

# **Acquiring Literacy Skills: A Comparison of Provincial and International Results from PISA and IALSS**

**Final Report**

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The views expressed in this report are those of the authors and do not necessarily reflect the opinion of the Council of Ministers of Education, Canada, Statistics Canada, or the Canadian Education Statistics Council.

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**The SPR Associates Team:** Victor Thiessen conducted the statistical analyses for the study. Ted Adam Harvey, President, SPR Associates, implemented the Delphi consultations with provincial representatives and provided additional support to Victor Thiessen. Other SPR staff assisting with the research included Marian Ficysz, who designed the web surveys for the Delphi process, Maxime Cappeliez and Daciana Drimbe.

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For more information regarding the study methodology or other aspects of the final report, contact Victor Thiessen at [Victor.Thiessen@dal.ca](mailto:Victor.Thiessen@dal.ca)

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<sup>1</sup> A Delphi panel is a systematic method for structuring thinking with and between a group of experts or practitioners, to allow them to contribute to the resolution of problems, issues and challenges, or to identify potential future trends. The same participants are consulted in two or more rounds of questions with findings and feedback from each round circulated between panel members. The information and views obtained from each round provide input to the next round, so that overall consensus begins to emerge. In this study, consensus was sought regarding the development of an optimal research design, and also interpretation of preliminary results (see Howard Linstone, *The Delphi Method*, Addison Wesley, 1975).

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## Executive summary

**Introduction:** This report provides provincial and territorial educational authorities with comparative Canadian information intended to support evaluation and planning for educational policy. Additionally, it compares Canada's performance on literacy tests and its determinants with those of other countries. A primary reason for these comparisons is to attempt to reconcile inconsistent results from different surveys.

**Data Sources:** The analyses employ two international data sets that have developed standardized measures of literacy skills: the Program for International Student Assessment (PISA) and the International Adult Literacy Skills Survey (IALSS). The former are used to assess the reading achievement of 15 year olds from surveys conducted in 2000 and 2003. The latter are used to assess the prose skills of youth between the ages of 16 and 24. The international comparisons are limited to countries that took part in both assessments, namely Canada, Switzerland, Italy, Norway, and the USA.

**Delphi Panel:** A unique element of the study was the use of a Delphi panel of provincial stakeholders from seven provinces, who provided input to the researchers at two points: (1) in design of the analysis; and (2) in interpreting the initial results. Results of the Delphi panel were noteworthy, pointing out a number of refinements of the analysis plan, some adjustments in the interpretation of results, and identifying some areas for recommendations (particularly as regards data availability, such as the need for better data on Aboriginal status in the surveys).

**Findings on Provincial Comparisons:** Considerable consistency was found in provincial reading achievements across the two PISA surveys. Alberta, British Columbia, and Ontario are the highest-performing provinces. The Atlantic provinces tend to be at the opposite end. Provinces with high average reading achievement scores also have a high proportion of their students performing at the highest level (top quintile) and a low proportion in the bottom quintile. This suggests that provinces that serve their typical students well also serve both their struggling and high-performing students well.

Provincial differences in reading achievement are relatively minor, and the differences that exist are partly the consequence of the intake characteristics of their students. Once the literacy scores have been adjusted for these characteristics, the provincial achievement gaps are substantially reduced. Nevertheless, even after these statistical adjustments, Alberta, British Columbia, and Ontario remain among the top-performing provinces and the Atlantic provinces continue to be near the bottom. Perhaps the former provinces have education systems that are more effective in supporting literacy success, but it must be emphasized that literacy scores represent the cumulative effects of not just prior schooling, but also that of the family and the wider community.

**Effects of Student Intake Characteristics:** There are two main reasons why adjusting for student intake characteristics generally has little effect on the relative provincial literacy scores. First, provincial differences in student intake characteristics are, with the exception of grade progression and type of classes taken, relatively small. Second, on those attributes in which provinces differ substantially, the differences have cross-cutting effects on scholastic outcomes. For example, skill attainments are better in private schools; on this factor the Atlantic provinces are disadvantaged. In contrast, immigrant students perform worse on reading achievement tests than do Canadian-born students, and the Atlantic provinces have relatively few of them. The positive effect of the one cancels the negative effect of the other to some extent.

Student intake characteristics and prior academic performance are related to reading achievement in the direction consistent with previous research. All aspects of academic performance in school (such as grade retention<sup>2</sup>, having taken remedial or enriched classes, and amount of instruction received in language, math, and science classes) are strongly associated with reading achievement. Collectively, parental education, income, occupational status and home resources have strong relationships with reading achievement. Immigrants

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2 Whenever the term grade retention is used, it refers to whether a student has been held back a year.

and those whose home language differed from that of the test language have lower reading achievement scores. Family structure variables have trivial independent associations with reading achievement.

**School Context and Educational Practices:** Provincial variation in school contexts (such as school size, admission criteria, and number and types of student assessments) is generally more pronounced than it is on student intake characteristics. Despite this, student socio-demographic and academic performance factors are decidedly stronger determinants of literacy attainment than are school-level factors. Some of the school-level factors are better thought of as selection effects than as causal factors. That is, schools in which there is a need for second chance programs, for example, are more likely to introduce them. The lower average literacy scores of such schools is a reflection of the composition of their students. Three school context variables appear to have appreciable effects: Larger schools and those with positive teacher behaviours have higher literacy skills, while schools with a semester curricular structure have lower average scores.

There is no evidence that schools that serve their solid reading achievers well do so at the expense of neglecting their low reading achievers. This conclusion is inferred from the fact that not a single school-level variable was found that simultaneously increased the likelihood of being in both the top and bottom quintile.

**Minority- and majority-language groups** differ substantially in their literacy skills. Conspicuous is the low reading achievement of francophone students living outside of Quebec. Their average reading achievement score was up to 65 points below that of anglophones in unilingual provinces. One reason for this is the socio-demographic characteristics of their students. Controlling for these significantly reduces, but does not eliminate, their literacy gap. Quebec students, in both the French and English sector, have approximately average literacy skills. Controlling for socio-demographic characteristics does not appreciably alter their relative performance. Instead, for both language groups and in both PISA data sets, controlling for prior academic performance has a pronounced effect of raising their relative standings. The implication is that in Quebec, practices such as grade retention and placing students into remedial classes may be keeping their students from excelling in reading achievement. It must be kept in mind, however, that these practices appear not to produce students with below-average reading achievement.

**International Comparisons:** Among the comparison countries considered in this report, Canada performed better than all other countries in the PISA surveys, but Norway surpassed Canada in the IALLS assessment. Analyses of the PISA data indicated that Canada's superior performance in that survey was not due to student intake characteristics. Rather, it was due in part to differences in school contexts between Canada and Norway. Nevertheless, even after controlling for these, Canada retained its top position. An analysis of the IALSS data showed that Norway's high scores on prose skills were partly attributable to young people in that country being more likely to participate in education and training after the age of 15 than were Canada's young people. Nevertheless, Norway retained its top position after controlling for this and other factors relevant to skill acquisition.

## 1. Introduction

Reading skills lay the foundation for effective development of skills in other domains and for higher academic achievement, with O'Reilly and McNamara (O'Reilly and McNamara 2007) finding it to be among the best predictors of student achievement. Specifically, students with solid reading skills are at an advantage for developing other skills, such as their problem-solving skills. Research also documents that reading skills have long-term effects on subsequent educational pathways (Thiessen 2007a; Thiessen 2007b) and a variety of labour market outcomes (Caspi et al. 1998). It is for these reasons that this report focuses on increasing our understanding of what educational authorities can do to improve the reading skills of their students.

This report has a number of analytical purposes:

- To profile provincial differences in reading achievement as well as on those student intake characteristics and school contexts that previous research has shown to be associated with reading achievement.
- To assess the simultaneous effects of student intake characteristics on reading achievement. In addition to increasing our understanding about which student attributes are associated with reading achievement, it will inform to what extent provincial differences in reading achievement are arguably due to the provincial composition of these characteristics.
- To develop and assess models of what schools can do to improve the reading achievement performance of its students.
- To examine similarities and differences in reading achievement between Canada's minority and majority language groups.
- To compare Canada's performance on literacy tests and its determinants with those of a select number of other countries. A primary reason for these comparisons is to attempt to reconcile apparent inconsistent results from different surveys.

The overall policy purpose of this report is to provide provincial and territorial educational authorities with the necessary information tools to support evaluation and planning for educational policy. For these analytic and policy purposes, two international data sets that have developed standardized measures of literacy skills are employed: the Program for International Student Assessment (PISA) and the International Adult Literacy Skills Survey (IALSS). The former are used to assess the reading achievement of 15 year olds from surveys conducted in 2000 and 2003. The latter are used to assess the prose skills of youth between the ages of 16 and 24; this survey was also conducted in 2003. The international comparisons are limited to countries that took part in both assessments, namely Canada, Switzerland, Italy, Norway, and the USA.

## 2. Literature review

This literature review is restricted to studies that analyze large-scale surveys that have employed standardized literacy skills. It begins with a brief overview of studies that document Canada's literacy achievement at provincial and international contexts. This is followed by a review of the empirical literature on the relationships of student attributes with skill acquisition. The role of school contexts on skill achievement is assessed next. It concludes with an examination of skill acquisition in the context of Canada's minority- and majority language groups.

### 2.1. *Canada's literacy achievement provincially and internationally*

In PISA 2000, the mean reading achievement in Alberta was significantly higher than the Canadian average, while each of the Atlantic provinces scored significantly below the Canadian average

(Council of Minister of Education 2003:87). In general, provinces that had a high mean also had high proportions in the top level and low proportions in the bottom levels of reading achievement. Although statistically significant provincial differences in reading achievement are evident, the relative magnitude of them is rather small. Willms (2004b:36) estimates that less than three per cent of the total variance is among provinces, about 16 per cent is among schools within provinces, and more than four-fifths is among students within schools. Additionally, provinces that produce good average results also tend to produce more equitable results in that the difference in achievements between the top and bottom ten per cent is low (Human Resources Development Canada, Council of Ministers of Education and Statistics Canada 2001:19). The mean PISA provincial reading achievement scores are relatively stable between 2000 and 2003. While Canada's mean score dropped slightly (by 6 points), only in Prince Edward Island and Saskatchewan were the declines of 22 points and 17 points, respectively, statistically significant.

In international comparisons, Canada's 15-year-olds did very well on the PISA 2000 reading achievement tests, ranking second only to Finland by scoring 34 points above the OECD average. Canada also did very well on PISA 2003, with only Finland and Korea obtaining higher mean scores. The rank order of the comparison countries in this report is roughly comparable between the two surveys: In both surveys, Canada is at the top, and Italy at the bottom. Although Norway ranks second in both surveys, there is a substantial gap (about 29 points) between Canada and Norway, with relatively small country differences between Norway, Switzerland, and the USA (OECD 2004:443). Among the comparison countries, Canada stands out as having the highest 10<sup>th</sup> and 90<sup>th</sup> percentile scores and the lowest gap between these two deciles. These patterns suggest that Canada's school system may be relatively effective in helping students at all levels of performance while at the same time minimizing inequalities in reading achievement.

In contrast to the PISA findings, in the IALSS data Norway ranked first, Canada second, and Italy was again in last position (Statistics Canada and OECD 2005:35). Additionally, Canada has a higher proportion scoring at the lowest level than does Norway. That is, not only does Norway have higher mean scores, but it also has less inequality in scores than does Canada. These discrepant results suggest that Canada may be serving its school-aged population particularly well, but may lag behind Norway in the implementation of life-long learning.

## **2.2. Student attributes and skill acquisition**

All studies document that females outperform males on standardized reading achievement and prose skills. For PISA 2000, the mean gender reading achievement gap across all OECD countries was 32 points—identical to that found for Canada (OECD 2001).

