with the respective average scale scores being 561 and 501 points. Internationally, the difference is 44 points.

Teachers were asked the same questions and the results are presented below. A difference of 20 points (27 points internationally) separates Elementary 4 students attending schools where, according to the teachers, the emphasis placed on academic success is *very high* (530 points) from those attending schools where the emphasis is *medium* (510 points). There is a more marked difference for secondary schools, with respective average scores of 561 and 506 points (41 points internationally).

Table 5.33 Distribution of data on the School Emphasis on Academic Success scale (reported by teachers)

	Very high emphasis (%)	High emphasis (%)	Medium emphasis (%)
Québec – Elementary 4	5 (1.8)	66 (4.3)	29 (4.3)
Québec – Secondary II	5 (2.2)	42 (4.2)	53 (3.6)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

Safety and discipline at school

The school climate was also evaluated using a series of five statements concerning safety and orderliness[29] with which teachers had to indicate their degree of agreement or disagreement. The results are presented in Table 5.34.

Table 5.34 Distribution of students on the Safe and Orderly School scale (reported by teachers)

	Safe and orderly (%)	Somewhat safe and orderly (%)	Not safe and orderly (%)
Québec – Elementary 4	43 (4.3)	53 (4.4)	4 (1.9)
Québec – Secondary II	44 (3.7)	54 (3.6)	2 (1.1)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

The percentage of Québec schools that teachers consider *safe and orderly* is below the average for participating countries. The achievement gaps between schools perceived as *safe and orderly* and those seen as *not safe and orderly* are significant.

Problems with discipline in the classroom and school can interfere with learning. Table 5.35 presents the perceptions of school principals regarding the extent of 10 disciplinary and safety problems in their schools.[30]

Table 5.35 Distribution of students on the School Discipline and Safety scale (reported by school principals)

	Hardly any problems (%)	Minor problems (%)	Moderate problems (%)
Québec – Elementary 4	56 (4.3)	40 (4.1)	4 (1.9)
Québec – Secondary II	14 (2.6)	73 (3.9)	13 (2.8)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

The distributions for Québec are quite similar to the international average distributions.

The difference in achievement between Québec Elementary 4 students attending schools with *hardly any problems* and those with *moderate problems* is 25 points. Internationally, this difference is 44 points. The difference in achievement between Québec Secondary II students attending schools with *hardly any problems* and those with *moderate problems* is 38 points, compared with 40 points internationally.

29 The statements were: This school is located in a safe neighbourhood; I feel safe at this school; This school's security policy and practices are sufficient; The students behave in an orderly manner; and The students are respectful of teachers.

30 The statements about student behaviour related to arriving late at school; absenteeism (unjustified absences); classroom disturbance; cheating; rudeness; vandalism; theft; bullying or verbal abuse among students (including texting, e-mailing); fighting among students; bullying or verbal abuse of teachers or staff (including texting, e-mailing).

Bullying

Québec students were asked how often they were bullied.[31] Nineteen percent of Elementary 4 students and 5% of Secondary II students stated that they had *often* experienced bullying. At the elementary school level, the Québec distributions were quite similar to the international ones. At the Secondary II level, the percentage of students who said that they were often victims of bullying is one of the lowest on the international scale (four countries have less than 5%).

Elementary 4 students who stated that they were *often* bullied have an average score that is 21 points lower than that of students reporting that they were *almost never* bullied. In Secondary II, the gap is not significant.

Table 5.36 Results for the Students Bullied at School scale (reported by students)

	Almost never (%)	Sometimes (%)	Often (%)
Québec – Elementary 4	44 (1.4)	37 (1.1)	19 (1.1)
Québec – Secondary II	73 (0.9)	22 (0.7)	5 (0.4)

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

31 Students were asked how often they had experienced the following: I was made fun of or called names; I was left out of games or activities by other students; Someone spread lies about me; Something was stolen from me; I was hit or hurt by other students; and I was made to do things I didn't want to do by other students.