Parental resources, especially parental SES and education, have pronounced effects on reading achievement (Jungbauer-Gans 2004). A meta-analysis indicates that family SES at the student level is one of the strongest correlates of academic performance (Sirin 2005). The cultural capital of parents has similar effects. For example, Jungbauer-Gans (2004) reports that cultural possession, number of books, home educational resources, cultural communication, and cultural activities of students are related to PISA reading scores in the expected direction even after introducing a variety of statistical controls.

Two aspects of family structure—number of siblings and living with both biological parents—have consistently been found to be associated with literacy skills. The former shows a negative relationship—children from larger families have lower literacy scores (Parcel and Dufur 2001; Sun 1999), while the latter is positively related (Sun 1999). Some studies indicate that both of



these relationships are due to socio-economic factors, since the relationships become insignificant after parental income, occupation, and/or education are held constant (Broh 2002; Dooley and Stewart 2004; Ma and Klinger 2000). Others find the relationship to remain significant, albeit weaker (Downey 1995; Frempong and Ma 2006; Jungbauer-Gans 2004; Marks 2006). Part of the inconsistent findings is due to which variables are included as control variables. Marks (2006) found that including home educational resources reduced the effects of family structure and number of siblings in addition to parental education and SES.

Immigrants perform less well on reading achievement than native-born young people (Frempong and Ma 2006; Jungbauer-Gans 2004; Willms 2006). Speaking a different language at home from the language of instruction in school has a negative effect on reading achievement (Jungbauer-Gans 2004). On the IALSS prose test, just under a third of both recent (under five years) and established (more than five years) immigrants scored in the bottom level, compared to only one in ten native-born Canadians (Statistics Canada and OECD 2005:219). Among immigrants, home language was a more decisive factor, with twice the proportion who spoke a language other than French or English scoring at the lowest level than did those whose home language was one of Canada's official languages (Statistics Canada and OECD 2005:223).

### **2.3. The role of schools on skill achievement**

The issue of whether schools can make a difference must be set within the context of the sources of variation in literacy skills. These typically show that by far the greatest proportion of variation is due to student characteristics, typically 80 per cent or more. In a study of New Brunswick elementary schools, Willms (2000:241) found that about 90 per cent of the variation in literacy skills was among students within classes; next most important was the difference between classes in the same school, leaving no more than five per cent due to differences between schools. School-level effects appear to be more substantial in PISA, with almost a third of the variance found at the school level (Willms 2006). There is some evidence that schools make less of a difference on reading achievement than they do on math and science achievement (Ma and Klinger 2000).

Previous research based on PISA 2000 indicates that school context factors are on the whole relatively small, and certainly much smaller than the effect of the SES student intake composition (Willms 2004a). Small positive effects were found for some school characteristics, such as the use of formal assessments, positive teacher-student relations, and a strong disciplinary climate (Willms 2004a). Ma (2000) also found disciplinary climate to be related to literacy skills. The generally weak associations of school context variables is likely one of the reasons that the findings are sometimes inconsistent. Willms (2004b) documents a small positive effect of school size on reading achievement in the PISA 2000 survey, while Ma (2000) failed to find a school size effect in the New Brunswick data. Another reason is that researchers exercise different decisions as to what other variables to hold constant. So for example, using the same data set as Willms (PISA 2000), Frempong (2006) did not find student-teacher relationships to have a significant effect, whereas Willms did. Both of them used the same statistical procedures; the main difference was which other variables were included in their models. Not only are school context effects small, they often are counter-intuitive. So, for example, Parcel (2001) found that as per pupil expenditures increased, reading performance decreased. Surprisingly, the quality of school resources and the availability of computers seem not to have any effect on reading achievement (Willms 2004b). Likewise Frempong (2006) found none of the school resource variables to be related to reading achievement. In connection to school context effects, it should be noted that regression models are generally unable to accurately detect small effects (Morgan 2001).

After controlling for student intake characteristics, Willms (2004a) found the mean reading achievement in private and rural schools to be comparable to those of public and urban schools.

There is some reason to believe that schools may play a more crucial role in the education of their more disadvantaged students. Examining provincial variations in literacy skills in the first IALSS, Willms (1999:24) found that “youth from advantaged backgrounds fare about the same across all states and provinces; it is the scores of less advantaged youth that vary considerably among jurisdictions and have the biggest effect on the overall scores for the jurisdiction.” In this respect, Canada appears to serve students from disadvantaged backgrounds better than the USA, since the relationship between the mean school reading achievement score and the mean SES of the schools is stronger (steeper slope) in the USA than in Canada (Willms 2004a:11). At the individual rather than school level, it also appears that the effect of parental education on literacy skills is weaker in Canada than in many other countries, and especially the USA (Human Resources Development Canada and Organisation for Economic Cooperation and Development 1997).

#### **2.4. *Minority- and majority language group differences***

There are numerous indications that language of instruction interacts with province of residence. One indication is that although francophones generally achieve higher scores in reading, math, and science than anglophones, this is not true of francophones living outside of Quebec. In both the School Achievement Indicators Program (SAIP) and the 2000 Program for International Student Assessment (PISA), francophones living outside of Quebec performed less well on the achievement tests than both francophones living in Quebec and anglophones generally (Council of Minister of Education 2003; Human Resources Development Canada, Council of Ministers of Education and Statistics Canada 2001). In short, francophones living in Quebec generally performed exceptionally well on skills tests, while francophones living outside of Quebec scored lower than anglophones.

Language and province also interact in the development of educational expectations and aspirations. With respect to technical/technology training, typically only about five per cent of 16-year olds in all provinces and language groups plan to participate in such programs; among Quebec francophone students, however, almost a quarter (23%) have such plans (Council of Ministers of Education 2003b:17). Similarly, Thiessen and Looker (2004) found that among anglophones, whether a student resides in Quebec or elsewhere plays a minor role at best in their educational aspirations, with about 45 per cent of them aspiring to obtain two or more university degrees. This contrasts sharply with the aspirations of francophones, who are substantially less likely to hold such high aspirations. Furthermore, among francophones it matters whether they live in Quebec or elsewhere: Only 17 per cent of those living in Quebec, but 29 per cent of those residing outside of Quebec aspire to more than one university degree.

The most detailed documentation of language group differences come from the SAIP reports (Council of Ministers of Education 2003a; Council of Ministers of Education 2003b; Council of Ministers of Education 2005). The remainder of this section summarizes some of the more important differences contained in these reports that are relevant to reading achievement.

- In Ontario, Quebec, and New Brunswick, anglophone parents are more likely than their francophone counterparts to have a university education. In Nova Scotia and Manitoba, the reverse is true.
- Principals in francophone schools are more likely than their anglophone counterparts to report that their school's capacity to provide instruction is limited by the lack of parental support for their school. The difference is most marked in Quebec. With the exception of Quebec, the same pattern is found with respect to instruction being limited by community conditions; in Quebec,

francophone principals are less likely to feel such a limitation than are anglophone principals.

- In Quebec, only about one in ten schools appears to operate on a semester basis in their science classes. This is in stark contrast to the remaining dual-language provinces where between 87 per cent and 100 per cent of schools operate on a semester basis.
- The percentage of classes with an average class size of 25 or more students varies in a complex fashion by province and language group. This percentage is highest (78%) in francophone schools in Quebec (only 40% of classrooms in Quebec anglophone schools are this large). In Manitoba as well, francophone schools tend to have larger class sizes than anglophone schools. In contrast, in Ontario and Nova Scotia, it is the English schools that have a high proportion of classes with more than 25 students. Substantial provincial and language of instruction differences exist in teachers' reports that large class sizes limit or restrict how they teach language arts classes. Nova Scotia and Manitoba francophone teachers are least likely to hold this view (18% and 21%, respectively), while New Brunswick francophone and Ontario anglophone teachers most likely to do so (49% and 44%, respectively).
- Between 91 per cent and 97 per cent of schools in both language sectors in New Brunswick and Ontario report that they have two or more distinct streams or ability groupings for their science students. This practice is much less common in Quebec, with francophone schools somewhat more likely to report doing this (60% versus 51% in francophone and anglophone schools, respectively).
- Less than 20 per cent of teachers in anglophone schools believe that low morale in their schools limit or restrict how they teach language classes. In contrast to these small provincial differences among teachers in anglophone schools, there are large differences within provinces between teachers in anglophone and francophone schools. The difference is most pronounced in Quebec, where only 17 per cent of anglophone teachers, compared to a majority (51%) of francophone teachers express this point of view.
- Relatively large provincial and language-of-instruction differences exist in the practice of collecting, marking, and returning writing assignments to students a few times a week or more. About a third of francophone teachers in Quebec report doing this, compared to three-quarters or more in Alberta and British Columbia. In all dual-language provinces, anglophone teachers are more likely than francophone teachers to engage in this practice. Equally large differences occur in the percentage of teachers using student textbooks a few times a week or more in planning language art lessons, ranging from a low of 38 per cent in anglophone Quebec schools to a high of 83 per cent in francophone Quebec schools. There are also large variations in whether teachers use teacher's guides or teacher's editions of textbooks in planning language arts lessons with the lowest being in anglophone Quebec schools (22%) and the highest in Nova Scotia francophone schools (81%).

### 3. Data, measurement, and statistical procedures

#### 3.1. Data

Three data sets that are both international in scope and use standardized skill achievement tests are employed in this report: PISA 2000, PISA 2003, and IALSS 2003. The two PISA surveys collected comparable (albeit not identical) information on many student characteristics and school context attributes, in addition to administering the reading achievement test. A student-nested-within-schools sampling design was used. School principals provided the information for school context variables. School principals provided the information for school context variables.<sup>3</sup> The reading achievement

<sup>3</sup> Further information on sampling and measurement details are given in Human Resources Development Canada, Canada Council

test was based on the prose and document measures in IALLS, but with a greater concentration of prose items.<sup>4</sup> To keep respondent burden during the administration of the literacy tests from becoming unreasonably severe, both PISA and IALSS administer various combinations of subsets of the full test to different students. This necessitates the construction of what are known as plausible values for the test score, rather than an overall test score. The analyses in this report use software that appropriately handles this added complexity.

The IALLS was designed to test literacy skills to be administered to an adult population.<sup>5</sup> Since this report focuses on literacy skills of youth, only respondents who were under 25 years of age were retained in the analyses. The usable sample size for this survey is too small to permit provincial comparisons. The Canadian implementation of the PISA surveys was sufficiently large to permit stable estimates of provincial differences (see the last row of Table 2 and Table 3 for the Canadian provincial sample sizes in PISA 2000 and 2003, respectively, and Table 9 and Table 10 for their respective international sample sizes).

Some of the inconsistent findings reviewed in the literature are likely due to differences in the measurement properties of the variables in the available data. This is especially an issue with respect to measures of parental education, income, and occupation. For the international PISA data, no direct measure of parental income is available. Hence household possessions are frequently used as a proxy. Additionally, only students' report of parental education is available. A meta-analysis of the effects of these parental characteristics indicates that large differences in results can occur as a result of such measurement differences (Sirin 2005). For example, the average Pearson correlation coefficient between parental SES and achievement in studies that used student report of parental SES was 0.19; in studies where parents' own report was used, the coefficient was 0.38, suggesting that random measurement error is much larger in student reports. The Canadian portion of PISA 2000 was supplemented with information from the parent file. Not only does this give the opportunity of using more reliable measures, it also contains information (such as parental income) that would otherwise not be available.

Missing data plagues all multivariate analyses. On some variables, especially school-context variables, the proportion of missing cases was substantial. To retain the maximum number of cases in the multivariate analyses, dichotomous variables with missing values were assigned to the modal category. For continuous variables, missing values were replaced with the mean of that variable and a missing value indicator constructed. Various missing value indicators were included in the regression models to assess whether the predicted skill attainment differed significantly between respondents for whom the information was available and those for whom it was not.

The utilization of tests of statistical significance is standard practice in survey research. Yet undue reliance on such tests can be misleading for several reasons. First, when complex sampling designs are used, as in the PISA studies where students from small provinces are oversampled, contradictory conclusions can emerge with respect to provincial differences. For example, in PISA 2000, Prince Edward Island exhibits the lowest mean reading achievement, yet in the weighted data the reading achievement in this province is not statistically significantly lower than that of Ontario, while other provinces with somewhat higher reading achievement scores are statistically significantly lower than Ontario. If unweighted data are used, then Prince Edward Island is significantly lower. This is of course due to the fact that tests of significance are intimately connected to the effective sample sizes. In the

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of Ministers of Education, and Statistics Canada. 2001. *Measuring Up: The Performance of Canada's Youth in Reading, Mathematics and Science. OECD PISA Study - First Results for Canadians Aged 15*. Ottawa, OECD. 2005. "PISA 2003 Data Analysis Manual." Paris: Organisation for Economic Development and Cooperation.

4 The effect of having a higher proportion of prose items in the PISA reading achievement test is that the gender gap in favour of females is higher in PISA than in IALSS (personal communication with Scott Murray from Statistics Canada, who is intimately familiar with the development of both tests).

5 Sampling design and measurement details are provided in Statistics Canada. 2002. "The Adult Literacy and Life Skills Survey, 2003: Public Use Microdata File User's Manual." Ottawa: Statistics Canada.

weighted (to reflect relative population sizes) sample, Prince Edward Island has the smallest effective sample size, whereas in the unweighted sample, (because of disproportionate sampling procedures employed specifically to make provincial comparisons stable) Prince Edward Island has a sample size that is approximately the same as that of every other province. For the same reason, the proportion of variance in reading achievement accounted for by province appears to be substantially less using the weighted than the unweighted data. Statistics Canada disclosure rules require the use of weighted data, but it is important to keep these differences in mind.

Inconsistent patterns of statistical significance can also occur when there are several variables that can be thought of as measuring different aspects of a common factor. Due to this collinearity, there may be apparently conflicting findings. For example, both student-teacher ratio and the principal's perception that teacher shortage is a problem at the school are possible measures of an insufficient number of teachers for effective learning. In one survey, the first measure may be statistically significant and the second one not, whereas the reverse pattern might occur in the second survey. Rather than concluding that the results are inconsistent across surveys, it might be better to conclude that insufficient numbers of teachers is a determinant of skill acquisition, although the precise nature of this insufficiency remains unclear. The approach taken in this report is to buttress conclusions through a judicious combination of use of tests of significance, consistency of patterns, and magnitude of estimated effects.

A unique element of the study was the use of a Delphi panel of provincial stakeholders from seven provinces, who provided input to the researchers at two points: (1) in design of the analysis; and (2) in interpreting the initial results. Input was provided by 10 participants nominated by the seven provinces, who were all active in related Provincial program areas. Input was provided via a web-based exchange, and in two conference calls. Results of the Delphi panel were noteworthy, pointing out a number of refinements of the analysis plan,<sup>6</sup> adjustments in the interpretation of the results, and identifying areas for recommendations (particularly as regards data availability, such as the need for better data on Aboriginal status in the surveys to meet the needs of some provinces). An interesting feature of the Delphi panel was a high degree of consensus among stakeholders on the validity of the design and analysis, and the conclusions drawn.

#### 4. Provincial comparison of reading achievement

The sampling design of the Canadian PISA surveys was planned to permit reasonably accurate provincial comparison of the mean reading achievement scores. In this section, information about the gross (raw) and net (after controlling for all student intake characteristics that are statistically significantly related to reading achievement) provincial reading scores are summarized. The information for this section is based on hierarchical linear modelling (HLM) which handles plausible values appropriately. The raw provincial ranks are based on the weighted average within-school performance; the net provincial differences are the same after HLM has controlled for the student intake characteristics.

A pragmatic decision was made to differentiate between student intake characteristics and school contextual variables on the simple criterion of whether the information was obtained from the student surveys or the principal reports. By this criterion, attending a private and/or rural school is treated as school context variables. Yet a plausible argument can be made to treat such factors as student intake characteristics. The decision is not irrelevant, since these factors remain statistically significant even after controlling for the other student intake characteristics (not shown) and therefore could alter the net provincial rank orders. Table 1 shows the provincial rank orders (from highest to lowest) using the pragmatic

<sup>6</sup> For example, basing analysis of the top and bottom reading/prose performers on quintiles rather than deciles; not grouping provinces by region; introducing an analysis of majority-language-minority language group differences; and refining some data specifications (e.g. examining more detail in parental resources --education of parents, income quartile, etc.; and including grade repetition along with whether or not a student had taken a grade 10 math or language class at age 15 (where such information is available).

criterion of what constitutes a student intake characteristic. The magnitudes of the provincial differences in reading achievement are contained in the first ten rows of the first (raw) and third (net) columns of Table 4 and Table 5. Information on raw and net provincial proportions in the top and bottom quintiles can be found in the appendix.

**Table 1: Rank order of provinces on mean reading achievement (raw and net)**

<b>Raw</b>										
2000	AB	BC	ON	QC	SK	MB	NS	NL	NB	PE
2003	ON	AB	BC	QC	NL	MB	NS	SK	NB	PE
Bottom quintile*										
2000	AB	QC	BC	ON	SK	MB	NS	NL	PE	NB
2003	ON	AB	BC	MB	QC	NL	SK	NS	NB	PE
Top quintile										
2000	AB	BC	MB	ON	QC	SK	NS	PE	NL	NB
2003	AB	ON	BC	QC	MB	NL	SK	NS	NB	PE
<b>Net of student/family intake characteristics</b>										
2000	QC	AB	ON	MB	BC	SK	NS	PE	NL	NB
2003	QC	AB	ON	BC	MB	NL	NS	SK	NB	PE
Bottom quintile*										
2000	QC	AB	ON	BC	MB	NS	SK	PE	NL	NB
2003	QC	AB	ON	BC	MB	SK	NS	NL	NB	PE
Top quintile										
2000	QC	ON	AB	MB	BC	NS	SK	PE	NL	NB
2003	QC	AB	ON	BC	MB	NL	NS	SK	NB	PE

\*Reversed, so that a rank of 1 indicates the fewest percentage in the bottom quintile.

Without controlling for student intake characteristics, Alberta, British Columbia and Ontario occupy the top three ranks in mean reading achievement in both surveys. Similarly, New Brunswick and Prince Edward Island consistently place in the bottom two ranks. Not only is the average reading performance consistent between the two surveys, the same is true when looking at the proportion of students in the top and bottom quintiles.

Controlling for student intake characteristics typically reduces the magnitude of the provincial differences in both surveys (as shown by comparing the raw and net provincial parameters in Table 4 and Table 5), indicating that part of the provincial differences can be traced to provincial variation in student intake characteristics, such as the immigrant status of their students. Quebec is the only province where controlling for student intake characteristics increased the magnitude of its difference relative to other provinces in both surveys; in the PISA 2000 survey (but not in the 2003 survey) Alberta and British Columbia also had larger net differences.

After controlling for student intake characteristics, Prince Edward Island and New Brunswick remain at the bottom. At the other end, Alberta and Ontario remain among the top three provinces in both surveys. Quebec now ranks among the top three provinces in both surveys.

#### 4.1. *Conclusions about provincial reading achievement differences*

- There is a relatively high consistency in the rank of the top- and bottom performing provinces.
- Provinces in which the mean reading achievement is high are also the ones that have low percentages of their students performing in the bottom quintile, and vice versa, high percentages of students in the top quintile. This suggests that provinces that serve the average student well may also serve both their at-risk and their top-performing students well. Stated differently, there is no indication that provinces that have a high proportion of their students achieving near the top do so at the expense of neglecting students near the bottom. Indeed, the reverse appears to be the case.
- On the whole, student intake characteristics do not account for the low rank of students in the Atlantic provinces.
- The approximately middle rank position of Quebec is due primarily to the composition of its students and their prior academic performance. The section on minority- and majority language groups will help clarify more precisely the factors that account for the improvement in Quebec's net reading achievement.
- The high ranking of Alberta (and to a lesser extent British Columbia and Ontario) is not an artifact of student intake characteristics in these provinces, since their superior performance remains after appropriate controls.
- Although the precise rank of any province in either survey year might be debatable on the grounds of sampling fluctuation, the consistency and magnitude of the differences between the high- and low-scoring provinces rule out sampling fluctuation leading to the conclusion that these differences are genuine.
- Taken together, the patterns reported in the above table suggest that the provinces of Alberta, British Columbia, Ontario, and Quebec either have effective schooling systems with respect to improving reading achievement, or students in these provinces score high on certain unmeasured student attributes that are positively associated with reading achievement. Likewise, the Atlantic provinces appear to have less effective schooling systems with respect to improving reading achievement, or else students in these provinces differ systematically but in unmeasured ways from those in the top-performing provinces on attributes that are negatively associated with reading achievement. Since over four-fifths of the variance in reading achievement scores is left unexplained by student intake characteristics, a good argument can be made that unmeasured student attributes might account for the remaining net provincial differences. On the other hand, the multivariate regression models constructed for these two data sets includes all student intake characteristics that previous research has shown to be important determinants of reading achievement.
- The distinction between provinces with possibly more (or less) effective approaches to reading achievement should be kept in perspective: the distinction accounts for at most about two per cent of the variance in reading achievement. The implication is that provinces are not that different in how well they facilitate or fail to facilitate students' literacy skills.

## 5. Provincial profiles

The literature review documented that provinces differ in the skill achievements of their students, the intake characteristics of the students they serve, and the curricular structure and other teaching practices. It is also known that both the intake characteristics and the organization of the delivery of education influence the skill achievements of their students. The former are beyond the direct control of educational authorities, while the latter are susceptible to educational policy instruments. The distinction between the two types of factors is not always clear. For example, the age composition of students can be altered by changing the cut-off date for the start of public education. Nevertheless, student age is treated as a student intake characteristic. This section begins with provincial profiles of student intake characteristics. These profiles document how factors that are known to affect academic performance generally, and skill attainment specifically, are distributed between the provinces. Table 2 and Table 3 provide that information for the PISA 2000 and PISA 2003 surveys, respectively. In the final column, eta-square ( $\eta^2$ ) is reported as the measure of the proportion of variance in each attribute that is accounted for by province. Only those attributes are profiled where provincial differences account for at least one per cent of the variance. In assessing these tables, it must be kept in mind that student attributes with relatively high  $\eta^2$  coefficients are prime candidates for altering the rank-order of net provincial differences in reading achievement. Likewise, relatively high  $\eta^2$  coefficients on the school context variables indicate the areas in which provinces differ in the structure and content of their educational systems in manners that may be associated with literacy attainment.

### 5.1. Student intake characteristics

It is gratifying to note that the distribution of most student intake characteristics is quite similar between the two PISA surveys (Table 2 and Table 3). In both surveys, the socioeconomic status of parents in Newfoundland and Labrador, Prince Edward Island, and New Brunswick rank among the bottom three, while those in Ontario, Alberta, and British Columbia are among the top three. Likewise in both surveys, immigrants are concentrated in Ontario and British Columbia, and probably for this reason these are also the two provinces with the lowest percentage of students whose home language was the same as their test language. This consistency indicates that the data on student intake characteristics are likely of high quality.