6 Conclusion

ACHIEVEMENT

It is important to note that the achievement of Québec students in mathematics and science was above the international centrepoint in TIMSS 2011 (500).

The average result achieved by Québec's Elementary 4 students was significantly higher in 2011 (533 points) than in 2007 (519 points). Fourteen of the 60 countries and jurisdictions that participated in TIMSS Elementary 4 obtained a result significantly higher than Québec. Québec boys were more successful than girls and the gender gap has been widening since 1995.

Québec's Secondary II students achieved an average result of 532 points in mathematics, a slight increase of 3 points in comparison with the previous study. Only a few countries and jurisdictions that participated in TIMSS Secondary II achieved significantly higher results than Québec. These participants are the same countries and jurisdictions that outperformed Québec in 2007.

In science, Québec students obtained an average result of 516 points, equivalent to that of 2007 (517 points). Twenty-one countries and jurisdictions obtained a result significantly higher than Québec. In 2011, Québec boys obtained a statistically higher score than girls (520/512). The boys' performance improved between 2007 and 2011, while that of the girls declined.

Québec's Secondary II students' 2011 average scale score was 520 points, a significant improvement over their 2007 score of 507 points. Fifteen countries and jurisdictions obtained an average scale score significantly higher than Québec's.

CONTEXT

The school's composition by student socioeconomic background affects performance in mathematics and science, but less so than internationally. This also applies to home resources.

The frequency of parental engagement in numeracy-related activities is linked positively to higher average results for students in Elementary 4 mathematics. A total of 57% of parents stated that they often participate in numeracy-related activities.

Student confidence in mathematics is very strongly linked to performance in the mathematics assessment for both Elementary 4 and Secondary II. Thirty-seven percent of Québec's Elementary 4 students stated that they were very confident about their abilities in mathematics, 42% also said that they liked mathematics and

39% reported being engaged in their mathematics lessons. In Secondary II, however, this picture changes with 21% of students reporting that they were confident with mathematics, 12% responding that they liked mathematics and 13% stating that they were engaged in their mathematics lessons.

The results indicate that students are more interested in and confident about science than mathematics. Forty-seven percent of Québec's Elementary 4 students reported that they were very confident in science, 52% also said they liked learning science and 48% stated that they were engaged in their science lessons. However, like mathematics, the situation in Secondary II is different, with 19% of students stating that they were very confident in science, 24% that they enjoyed learning science and 21% that they were engaged in their science lessons.

The impact of teachers working in collaboration to improve teaching does not differ from one subject to the next: 21% in Elementary 4 and 11% in Secondary II of students assessed in mathematics had teachers whose practices were considered very collaborative on the TIMSS scale. In science, proportions are respectively 20% and 14%.

More than half the teachers consider that students' lack of sleep limits instruction in mathematics and science. Disruptive students interfere more with instruction in mathematics and science in Québec than internationally.

The impact of the emphasis placed by the school on achievement in mathematics and science is, in general, more pronounced in Québec than internationally. Based on the School Emphasis on Academic Success scale designed by TIMSS, students were grouped into three categories of school, as perceived by the principal and teachers. An analysis reveals that Elementary 4 students who attend schools that place *very high emphasis* on achievement obtain scores that are between 20 and 46 points[32] higher than those of students attending schools that place *medium emphasis* on achievement. This scale also reveals that Secondary II students who attend schools that place *very high emphasis* on achievement obtain scores that are between 32 and 64 points[33] higher than those of students attending schools that place *medium emphasis* on achievement.

Attending a safe and orderly school is linked to higher scores in mathematics and science, although the difference between schools is less pronounced in Québec than internationally. Although most of the schools are rated *somewhat safe and orderly* and very few schools report moderate discipline problems, 37% of Québec's Elementary 4 students have *sometimes* been bullied and 19% have *often* been bullied. In Secondary II, 22% of the students reported that they had *sometimes* been bullied and 5% that they had *often* been bullied.