**Table 2: Provincial profiles (PISA 2000) <sup>7</sup>**

Student characteristics	NL	PE	NS	NB	QC	ON	MB	SK	AB	BC	Total	Eta-Square
Immigrant student	0	2	4	2	7	15	6	2	7	16	11	0.03
Home language same as test language	99	96	96	93	88	84	88	95	90	83	87	0.01
Parental education (years)	13.32	13.63	13.82	13.45	13.39	13.86	13.44	13.50	13.70	13.92	13.69	0.01
Highest parental occupational status	47.67	49.51	51.66	49.99	51.53	54.12	50.42	51.01	54.01	53.26	52.80	0.01
Parental income in the top quintile	11	11	15	12	16	25	15	13	25	19	20	0.03
Index of home educational resources	0.18	-0.14	-0.01	-0.14	-0.05	0.04	-0.16	-0.19	0.08	0.04	0.00	0.01
More than 100 books in home	60	56	62	54	42	60	53	55	59	59	55	0.02
Respondent repeated a grade in elementary school	8	15	11	11	23	3	8	10	9	5	10	0.07
Grade compared to modal grade	-0.09	-0.13	-0.37	-0.13	-0.46	-0.02	-0.12	-0.16	-0.11	-0.06	-0.16	0.13
Any make-up classes in last three years?	18	12	14	20	44	18	17	14	21	23	25	0.06
Any advanced classes in last three years?	36	20	28	25	33	36	36	25	36	39	35	0.01
Grade 10 math class	80	79	61	76	52	87	79	79	80	84	76	0.10
Grade 10 language class	81	80	61	77	54	88	80	80	82	86	77	0.10
University-preparatory math class	74	72	54	70	32	8	51	75	64	71	37	0.29
Instructional time in language, math, and science (hours per week)	5.05	5.14	4.65	4.85	4.50	4.85	4.76	4.36	5.27	4.59	5.05	0.02
<b>School Context</b>												
Rural school	83	66	62	69	37	34	59	79	61	31	49	0.12
Private school	0	1	1	0	27	7	10	4	5	21	12	0.10
Number of students in the school	340.30	711.09	518.38	904.88	853.10	882.85	490.15	367.60	549.77	732.59	709.22	0.16
Grade 10 has a semester structure	46	82	41	80	8	77	73	82	73	53	56	0.31
Number of programs for gifted students	2.08	2.02	1.45	1.88	1.68	1.72	1.90	1.69	1.87	2.19	1.80	0.03
School offers trade, special needs or alternative program	78	99	67	90	46	74	80	84	83	85	71	0.10
Index of negative teacher behaviours	-0.21	0.45	0.03	0.26	0.43	-0.24	0.16	-0.04	-0.12	-0.05	-0.12	0.08
Number of students (unweighted)	2154	1601	2895	2922	4457	4261	2575	2701	2715	2996	29377	

Note: Whole numbers are percentages; all others are means.

**Table 3: Provincial profiles (PISA 2003)**

Student characteristics	NL	PE	NS	NB	QC	ON	MB	SK	AB	BC	Total	Eta-square
Immigrant student	1	2	3	3	7	19	8	3	7	17	12	0.04
Home language same as test language	99	97	96	94	90	82	85	95	89	81	87	0.02
Parental education (years)	13.75	14.60	14.27	14.27	14.27	14.84	14.34	14.26	14.63	14.52	14.53	0.01
Highest parental occupational status	48.37	49.43	50.35	49.79	51.70	53.56	51.72	51.20	54.35	52.78	52.58	0.01
Index of home possessions	0.52	0.34	0.47	0.29	0.28	0.61	0.43	0.43	0.68	0.67	0.51	0.03
Index of home educational resources	0.15	-0.11	-0.03	-0.11	0.07	0.11	-0.06	-0.11	0.09	0.11	0.07	0.01
More than 100 books in home	54	53	57	50	39	55	54	53	59	56	52	0.02
Repeated a grade in elementary school	2	12	4	6	14	2	4	7	5	2	6	0.04
Grade compared to modal grade	-0.06	-0.08	-0.29	-0.12	-0.58	-0.04	-0.09	-0.15	-0.07	-0.04	-0.19	0.19
Took remedial classes	22	19	20	18	22	17	18	19	23	23	20	0.00
Took enriched classes	16	17	18	17	17	15	18	18	22	24	18	0.01
Has a tutor	20	8	8	9	10	13	6	6	11	17	12	0.01
Hours of instructional time per week	23.62	23.47	23.91	22.65	23.25	23.00	24.22	22.73	25.70	23.91	23.58	0.01
<b>School Context</b>												
Rural school	82	73	71	76	33	25	69	84	55	36	48	0.17
Private school	2	4	0	3	22	14	14	3	5	19	12	0.05
School size	305.75	484.39	494.81	608.60	687.27	860.78	390.93	298.86	437.53	650.22	591.44	0.19
All classes grouped by student ability	16	21	9	18	22	17	12	6	25	12	17	0.02
40 or more assessments per year	13	28	18	20	17	30	10	23	15	9	19	0.04
Admission by academic performance	25	27	22	36	53	53	45	28	47	39	44	0.04
Percent repeating an elementary grade	2.65	2.13	3.18	4.85	5.47	5.11	2.31	1.61	1.62	3.80	3.53	0.08
Number of teacher-developed assessments	10.32	11.33	10.48	11.31	8.91	11.12	10.49	10.80	10.88	11.02	10.54	0.10
Index of perceived shortage of teachers	-0.15	-0.40	0.02	0.26	0.09	-0.39	0.03	-0.11	-0.15	-0.26	-0.15	0.05
Index of positive teacher behaviours	0.48	0.30	0.08	-0.06	0.22	0.24	0.42	0.33	0.30	0.09	0.25	0.01
Index of quality of educational resources	-0.21	-0.14	-0.50	-0.41	0.02	-0.14	-0.04	0.15	-0.04	0.26	-0.04	0.03
Index of student-teacher relations	0.04	0.04	0.05	0.05	0.03	0.03	0.03	0.03	0.04	0.03	0.03	0.01
Number of students (unweighted)	2314	1653	2871	3781	3377	2636	2798	2363	2458	2966	27217	

Note: Whole numbers are percentages; all others are means.

The largest provincial differences are not socio-demographic, but rather in the progression of students through the different grades and the types of classes taken. Between one- and three-tenths of the variance in these attributes is provincially-based. Students in Ontario and Quebec are particularly unlikely to have taken a university-preparatory math class by age 15 (8% and 32%, respectively) while in all other provinces at least half the students have taken such a class. Quebec also stands out as having the highest percentage of students who have been retained a grade, and mainly as a consequence of this, as having more students who at age 15 are at a grade level below Grade 10.<sup>8</sup>

## 5.2. School context

Provinces differ most on the prevalence of a semester structure in their schools, with almost a third (32%) of the variance on this characteristic associated with province (this information is available only in PISA 2000). It is particularly uncommon in Quebec (11 per cent of schools) and most common in Saskatchewan (88%). In all other provinces, a semester structure is found for about half to over four-fifths of the schools.

Substantial provincial variation also occurs in the distribution of rural and private schools, as well as in school size. The Atlantic provinces have the highest concentration of schools in rural areas. With respect to private schools, Quebec is noteworthy in having at least twice as many private schools as any other province, in contrast to the Atlantic provinces in which one per cent or fewer schools classified as private. Schools in Quebec, Ontario, and British Columbia are the largest, while those in Newfoundland and Labrador and Prince Edward Island are the smallest.

Three important conclusions can be drawn from these profiles. First, provincial differences in student intake characteristics are, with the exception of grade progression and type of classes taken, relatively small. Second, on those attributes in which provinces differ substantially, the nature of the differences are known to have cross-cutting effects on scholastic outcomes. For example, academic performance, including skill attainments, is better in high-income and high occupational status homes; on these criteria the Atlantic provinces are disadvantaged. In contrast, immigrant students perform worse on reading achievement tests than do Canadian-born students but not many of them live in the Atlantic provinces. The positive effect of the advantages will cancel out the negative effect of the disadvantages to some extent. As a result, we can expect that controlling for student intake characteristics will not dramatically alter provincial differences in skill acquisition. Third, provincial variation in school contexts is generally more pronounced than it is on student intake characteristics. All other things being equal, this should improve our ability to ascertain which school-level factors are associated with literacy acquisition.

## 6. Multivariate analyses of literacy achievement in Canada

The previous sections documented provincial differences in reading achievement and the provincial distribution of student intake characteristics and school contexts. With this information in mind, we turn now to the question of the relative importance of the different student intake characteristics and school context variables on reading achievement. Many of the measures of both student and school characteristics are common between the two PISA surveys. This permits an assessment of the consistency of certain effects. Further, some variables are unique to one of the surveys. This affords the opportunity of ascertaining whether the findings remain robust when the non-common items are included in the analysis. This reduces the possibility of what is technically known as “omitted variable bias.”

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<sup>8</sup> While Quebec has the highest retention rate, it should also be noted that the intake age criteria for entrance into school is older in Quebec than the Canadian average.

## 6.1. Reading achievement performance

Table 4 and Table 5 provide the HLM regression results for the reading achievement scores for PISA 2000 and 2003, respectively. Three models are presented. The first model simply provides estimates of the raw mean provincial reading achievement scores, calculated on the basis of the five plausible values. Ontario is the reference province, so that all provincial estimates are given relative to its mean score of 532 and 538 in 2000 and 2003, respectively.<sup>9</sup> The second model introduces student intake characteristics. Hence the provincial means are those obtained after controlling for these characteristics. Since raw and net provincial differences have been discussed previously, they will not be discussed here. Model 3 adds the school context variables. This model informs whether differences at the school level are associated with the mean achievements of their students. In all models, reading achievement is expressed in the original units. These were calibrated to have an international mean of 500 and a standard deviation of 100. A useful way to interpret the practical importance of the calculated effects (the numbers in the columns labeled “b”) is to note that 60 points is roughly equivalent to one grade level, and consequently one point is approximately equivalent to about three school days in a 180-day school year (Willms, personal communication). Taking two examples, New Brunswick students lag behind their Ontario counterparts by about half a year ( $b = -.34.3$ ), and females outperform males by just under half a year ( $b = 26.0$ ).<sup>10</sup>

### 6.1.1. Student intake characteristics

All student intake characteristics are significantly related to reading achievement in the direction consistent with previous research. These are summarized briefly here. First, all measures of academic performance in school are strongly associated with reading achievement, and each of them has substantial effects independent of the other measures of academic performance. So, for example, the effects of grade retention in primary school remain large even after controlling for whether their last math class was at a university-preparatory level, whether they took remedial or enriched classes in the last three years, whether they took Grade 10 math and language classes by the age of 15, and what their current grade in school is. Additionally, each hour of instruction in language, math, and science to which students were exposed at age 15 has an effect equivalent to between about three to nine school days of instruction.

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<sup>9</sup> In HLM, estimates of reading achievement reflect the weighted mean school scores and primarily for this reason differ slightly from previous published results.

<sup>10</sup> The columns in the tables labeled “se” are the standard errors of the estimated effects. When the absolute estimated effect exceeds twice the value of its standard error, the effect has less than a five per cent chance of being due to sampling fluctuations; i.e., it is a statistically significant effect.

**Table 4: HLM regression parameters for reading achievement in Canada (PISA 2000)**

	b		se	b		se	b		se
Ontario	532.0		3.706	487.6		3.722	495.9		5.440
Newfoundland and Labrador	-22.9	**	7.440	-31.5	***	4.867	-33.2	***	4.911
Prince Edward Island	-40.2	***	10.231	-18.7	**	6.151	-17.0	**	5.821
Nova Scotia	-12.1		5.834	-16.8	***	4.133	-19.0	***	4.532
New Brunswick	-34.3	***	5.967	-37.7	***	4.117	-35.4	***	4.180
Quebec	1.6		5.371	41.6	***	5.004	28.3	***	4.914
Manitoba	-7.1		6.062	-9.4	*	4.047	-7.1		4.033
Saskatchewan	-3.8		5.364	-15.8	***	4.259	-10.7		4.334
Alberta	11.5		5.737	3.4		4.061	4.3		3.682
British Columbia	3.8		5.215	-11.9	**	3.873	-14.4	***	3.745
Female				26.0	***	1.394	26.0	***	1.391
Number of siblings				-2.9	***	0.657	-2.8	***	0.654
Nuclear family				2.2		1.497	2.1		1.501
Immigrant youth				-20.3	***	2.913	-21.4	***	2.907
Number of schools attended				2.9	***	0.505	2.9	***	0.502
Parental years of education				4.5	***	0.402	4.5	***	0.402
Income (in quintiles)				1.2	*	0.574	1.2	*	0.574
Index of home educational resources				2.8	***	0.762	2.7	***	0.760
Parental occupational status				0.5	***	0.051	0.5	***	0.051
At least 100 books in the home				17.4	***	1.570	17.4	***	1.567
francophone				-12.1	**	4.517	-11.5	**	4.111
Repeated a grade in primary school				-39.3	***	2.676	-39.5	***	2.645
Took remedial classes				-46.9	***	1.744	-47.0	***	1.736
Took enriched/advanced classes				20.2	***	1.802	19.9	***	1.810
Took Grade 10 math class				9.3	**	3.354	9.2	**	3.354
Took Grade 10 language class				18.2	***	3.759	18.2	***	3.757
Took math at a university-preparatory level				34.5	***	1.909	34.5	***	1.908
Instructional time in language, math, and science (in hours/week)				2.8	***	0.447	3.1	***	0.458
Occupational status of parents not ascertained				-43.8	***	5.879	-43.5	***	5.909
Instructional time not ascertained				-38.6	***	2.602	-38.9	***	2.565
Rural school							5.5		2.850
Private school							5.5		4.793
School size (in hundreds)							1.0	**	0.331
Semestered school							-16.2	***	3.009
School offers programs for gifted students							3.8	**	1.269
School offers second chance programs							-9.5	**	2.970
Index of negative teacher behaviours							-2.0		1.189
Index of curricular autonomy							1.8		1.087
Proportion of explained variance			0.011			0.399			0.408

\*p < .05

\*\*p < .01

\*\*\*p < .001

**Table 5: HLM regression parameters for reading achievement in Canada (PISA 2003)**

	b	se	b	se	b	se
Ontario	538.1 ***	3.435	504.8 ***	4.849	501.3 ***	5.021
Newfoundland and Labrador	-22.0 ***	6.255	-15.2	4.503	-8.3	4.868
Prince Edward Island	-69.5 ***	11.560	-32.7 ***	6.400	-25.7 ***	6.278
Nova Scotia	-25.8 ***	4.938	-15.2 ***	3.976	-9.5 *	3.926
New Brunswick	-37.7 ***	4.833	-26.5 ***	3.470	-17.9 ***	3.745
Quebec	-13.4	6.277	19.5 ***	3.933	20.4 ***	3.749
Manitoba	-22.5 ***	6.251	-12.2 **	4.124	-9.1 *	4.074
Saskatchewan	-28.2 ***	6.074	-18.1 ***	4.419	-14.3 ***	4.297
Alberta	-2.2	6.989	2.8	4.630	1.9	4.438
British Columbia	-4.6	4.444	-1.0	3.720	2.1	3.618
Female			26.5 ***	1.782	26.4 ***	1.781
Nuclear family			11.1 ***	1.841	10.9 ***	1.839
Repeated a grade in primary school			-34.6 ***	3.884	-34.5 ***	3.900
Took remedial classes			-25.4 ***	2.730	-25.2 ***	2.724
Took enriched/advanced classes			6.7 **	2.473	6.8 **	2.463
Had a tutor			-27.5 ***	2.670	-27.9 ***	2.675
Grade relative to modal grade			35.8 ***	2.245	34.8 ***	2.242
Immigrant student			-7.7 *	3.651	-8.1 *	3.717
Language at home same as test language			18.4 ***	3.529	18.8 ***	3.510
At least 100 books in the home			13.4 ***	1.895	13.5 ***	1.898
Parental years of education			0.6	0.445	0.6	0.447
Parental occupational status			0.5 ***	0.066	0.5 ***	0.066
Index of home educational resources			3.8	1.530	3.7	1.530
Index of home possessions			10.7 ***	1.677	10.6 ***	1.684
Instructional time (hours/week)			1.2 ***	0.128	1.2 ***	0.128
Instructional time not ascertained			-39.7 ***	3.498	-39.1 ***	3.506
Occupational status not ascertained			-23.0 ***	4.878	-22.5 ***	4.902
School size					1.3 ***	0.262
At least 40 assessments per academic year					-6.1	3.480
Admission based on academic performance					5.1	2.690
Estimated per cent repeating a primary grade					-1.0 **	0.314
Index of student-teacher relationships					-174.3 ***	39.457
Index of positive teacher behaviours					3.9 *	1.602
Proportion of explained variance		0.010		0.317		0.329

\*p < .05

\*\*p < .01

\*\*\*p < .001

Collectively, parental education, income, occupational status and home resources have strong relationships with reading achievement. What differs between the surveys is how important each aspect is. For example, home possessions are more influential than parental education in PISA 2003, whereas the exact opposite is the case for PISA 2000. Part of the reason for this is that a more reliable measure of parental education (based on parent report in the first instance and then supplemented with student report for missing values) was used in the PISA 2000 analyses.

Both immigrant status and whether the language spoken at home was the same as the test language have the expected effects. Foreshadowing results to be presented in a subsequent section, after controlling for province and other intake characteristics, francophone students

have lower reading achievement scores than do anglophone students. Family structure variables have trivial independent associations with reading achievement.

Perhaps more of methodological than of substantive importance is the fact that students who failed to provide information about their parents occupation or on the amount of instruction time they received have particularly low reading achievement scores. In both PISA surveys, the combined effect of these two factors is the equivalent of more than one year's schooling.

### **6.1.2. School context and educational practices**

While the distribution of student intake characteristics is essentially beyond the control of educational authorities, this is not the case for the factors considered in this section. For organizational purposes, four aspects of school context and practices are considered: school resources; school structure, policies and practices; the introduction of special programs; and teacher characteristics. Information for these come from the school questionnaire completed generally by the school principal. The components of each are described in the following four sections. In light of the policy relevance of school context variables, more detailed analyses of the possible effects of these were conducted and are described below.

#### **School resources**

The effects of five aspects of school resources on literacy achievement were examined: student-teacher ratio, computer-student ratio, shortage of teachers, adequacy of physical infrastructure, and quality of educational resources. Since school resources can be expected to affect other aspects of educational practice, the effects of school resources were explored initially without including any other school context and educational practices variables (data not shown). The results are not entirely consistent between the two PISA surveys. In both data sets, the student-computer ratio had a small independent effect on skill scores, although the effect was not always statistically significant. In neither data set was the perceived quality of educational resources a factor in literacy attainment. For PISA 2000, only the perceived adequacy of the physical infrastructure had a significant independent relationship with reading achievement. In contrast, for PISA 2003 this variable was unrelated to reading achievement. Instead, the perceived shortage of teachers had the expected negative relationships with skill scores. Finally, and counter-intuitively, the student-teacher ratio was positively associated with literacy skills in PISA 2003; that is, the larger the average class size, the better were the skill scores. The possibility that the counter-intuitive finding constituted an artifact of school size was considered, since larger schools have a higher student-teacher ratio and a lower computer-student ratio (absolute correlations exceed 0.30). However, even after controlling for school size, the counter-intuitive finding remained, although it was attenuated somewhat. In the full model, the student-teacher ratio retained the same sign, but was no longer statistically significant and was therefore dropped from the analysis. On the whole, then, school resources appear to have at best only minor and contradictory associations with reading achievement.

#### **School structure, policies, and practices**

Schools differ in their structure, policies, and educational practices. Among the more important questions are whether differences in school size, amount of instructional time, number of student assessments, semestering, partnerships with business, admission criteria, and ability grouping are consequential for skill acquisition. The strongest effect among these variables is whether a semester structure is being used. Schools that have adopted a semester structure of course offerings tend to have lower reading achievement scores (equivalent to about a quarter of a year of instruction).

Reading achievement scores are on average higher in larger schools in both surveys. One can imagine various reasons for this, such as the possibility that larger schools have better facilities, or extra programs that better meet the needs of the students. However, even after controlling for all other school contextual and educational practices variables, the relationship persists. This suggests that there are some unmeasured factors that advantage larger schools with respect to the skill acquisition of their students.

Admission criteria have a noticeable association with literacy skills. Not surprisingly, schools that restrict admission based on a student's prior academic performance have higher average literacy skills, although the effect is not significant for PISA 2000. For that data set, schools in which the desires of parents are taken into consideration in the admission process have modestly lower reading achievement.

Requiring mandatory volunteer work of students has no apparent effect on reading achievement scores. Schools that have a partnership arrangement with a business concern are also neither advantaged nor disadvantaged with respect to average reading achievement of students in such schools.

### **Introduction of extra- or specialized programs**

Information regarding whether the school offers any extra- or specialized programs was available in both PISA surveys, although the information requested was different. For PISA 2003, with its emphasis on math achievement, principals were asked only about the types of extra math activities in their school. This index was positively associated with reading achievement. In PISA 2000, principals were asked whether their school provided any of the following: extra courses on academic subjects for gifted students, special language training for low achievers, special courses in study skills for low achievers, special tutoring by staff members, or room(s) where the students can do their homework with staff help. Providing space for students to do their homework failed to have a significant association with reading achievement. Both forms of special attention to low achievers are associated with lower reading achievement of about six points. In contrast, providing extra courses on academic subjects for gifted students and special tutoring by staff members had independent positive associations with reading achievement, with each resource associated with an approximately nine point higher mean reading achievement. It is not possible with the data at hand to determine whether any of the negative or positive effects are genuinely causal. This is primarily because we do not know whether these resources were introduced because the school was serving students who had disproportionate need for such programs (selection effects at the school level). Additionally, we do not know whether students who availed themselves of these opportunities (in schools where they were offered) improved their literacy skills. That is, we don't know which students (selection effects at the student level) took advantage of these resources (this was not asked on the student questionnaire), nor do we know whether their rate of skill acquisition increased for them (the information is cross-sectional rather than longitudinal).

The PISA 2003 survey provided more detailed information about types of special programs available in the school. Factor analysis of the various items indicated that these could be classified into four types of extra programs: 1) trades, special needs, alternate and second chance, 2) programs for gifted students, 3) programs for low achievers/at risk students, and 4) programs in arts and sports. Preliminary analyses indicated that there was a positive relationship between the number of programs for gifted children and their reading achievement. For all other types of programs, it was essentially whether the school offered any or none of them. Hence for the latter, a simple dichotomy was constructed consisting of



any versus none. An indicator for programs for gifted students consisted of a count of the number of such programs/resources in the school. Corroborating the preliminary analysis, “second chance” programs (trades, special needs, alternate, and returning dropouts) have a negative association with reading achievement. Programs for gifted students have a positive association, as do arts and sports programs. Programs designed especially for low achievers have no independent effects.

About 60 per cent of students attend a school in which a language immersion program is available. Schools offering immersion programs, regardless of in which language (French, English, or other) consistently have higher average reading scores.

### **Teacher characteristics and behaviours**

In both surveys, teacher behaviours are modestly related to student achievement scores: the more positive their behaviour (as assessed either by the school principal or the average of the student ratings of their teachers) the higher are the reading achievements in that school. Both teacher morale and curricular autonomy have small positive effects if they are the only teacher behavioural attributes considered. Due to collinearity, these effects disappear in the full model (although curricular autonomy remains marginally significant).

### **6.1.3. Summary of student and school effects**

- Student attributes are associated with reading achievement in a manner consistent with the findings from previous research.
- In combination, measures of academic performance and classes taken have the strongest associations with reading achievement.
- Home advantages in the form of parental education, occupation, and educational resources continue to give children from such homes a competitive literacy skills advantage. It should be pointed out that equipping the home with many books has effects additional to the other forms of parental capital and home resources. This suggests that a “reading culture” at home is an important ingredient in children’s acquisition of literacy skills.
- Students who failed to provide information about parental resources and/or the amount of time they were exposed to in language, math, and science classes have particularly low reading achievement scores.
- Although there are relatively large provincial differences in school characteristics and curricular programs offered, these factors have relatively little explanatory power. Only three school context variables appear to have measurable or consistent effects: school size, a semester structure, and teacher behaviours. One possibility is that the small effects and the less consistent results for school context factors are manifestations that these attributes are not well-captured in the PISA surveys.