32 The minimum and maximum gaps are taken from the Elementary 4 mathematics and science tables, prepared from data reported by school principals and by teachers.

33 The minimum and maximum gaps are taken from the Secondary II mathematics and science tables, prepared from data reported by school principals and by teachers.

APPENDIX 1

Standard error statistic, confidence interval and statistically significant difference

In TIMSS, the average achievement scale scores are based on representative samples of students. These scores provide estimates of the actual average achievement scale scores students would have demonstrated had they all taken the assessment. Because an estimate is rarely exact, it is common practice to provide a range of scores within which the "true" achievement level might fall. This range of scores is called a **confidence interval** and represents the high- and low-end points between which the actual achievement results should fall 95% of the time. The high- and low-end points are calculated by multiplying the standard error statistic by 2. In the TIMSS report, confidence intervals appear in parentheses next to the achievement scores.

The statistics presented here show that the actual achievement level of all students would fall somewhere in the established range of 19 times out of 20, if the assessment were repeated under the same conditions with a different sample of students. If the confidence intervals of the countries and provinces overlap, it is possible to conclude that the difference is defined as not statistically significant.

In this report, the term **statistically significant difference** means that any differences are probably "real" differences and not due to chance.

APPENDIX 2: TIMSS 2011 International Benchmarks of Mathematics Achievement, Elementary 4

Low International Benchmark – 400

Students have some basic mathematical knowledge. Students demonstrate an understanding of adding and subtracting with whole numbers. They demonstrate familiarity with triangles and informal coordinate systems. They can read information from simple bar graphs and tables.

Intermediate International Benchmark – 475

Students can apply basic mathematical knowledge in straightforward situations. Students at this level demonstrate an understanding of whole numbers. They can extend simple numeric and geometric patterns. They are familiar with a range of two-dimensional shapes. They can read and interpret different representations of the same data.

High International Benchmark – 550

Students can apply their knowledge and understanding to solve problems. Students can solve multi-step word problems involving operations with whole numbers. They can use division in a variety of problem situations. They demonstrate understanding of place value and simple fractions. Students can extend patterns to find a later specified term and identify the relationship between ordered pairs. Students show some basic geometric knowledge. They can interpret and use data in tables and graphs to solve problems.

Advanced International Benchmark – 625

Students can apply their understanding and knowledge in a variety of relatively complex situations and explain their reasoning. They can apply proportional reasoning in a variety of contexts. They demonstrate a developing understanding of fractions and decimals. They can select appropriate information to solve multi-step word problems. They can formulate or select a rule for a relationship. Students can apply geometric knowledge of a range of two- and three-dimensional shapes in a variety of situations. They can organize, interpret, and represent data to solve problems.

APPENDIX 3: TIMSS 2011 International Benchmarks of Mathematics Achievement, Secondary II (Grade 8)

Low International Benchmark – 400

Students have some knowledge of whole numbers and decimals, operations, and basic graphs.

Intermediate International Benchmark – 475

Students can apply basic mathematical knowledge in straightforward situations. They can add and multiply to solve one-step word problems involving whole numbers and decimals. They can work with familiar fractions. They understand simple algebraic relationships. They demonstrate understanding of properties of triangles and basic geometric concepts. They can read and interpret graphs and tables. They recognize basic notions of likelihood.

High International Benchmark – 550

Students can apply their understanding and knowledge in a variety of relatively complex situations. They can relate and compute with fractions, decimals, and percents, operate with negative integers, and solve word problems involving proportions. Students can work with algebraic expressions and linear equations. Students use knowledge of geometric properties to solve problems, including area, volume, and angles. They can interpret data in a variety of graphs and tables and solve simple problems involving probability.

Advanced International Benchmark – 625

Students can organize and draw conclusions from information, make generalizations, and solve non-routine problems. They can solve a variety of ratio, proportion, and percent problems. They can apply their knowledge of numeric and algebraic concepts and relationships. Students can express generalizations algebraically and model situations. They can apply their knowledge of geometry in complex problem situations. Students can derive and use data from several sources to solve multi-step problems.