It is important to note that some variables not included in the above models may nevertheless be important determinants of literacy skills. Curricular autonomy, for example, is unevenly distributed across province. In particular, it is noticeably lower in Quebec. If province is not included as a predictor, it is positively related to all skill attainments. Once province is included, its predictive power evaporates because of this provincial variation. Its practical importance remains, however, since it suggests that the literacy performance of Quebec students might be increased if schools in that province had greater autonomy over their curriculum. Likewise, private schools have moderately better outcomes (approximately 15 points, which is highly significant statistically) even after all student intake characteristics have

been held constant but before the other school context variables are entered. The fact that there is no statistically significant private school effect only in the full model simply indicates that private schools are more likely to have features that are associated with better reading achievements, rather than that the private school effect is due to the intake composition of their students.

## 6.2. Analysis of low and high reading achievers

The preceding section documented the student attributes and school contexts that are associated with higher or lower average reading achievements. The focus now is on the factors that predict membership in two groups: those whose reading achievement is especially low, and those whose reading achievement is exceptionally high. For statistical reasons it is advantageous to keep the number of students in these two groups the same. For this reason they are defined here as those whose reading achievement scores fell in the bottom and top 20 per cent in the distribution of Canada's scores in the PISA surveys. Students whose reading performance is in the bottom quintile might be at risk of not being able to function effectively in a knowledge-intensive economy. Those in the top quintile will likely have a competitive advantage in Canada's economy. Four questions are addressed here:

- What are the characteristics of the top performing students?
- What are the characteristics of the students who are struggling in their mastery of reading skills?
- What are the school-level factors that seem to reduce the incidence of students with particularly low reading achievement and/or to increase the proportion of top performers?
- Are schools that produce a high proportion of students with excellent reading skills doing so at the expense of neglecting their low reading achievers?

The answers to the first two questions are straightforward (see Tables 1 to 4 in the Appendix I).<sup>11</sup> First, without exception all student characteristics that were positively associated with average reading achievement are also associated with higher odds of being in the top quintile and lower odds of being in the bottom quintile. Second, those attributes that were negatively associated with reading achievement have lower odds of being in the top quintile and higher odds of being in the bottom quintile. No student characteristics were found that appreciably affected the odds of having excellent reading skills that did not also affect the likelihood of having poor reading skills.

The answers to the third and fourth questions are less clear. Some schools appear to have modestly higher proportions of top-performing students than others. For example, larger schools, those with positive student-teacher relationships and teacher behaviours, and schools that do not operate on a semester system. However, the same factors are associated with having a lower proportion of students in the bottom quintile. This leads to a similar conclusion as was found for student characteristics: Most school-level factors that increased the odds of having a high proportion of excellent reading skills also decreased the odds of having a high proportion of students with poor reading skills.

Additionally, it is debatable whether the school-level factors are causal. It may be better to conceive of them as selection effects. So, for example, in schools that take prior academic performance into account in their admission policies, the odds are 17 per cent higher of being in the top quintile. In these schools the odds are also 17 per cent lower that a student will be in the bottom quintile. This is clearly a selection effect.

For some characteristics, the causal direction is probably reversed. A good example is whether schools offering second chance programs serve the struggling students better than schools that

<sup>11</sup> As will become apparent in this section, most of the findings in the quintile analyses are congruent with those reported in previous tables. For this reason the tables are relegated to the appendix.

don't provide such alternate programs. One would not want to conclude that schools that offer such programs are doing a disservice to students with poor reading skills despite the fact that the odds of a student being in the bottom quintile are 27 per cent higher in schools that offer these programs. One would rather be inclined to conclude that schools with a high proportion of students with poor literacy skills are apt to introduce such programs. Cross-sectional data cannot assess the causality question empirically.

Some school-context variables arguably have reciprocal causal effects. The examples here concern the effects of teacher behaviours and student-teacher relations. In all analyses, schools with positive teacher behaviours and positive student-teacher relations tend to have higher mean reading achievements, a higher proportion of their students in the top quintile, and a lower proportion of students in the bottom quintile. A plausible argument can be made that schools that have a high proportion of students with solid reading skills (and/or a low proportion of students with poor reading skills) create a school atmosphere that spawns positive teacher behaviours and teacher-student relations. This positive atmosphere will likely subsequently facilitate the acquisition of students' reading skills. Although this argument can be made, it cannot be empirically tested without longitudinal data.

Finally, there is no evidence that schools that serve their solid reading achievers well do so at the expense of neglecting their low reading achievers. This conclusion is inferred from the fact that not a single school-level variable was found that simultaneously increased the likelihood of being both in the top and bottom quintile. To take a specific example, it is not the case that schools that have special programs for their gifted students tend to have higher proportions in the bottom quintile; indeed, the reverse is true. One other finding relevant to this conclusion is that schools in which all classes are grouped by ability actually have lower odds of having students in the top quintile.

## 7. Minority and majority language groups

Previous research clearly indicates that the effects of language of instruction with province of residence must be considered simultaneously in any investigation of skill attainment in Canada. This can be done effectively by creating five subgroups based on province of residence and language of instruction (the symbols in parentheses are the ones that are used subsequently in the profile analyses):

Province of residence	Language of instruction	
	French	English
Quebec	francophone majority (FQ)	anglophone minority (AQ)
Manitoba, Ontario, New Brunswick, Nova Scotia	francophone minority (F~Q)	anglophone majority (A~Q)
Newfoundland and Labrador, Prince Edward Island, Saskatchewan, Alberta, British Columbia		anglophone in unilingual system (AU)

### 7.1. Profiles of minority-majority language groups

Both the composition of students and the context of their high schools differ between the five language groups in many ways. Table 6 provides these profiles based on both PISA surveys.<sup>12</sup> Only those attributes

<sup>12</sup> Where identical information is available from both surveys, the profiles were quite consistent. Hence the information for these variables is presented for only one survey.

on which at least one per cent of the variance is associated with language group are profiled.

**Table 6: Profile of minority-majority language groups**

Student characteristics	AU	A~Q	AQ	FQ	F~Q	Eta Square
Immigrant student <sup>1</sup>	10	16	6	8	4	0.01
Home language same as test language <sup>1</sup>	87	85	79	91	65	0.01
Parental income in the top quintile <sup>2</sup>	19	23	18	16	18	0.01
Highest parental years of education <sup>2</sup>	13.74	13.82	13.96	13.33	13.40	0.01
More than 100 books in home <sup>1</sup>	57	55	63	36	43	0.03
Index of home possessions <sup>1</sup>	0.63	0.58	0.68	0.22	0.24	0.04
Repeated a grade in primary school <sup>1</sup>	7	5	14	24	6	0.07
Grade compared to modal grade <sup>1</sup>	-0.07	-0.07	-0.37	-0.60	-0.07	0.19
Took make-up classes in last three years <sup>2</sup>	21	18	31	46	20	0.07
Took enriched classes <sup>1</sup>	22	16	33	15	10	0.01
Took Grade 10 math class <sup>2</sup>	81	84	60	52	79	0.09
Took Grade 10 language class <sup>2</sup>	83	85	63	53	80	0.09
University-preparatory math class <sup>2</sup>	69	17	35	32	34	0.21
Instructional time in language, math, and science (hours per week) <sup>2</sup>	4.85	4.83	4.15	4.51	5.04	0.01
<b>School context</b>						
Rural school <sup>1</sup>	60	42	13	36	51	0.06
Private school <sup>1</sup>	9	9	25	25	1	0.05
School size <sup>1</sup>	552.47	774.92	511.78	777.12	564.18	0.07
Teacher/student ratio <sup>1</sup>	16.46	16.01	14.61	16.98	15.28	0.03
Ratio of students to total number of computers in the school <sup>1</sup>	4.90	4.76	5.84	7.39	4.60	0.16
Grade 10 has a semester structure <sup>2</sup>	72	73	22	9	87	0.29
Shortage of teachers (WLE) <sup>1</sup>	-0.23	-0.26	-0.13	0.04	0.45	0.04
Student performance admission requirement <sup>1</sup>	0.38	0.47	0.47	0.53	0.28	0.02
Curricular autonomy <sup>1</sup>	3.05	3.03	2.98	3.23	2.07	0.05
Number of types of math activities <sup>1</sup>	0.87	1.27	0.91	0.93	1.13	0.05
Index of programs in arts and sports <sup>2</sup>	1.54	1.09	0.98	1.02	0.87	0.07
Index of programs for gifted students <sup>2</sup>	2.00	1.75	2.07	1.63	1.27	0.03
Trade, special needs or alternative program <sup>2</sup>	84	75	55	45	73	0.10
Quality of instructional resources <sup>1</sup>	0.13	-0.17	0.16	0.00	-0.42	0.03
No classes grouped by student ability <sup>1</sup>	36	50	34	49	56	0.02
Number of assessments using teacher-developed tests <sup>1</sup>	10.92	11.13	10.47	8.65	10.47	0.13

Note: Whole numbers are percentages; all others are means.

<sup>1</sup>Source: PISA 2003

<sup>2</sup>Source: PISA 2000

The analyses in the preceding section documented that one of the strongest predictors of reading achievement is the grade in school relative to the modal grade<sup>1311</sup> (Grade 10). This is also one of two student attributes on which the language groups differ the most, with almost a fifth (0.19) of the variance accounted for by language group. On this attribute (and grade retention, which is a primary reason for grade in school at age 15), Quebec students stand out as farthest behind modal grade and most likely to have repeated a grade in primary school. Within Quebec, it is the francophone students who are particularly likely to be behind grade and to have experienced grade retention

<sup>13</sup> The differences are also attributable to the fact that students in Quebec begin school at the age of 7, rather than 6, if their birthdays fall in October, November and December.

in primary school. Likewise, Quebec francophone students are the least likely to have taken either a Grade 10 language or math class by the age of 15. The latter differences are most likely due to the higher grade retention rates in Quebec francophone schools.

The other student attribute which differs widely between the language groups is whether the last math class was taken at a university-preparatory level. More than two-thirds of anglophone students in unilingual provinces took their last math class at a university-preparatory level. At the opposite extreme, less than one in five anglophone students in dual-language provinces outside of Quebec took a university-preparatory math class, while about one in three students in the remaining language groups took such a class.

Language groups differ in their home possessions and equipping their home with at least 100 books, exhibiting the following rank order (from least to most):

$$FQ < F\sim Q < A\sim Q < AU < AQ$$

What is remarkable in this rank order is that francophones and anglophones residing in Quebec are at opposite extremes.

The largest language group school context difference is on whether schools operate on a semester system. Quebec schools, especially in the French-language sector, are least likely (less than one quarter) to have a semester curricular structure, while this is the norm (more than seven out of ten schools) for the other language groups. Language group differences are also pronounced on the number of teacher-developed tests. Interestingly, such tests are least frequent in francophone Quebec schools and most frequent in anglophone schools outside of Quebec.

Attending a private school is primarily a Quebec versus other provinces matter. One quarter of both English- and French-speaking schools in Quebec were private. This stands in contrast to just under one in ten anglophone schools outside of Quebec and just one per cent of the francophone schools outside of Quebec. Large rural-urban differences are also found, with the following inequalities (from least to most rural):

$$AQ < FQ < A\sim Q < F\sim Q < AU.$$

Sizeable language group differences also characterize the nature of extra programs provided by the schools. francophone schools outside of Quebec have the fewest programs in arts and sports, while anglophone schools in unilingual provinces have the largest number. English-language schools tend to have more programs for gifted students than do French-language schools. Quebec francophone schools stand out as being the least likely to have second chance programs in the form of trade, special needs, or alternative programs.

## **7.2. *Multivariate analysis of reading achievement***

The review of the literature indicated that language groups differ in their literacy skills. That literature, however, did not take into account language group differences in student intake characteristics. Further, in our multivariate analyses of provincial differences, a consistent finding was that Quebec's relative performance increased substantially after controlling for student intake characteristics. At that point, the issue of why Quebec's relative performance improved so consistently was left unexplored. This section rectifies that situation by examining in greater detail the changes in the performance of the five language groups after controlling for two types of student intake

characteristics: demographic attributes and prior academic performance. Demographic characteristics include gender, parental capital of various kinds, immigrant status, and family structure variables. Prior academic performance includes grade retention, grade relative to modal grade, and all the various types of classes and levels at which those classes were taken. Table 7 shows the effects of these two sets of controls for the two PISA surveys (the complete results are in the Appendix I).

**Table 7: Raw and net language group differences in PISA reading achievement**

	Raw		Net of demographic attributes		Net of academic performance	
	b		b		b	
<b>PISA 2000</b>						
Anglophone in unilingual province	535.4		484.3		463.0	
Anglophone outside of Quebec	3.5		2.6		24.0	***
Anglophone in Quebec	-2.4		5.3		41.2	***
Francophone in Quebec	-3.2		-5.9		6.2	*
Francophone outside of Quebec	-64.8	***	-52.6	***	-37.0	***
<b>PISA 2003</b>						
Anglophone in unilingual province	529.7		463.6		494.4	
Anglophone outside of Quebec	5.5		3.7		2.6	
Anglophone in Quebec	-4.3		-5.9		6.8	
Francophone in Quebec	-5.1		2.0		26.5	***
Francophone outside of Quebec	-35.9	***	-24.0	***	-23.0	***

An examination of the reading achievement coefficients associated with the language groups reveals some important patterns. First, in both data sets, the rank orders of the raw reading achievement scores are consistent. From lowest to highest, these are

$$F\sim Q < FQ < AQ < AU < A\sim Q.$$

Conspicuous is the low reading achievement of francophone students living outside of Quebec. Their average reading achievement score was 65- and 36 points below that of anglophones in unilingual provinces in the PISA 2000 and PISA 2003 assessments, respectively. The raw reading achievements of the other language groups differ only slightly and can be considered equal within sampling fluctuations.

Holding student demographic characteristics constant has modest effects on the estimated reading achievements of the different language groups. The biggest effect is for francophones from outside of Quebec. For them, holding demographic factors reduces the language group gap in reading achievement by 12 points in both surveys. Nevertheless, the reading achievement of non-Quebec francophones remains significantly below that of the other language groups.

The most dramatic effects on estimated reading achievement occur when prior academic performance is also held constant. In both surveys, it increases the reading achievement scores of both language groups in Quebec. For Quebec francophones, the increase is 12 points (from six points below anglophones in unilingual provinces to six points above) in 2000, and 24 points in 2003. For Quebec anglophones, the increase is especially large (36 points) in PISA 2000. For anglophones in dual-language provinces, the effects differ between the two surveys. In 2000, but not in 2003, holding academic performance constant noticeably improves their relative performance. The same is true for non-Quebec francophones.

The documented patterns support two conclusions:

- Francophone students outside of Quebec have substantially lower reading skills than the other language groups. One contributing factor is the socio-demographic characteristics of their

students. Controlling for these significantly reduces, but does not eliminate, their literacy gap in either survey. In PISA 2000, the academic performance among these students was relatively poor, and likely for this reason, they appear to have made curricular choices that kept them at below-average reading achievement. For this reason, controlling for prior academic performance also increase their relative performance (but does not eliminate their low achievement). By 2003, the French-language school systems outside of Quebec appear to have resolved some of the academic problems, since in the PISA 2003 assessment, controlling academic performance has no significant additional effect.

- Quebec students, in both the French and English sector, have approximately average literacy skills. Controlling for their socio-demographic intake characteristics does not appreciably alter their relative performance. Instead, for both language groups and in both PISA data sets, controlling for prior academic performance has a pronounced effect of raising their relative standings. The implication is that in Quebec, practices such as grade retention and placing students into remedial classes may be keeping their students from excelling in reading achievement. It must be kept in mind, however, that these practices appear not to produce students with below-average reading achievement.

## 8. International comparisons

Prior research has indicated that Canada performs especially well on PISA reading achievement scores, but not as well on IALSS prose. Specifically, Canada ranks ahead of all comparison countries included in this report on the PISA tests, whereas Norway outranks Canada on IALSS. Table 8 expands on the previous research by providing information from both PISA surveys and by examining whether the rank order of countries in the top and bottom quintile of skill scores mirror those based on the mean scores.

An examination of this table shows that Canada's mean performance exceeded that of Norway by about 28 points in both PISA surveys. Likewise, in both PISA assessments, Canada has a higher proportion than Norway of its students performing in the top international quintile; vice versa, Norway has a higher proportion than Canada in the bottom quintile. The consistency of these findings indicates that Canada's superior performance among its 15-year-olds is quite stable. Further, Canada's advantage is manifest not only in the average performance on PISA assessments, but also in its share of students in the top and bottom quintiles.

**Table 8: International comparison of mean and top and bottom quintiles of literacy skills.**

	Canada	Norway	Italy	Switzerland	USA
<b>PISA 2000</b>					
Mean reading achievement	534	505	487	494	504
Percent in bottom international quintile	12	20	22	24	21
Percent in top international quintile	26	19	10	16	19
<b>PISA 2003</b>					
Mean reading achievement	528	500	476	499	496
Percent in bottom international quintile	10	19	26	18	21
Percent in top international quintile	27	19	12	18	19
<b>IALSS 2003</b>					
Mean Prose core	287	301	244	281	269
Percent in bottom international quintile	13	6	45	16	23
Percent in top international quintile	27	36	6	23	15
Number of cases (unweighted)	3574	996	1147	458	641

In sharp contrast to the PISA results, among 16-24-year old youth, Norway has the edge over Canada in all these respects on the IALSS prose assessment.

A number of possible reasons might account for these anomalous findings:

- Student and school attributes in the PISA surveys are distributed in a manner that favours the reading achievement of Canada over Norway. In that case, once these attributes are held constant, Canada's superiority over Norway should disappear.
- The PISA and IALSS measures were intended to be approximately interchangeable, but Norwegian young people gain more skills than Canadians do after mid-adolescence. Since PISA captures skill attainment at only age 15, whereas the IALSS youth subsample is measured at ages 16-24, the educational, training, and labour market experiences and opportunities of Norwegian young adults might be superior to those of Canadian young adults. This implies that the Canadian advantage in PISA might be attributable to superior public schooling but that this advantage dissipates subsequently because their skills are not utilized or augmented as effectively.
- The inconsistent rankings are due to methodological artifacts.
- The underlying skills measured by IALSS and PISA differ, with Norwegian young people possessing more of the skills measured by IALSS than do their Canadian counterparts.

This section assesses the merits of these possible explanations.

## **8.1. International profiles**

Comparing the international profiles of student and school characteristics from the PISA surveys across the five countries will provide an indication of whether Canada's high international rank in reading achievement in these surveys might be due to particularly favourable intake characteristics of its students. Table 9 provides these profiles for the PISA 2000 survey, while Table 10 does so for the PISA 2003 survey. The same criteria were used for constructing the international profiles as was employed for the provincial profiles: country differences in the attributes must account for a minimum of one per cent of the variance in the attribute, and the attribute is a determinant of reading achievement. The main focus in this section is on a comparison of Canada with Norway.

### **8.1.1. Student characteristics**

The five comparison countries differ most on parental education, accounting for 14 per cent and nine per cent of the variance in PISA 2000 and PISA 2003, respectively. With the exception of parental education in PISA 2000, Norway ranks higher than Canada on all measures of parental resources: parents in this country have more education, higher occupational status, more home possessions and a higher proportion with at least one hundred books in the home. Since parental education and household resources are strong determinants of reading achievement, it becomes already clear that Canada's reading achievement advantage on the PISA surveys is unlikely due to favourable distribution on student attributes. In comparison to Canada, Norway has fewer students who are behind grade. Norway also has about half the proportion of immigrants as Canada, and perhaps for this reason it has the highest percentage of students speaking the same language at home as the test language. These are all factors that should work in favour of the reading achievement scores for Norwegian students. On the other hand, total instructional time per week is the lowest in Norway, and this should disadvantage Norwegian students.



**Table 9: International profiles (PISA 2000)**

Student characteristics	Canada	Norway	Italy	Switzerland	USA	Eta-square
Immigrant student	11	6	2	14	7	0.01
Nuclear family	72	72	74	78	54	0.01
Number of siblings	1.85	2.05	1.32	1.65	2.41	0.04
Home language same as test language	89	94	82	81	89	0.01
Highest years of education of parents	15.98	15.22	13.96	14.02	15.49	0.14
Highest parental occupational status	52.85	53.91	47.08	49.21	52.39	0.02
Index of household possessions	0.41	0.56	0.12	0.05	0.61	0.04
Index of home educational resources	0.00	0.10	0.18	0.29	-0.28	0.02
Mother in the labour force	20	27	23	41	16	0.06
Home internet connection	70	71	33	52	70	0.07
Grade in school relative to modal grade	-0.16	0.00	-0.14	-0.07	-0.47	0.04
Participated in remedial reading	13	14	38	24	19	0.05
Participated in skills training programs	23	10	20	11	30	0.02
Participated in enrichment programs in	29	13	9	42	39	0.04
Parental occupation not ascertained	3	2	3	3	14	0.03
<b>School context</b>						
Rural school	50	71	37	67	49	0.04
Private school	11	5	15	12	17	0.01
Number of students in the school	632.8	136.7	458.1	321.8	461.0	0.12
Student-teacher ratio	16.5	7.6	8.3	11.4	13.2	0.43
Proportion of teachers fully certified	95	88	72	82	86	0.10
Index of quality of instructional resources	-0.03	0.57	0.05	-0.44	-0.13	0.06
School has program for gifted students	34	16	51	52	56	0.05
School provides language and other study help for low achievers	83	94	95	75	73	0.06
Index of positive teacher behaviors	-0.19	0.05	-0.39	-0.39	-0.24	0.01
Index of student-teacher relationships	0.19	-0.13	-0.26	-0.25	-0.17	0.05
Number of schools (unweighted)	1117	176	172	282	153	
Number of students (unweighted)	29614	4142	4984	6090	3838	

Note: Whole numbers are percentages; all others are means.

### 8.1.2 School Contexts

As was the case for the student intake profiles, all five comparison countries differ significantly (and in some cases quite substantially) on all school context variables. The largest country differences are on student-teacher ratio, curricular autonomy and number of assessments using teacher-developed tests. In general, country differences in school contexts are substantially larger than those found for student attributes.

Norwegian schools differ from those of Canada and the other countries in several notable respects. Norwegian schools are predominantly rural with at least two-thirds being located in rural areas, compared to about half for Canadian schools. Perhaps as a reflection of the rural nature of Norway, it has the smallest average school size—generally less than half that of the comparison countries. This may also be one of the reasons why Norway offers relatively few math activities in their schools.

**Table 10: International profiles (PISA 2003)**

Student intake characteristics	Canada	Norway	Italy	Switzerland	USA	Eta-square
Immigrant student	12	6	3	13	7	0.03
Nuclear family	70	64	80	74	55	0.02
Home language same as test language	87	95	81	88	91	0.01
Parental education (in years)	14.53	14.59	12.52	12.26	13.51	0.09
Highest parental occupational status	52.58	54.63	46.83	49.30	54.55	0.03
Index of household possessions	0.51	0.74	0.14	0.19	0.34	0.04
Index of home educational resources	0.07	0.28	0.09	0.03	-0.17	0.01
More than 100 books in home	52	63	41	44	41	0.01
Mother in the labour market	78	83	59	68	75	0.06
Home internet	86	95	94	94	79	0.02
Hours of instructional time per week	23.58	22.12	26.44	24.14	22.21	0.04
Took remedial classes	20	13	38	15	25	0.04
Took enriched classes	18	10	17	10	30	0.01
Has a tutor	12	4	20	11	12	0.02
<b>School Context</b>						
Rural school	47	67	20	71	45	0.06
Private school	12	4	16	10	19	0.01
School size	591.44	274.56	443.10	384.12	610.05	0.03
Student-teacher ratio	15.99	9.28	9.18	12.31	13.11	0.15
Student performance admission requirement	43	1	37	66	37	0.03
All classes grouped by student ability	16	6	4	16	14	0.02
No classes grouped by student ability	46	64	67	53	37	0.06
40 or more assessments per year	19	6	45	11	21	0.05
Number of assessments using teacher-developed tests	10.54	8.85	7.89	10.87	11.35	0.25
Index of teacher behaviours	0.07	-0.39	0.19	0.34	-0.06	0.02
Curricular autonomy index	3.08	2.75	3.77	2.18	3.69	0.22
Index of quality of instructional resources	-0.43	-0.58	-0.45	0.14	0.17	0.08
Index of poor student-teacher relations (school average)	-0.24	0.02	0.36	-0.09	-0.06	0.03
Number of math activities	0.97	0.57	1.57	0.13	1.17	0.11
Number of schools (unweighted)	1087	182	406	445	274	
Number of students (unweighted)	27217	4064	11639	8420	5455	

Note: Whole numbers are percentages; all others are means.