APPENDIX 4: TIMSS 2011 International Benchmarks of Science Achievement, Elementary 4

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Low International Benchmark – 400

Students have some elementary knowledge of life science and physical science. Students can demonstrate some knowledge of simple facts related to human health and the behavioural and physical characteristics of animals. They recognize some properties of matter, and demonstrate a beginning understanding of forces. Students interpret labelled pictures and simple diagrams, complete simple tables, and provide short written responses to questions requiring factual information.

Intermediate International Benchmark – 475

Students can apply basic knowledge and understanding to practical situations in the sciences. Students recognize some basic information related to characteristics of living things and their interaction with the environment, and show some understanding of human biology and health. They also show some understanding of familiar physical phenomena. Students know some basic facts about the solar system and have a developing understanding of Earth's resources. They demonstrate some ability to interpret information in pictorial diagrams and apply factual knowledge to practical situations.

High International Benchmark – 550

Students can apply knowledge and understanding to explain everyday phenomena. Students demonstrate some understanding of plant and animal structure, life processes, and the environment and some knowledge of properties of matter and physical phenomena. They show some knowledge of the solar system, and of Earth's structure, processes, and resources. Students demonstrate beginning scientific inquiry knowledge and skills, and provide brief descriptive responses combining knowledge of science concepts with information from everyday experience of physical and life processes.

Advanced International Benchmark – 625

Students can apply their knowledge and understanding of scientific processes and relationships in beginning scientific inquiry. Students communicate their understanding of characteristics and life processes of organisms as well as of factors relating to human health. They demonstrate understanding of relationships among various physical properties of common materials and have some practical knowledge of electricity. Students demonstrate some understanding of the solar system and Earth's physical features and processes. They show a developing ability to interpret the results of investigations and draw conclusions as well as a beginning ability to evaluate and support an argument.

APPENDIX 5: TIMSS 2011 International Benchmarks of Science Achievement, Secondary II (Grade 8)

Low International Benchmark – 400

Students can recognize some basic facts from the life and physical sciences. They have some knowledge of the human body, and demonstrate some familiarity with everyday physical phenomena. Students can interpret pictorial diagrams and apply knowledge of simple physical concepts to practical situations.

Intermediate International Benchmark – 475

Students can recognize and communicate basic scientific knowledge across a range of topics. They demonstrate some understanding of characteristics of animals, food webs, and the effect of population changes in ecosystems. They are acquainted with some aspects of sound and force and have elementary knowledge of chemical change. They demonstrate elementary knowledge of the solar system, Earth's processes, and resources and the environment. Students extract information from tables and interpret pictorial diagrams. They can apply knowledge to practical situations and communicate their knowledge through brief descriptive responses.

High International Benchmark – 550

Students can demonstrate conceptual understanding of some science cycles, systems, and principles. They have some understanding of biological concepts including cell processes, human biology and health, and the interrelationship of plants and animals in ecosystems. They apply knowledge to situations related to light and sound, demonstrate elementary knowledge of heat and forces, and show some evidence of understanding the structure of matter, and chemical and physical properties and changes. They demonstrate some understanding of the solar system, Earth's processes and resources, and some basic understanding of major environmental issues. Students demonstrate some scientific inquiry skills. They combine information to draw conclusions, interpret tabular and graphical information, and provide short explanations conveying scientific knowledge.

Advanced International Benchmark – 625

Students can demonstrate a grasp of some complex and abstract concepts in biology, chemistry physics, and Earth science. They have an understanding of the complexity of living organisms and how they relate to their environment. They show understanding of the properties of magnets, sound, and light, as well as demonstrating understanding of structural matter and physical and chemical properties and changes. Students apply knowledge of the solar system and of Earth's features and processes, and apply understanding of major environmental issues. They understand some fundamentals of scientific investigation and can apply basic physical principles to solve some quantitative problems. They can provide written explanations to communicate scientific knowledge.

7 References

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