There are several indications that Norway is more dedicated to egalitarian schooling. For example, Norway has few private schools represented in this survey (under five per cent), compared to over one in ten in Canada. Likewise almost two-thirds of Norwegian schools report that they do not group their students by ability, compared to under half of Canadian schools. Norwegian schools are somewhat more likely than Canadian schools to provide language and other study help for low achievers (and somewhat less likely to have programs for gifted students). Finally, only one per cent of Norwegian schools report having student performance as an admission requirement, compared to over two in every five in Canada.

In contrast to the student attributes, Canada appears to have more favourable school context variables than Norway in many respects. This should result in a smaller gap in reading achievement between Canada and Norway once school context variables are held constant. The next section assesses whether the contradictory international rankings for Canada and

Norway might be explained through differences in their respective country profiles.

## 8.2. *International multivariate analyses of literacy*

For the PISA surveys, three models, parallel to those developed for assessing provincial differences in reading achievement, are presented here for assessing national differences among the comparison countries. Model 1 provides the raw national differences. Model 2 shows the effects of student intake characteristics and the net country differences in reading achievement once student characteristics are controlled. The final model shows the effects of school-context variables in an international context. For the IALSS survey, only models 1 and 2 can be developed, since there are no school-level variables available in this survey.

Table 11 presents the results for PISA 2000 and Table 12 for PISA 2003. Since the raw country differences were examined at the beginning of this section, attention here is on the effects of student and school variables. An examination of the parameter estimates here with those found for the analysis of the Canadian data supports three conclusions.

First, all variables that were significant determinants of reading achievement for Canada are also significant factors in an international context.<sup>14</sup> Not only that, the relative magnitudes of the effects are similar. In an international context, the effects are generally larger than they were when the analysis was restricted to Canada. This is because there is substantially greater heterogeneity internationally than domestically. It is also partly for this reason that additional variables, such as home internet access, have appreciable effects.

Second, as intimated in the examination of the country profiles, it can now be stated with greater certainty that Canada's superior reading achievement relative to that of Norway is not due to the distribution of student intake characteristics. Indeed, a comparison of the country parameters of Model 2 with Model 1 shows that the gap between Canada and Norway widens somewhat in both PISA surveys after controlling for student attributes.

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<sup>14</sup> The international comparisons are restricted to attributes that were measured in the PISA questionnaires. Additionally, countries made different decisions about which questions to exclude, either in the questionnaires themselves, or in the public release of the data sets. The models developed here are based on those variables that were available across all comparison countries.

**Table 11: International determinants of reading achievement (PISA 2000)**

	b		se	b		se	b		se
Canada	531.2		1.890	502.5		2.741	495.2		3.191
Norway	-26.3	***	4.733	-32.4	***	3.614	-17.2	***	4.948
Italy	-54.6	***	7.579	-23.3	***	4.863	-19.3	***	5.727
Switzerland	-48.3	***	5.764	-46.9	***	4.136	-42.3	***	4.810
USA	-35.2		7.320	-4.3		3.973	-6.3		4.211
Female				27.3	***	1.061	27.3	***	1.061
Immigrant				-14.4	***	2.302	-14.8	***	2.294
Nuclear family				8.6	***	1.152	8.6	***	1.148
Number of siblings				-2.4	***	0.463	-2.3	***	0.462
Home language same as test language				22.7	***	1.542	22.9	***	1.538
Parental education				2.2	***	0.276	2.2	***	0.275
Highest parental occupational status				0.8	***	0.035	0.8	***	0.036
Index of household possessions				-8.0	***	0.741	-8.1	***	0.739
Index of home educational resources				9.4	***	0.576	9.3	***	0.577
Mother in the labour force				-1.7	**	0.632	-1.7	**	0.630
Home internet				15.4	***	1.331	15.3	***	1.335
Grade relative to modal grade				37.2	***	1.314	37.1	***	1.287
Participated in remedial reading classes				-49.6	***	1.905	-49.9	***	1.902
Participated in skills training				-37.3	***	1.598	-37.2	***	1.599
Participated in enriched/advanced classes				31.2	***	1.543	31.1	***	1.549
Occupational status not ascertained				-40.3	***	3.226	-40.0	***	3.243
Private school							18.2	***	4.635
School size (in hundreds)							0.9	**	0.268
Student-teacher ratio							1.0	*	0.433
School has programs for gifted students							5.2	*	2.452
Index of quality of school's educational materials							-2.6	*	1.142
Index of teacher behaviours							5.8	***	1.265
Index of student-teacher relations							-12.9	***	1.715
Proportion of explained variance			0.045			0.333			0.377

\*p &lt; .05

\*\*p &lt; .01

\*\*\*p &lt; .001

Finally, the country profiles also suggested that Canada's solid performance may have something to do with relatively favourable school characteristics. This possibility also receives empirical support from the third model in both PISA surveys. Note that the gap in reading achievement between Canada and Norway is reduced by about one half after controlling for school context factors (from 32 to 17 reading achievement points in 2000; and from 35 to 13 points in 2003). Nevertheless, in both surveys the gap between Canada and Norway remains statistically significant.

**Table 12: International determinants of reading achievement (PISA 2003)**

	b	se	b	se	b	se
Canada	529.1	2.102	501.6	2.640	473.4	5.967
Norway	-26.7***	4.041	-34.6***	3.296	-13.2**	4.107
Italy	-68.0***	6.341	-52.8***	4.298	-42.0***	4.780
Switzerland	-33.7***	4.637	-30.8***	3.224	-20.6***	3.896
USA	-36.7***	4.459	-25.5***	2.840	-27.3***	3.071
Female			25.5***	1.103	25.5***	1.106
Immigrant			-16.8***	2.485	-17.3***	2.502
Nuclear family			9.5***	1.228	9.5***	1.229
Home language same as test language			15.8***	1.978	15.9***	1.973
Parental education			0.6**	0.206	0.6**	0.206
Highest parental occupational status			0.5***	0.040	0.5***	0.040
Index of household possessions			9.6***	0.938	9.5***	0.938
Index of home educational resources			3.5***	0.765	3.4***	0.762
At least 100 books in the home			14.1***	1.313	14.2***	1.313
Grade relative to modal grade			38.1***	1.333	37.2***	1.338
Hours of instructional time			1.1***	0.088	1.2***	0.088
Instructional time not ascertained			-37.2***	1.783	-37.1***	1.782
Parental education not ascertained			-11.1*	4.788	-10.9*	4.787
Occupational status not ascertained			-24.2***	3.101	-24.2***	3.103
Index of attitude towards school			3.7***	0.567	3.7***	0.566
Index of student-teacher relations			4.6***	0.721	4.5***	0.714
Forty or more assessments per year					-7.2*	2.834
Student performance admission requirement					6.2**	2.389
School size (in hundreds)					0.9***	0.237
Student-teacher relations (standardized)					-5.7***	1.685
Index of quality of educational resources					3.6**	1.150
Number of math activities					5.6***	1.466
Student-teacher ratio					0.6*	0.323
Proportion of explained variance		0.146		0.409		0.419

\*p &lt; .05

\*\*p &lt; .01

\*\*\*p &lt; .001

The advantage of the IALSS data is that it permits an assessment of whether country differences in young people's experiences between the ages of 16 and 24 might account for Norway's high literacy skills in that survey. Of special interest are country differences in learning and training opportunities after the age of 15. Since this is the age period in which there are multiple and fluid transitions, the timing and nature of transitions into parenthood or between education and work, for example, are likely candidates to account for country differences in literacy acquisition.

Since the IALSS survey was designed for assessing adult literacy, it is not ideally suited for assessing how the nature of youth transitions affects their literacy acquisition. The main reason is that many factors that are relevant to adults are not applicable to large portions of youth. For example, whether opportunities for developing reading, math, or problem-solving skills are provided at work is applicable to those who are in the labour force. Since many young people are still pursuing their formal education, these questions are not applicable, resulting in large percentages of missing data. Additionally, some of the comparison countries did not release information on certain variables. For example, the USA did not release information on some of the crucial educational and training

variables. Consequently, the analyses based on the IALSS survey are somewhat limited. Table 13 provides information on the raw (first two columns) and net (last two columns) prose achievement.

**Table 13: International multiple regression estimates of prose achievement (IALSS 2003)**

	b	se	b	se
Canada	287.2	1.60	279.0	8.37
Norway	14.0***	3.06	10.1**	3.07
Italy	-43.0***	3.22	-31.6***	4.40
Switzerland	-5.8	4.08	1.74	6.19
USA	-17.8***	3.34	-16.7***	4.20
Female			7.2***	2.66
Rural			0.1	3.61
Immigrant			-19.2**	7.85
Parent			-5.7	3.82
Test language=home language			7.7	7.45
Mother has less than high school certificate			-0.2	3.67
Father has less than high school certificate			-15.2**	5.16
Mother participated in PSE			9.8**	4.07
Father participated in PSE			11.2**	3.69
Remedial reading classes			-19.2***	3.75
Full-time student			0.9	4.24
Did not participate in any education or training in the previous year			-11.9**	4.26
Years of education			6.3***	0.61
Proportion of explained variance	0.05		0.33	

\*p < .05

\*\*p < .01

\*\*\*p < .001

The parameter estimates based on IALSS show some of the familiar patterns. Females, young people whose parents are better educated, and those who took the skills test in the same language as spoken at home have higher prose scores, while immigrants and those who had taken remedial reading classes have lower scores. Not surprisingly, the educational attainment of young people is strongly associated with their prose skills. Most importantly, Table 13 shows that continued participation in training and education is a major factor in young people's literacy attainment. It is also on this feature that Norway has a somewhat better record than Canada: 82 per cent of Norwegian young people compared to 75 per cent of their counterparts in Canada had participated in some form of education or training during the previous 12 months. This is one of the reasons why the net gap in prose scores between Norway and Canada is substantially smaller than the raw gap. Nevertheless, Norwegian young people score significantly higher than their Canadian counterparts even after these controls. Hence it must be concluded that country differences in life-long learning is only a partial reason for Norway's superior performance on the IALSS survey.

### 8.2.1. Conclusions about inconsistent country rankings

Four possible reasons for the inconsistent rankings of Canada and Norway between the PISA and IALSS surveys were provided earlier. The analyses conducted here indicate that all four of them may play some part in explaining the differences. Analyses of the PISA data indicated that Canada's superior performance in that survey was not due to student intake characteristics. Rather, it was due in part to differences in school contexts between Canada and Norway. Nevertheless, even after controlling for these, Canada retained its top position.

An analysis of the IALSS data showed that Norway's high scores on prose skills were indeed partly attributable to young people in that country being more likely to participate in education and training after the age of 15 than were Canada's young people. Nevertheless, Norway retained its top position after controlling for this and other factors that are relevant to skill acquisition. It is possible that a more stringent and complete set of controls might have eliminated the gap between Norway and Canada. For example, on an index of reading engagement at work, Canada's young people scored considerably lower than Norwegian youth. However, since information on this variable was missing for over 35 per cent of the youth, its explanatory potential was quite limited.

Turning to methodological artifacts, one possibility concerns the response rates. There are especially large country differences in response rates in IALSS, from a low of 40 per cent to a high of 82 per cent, with Canada's overall response rate at 66 per cent and Norway's at 56 per cent. Although literacy scores were imputed for missing cases (if the background questionnaire was completed), it is likely that the quality of the data will be uneven as a result of these imputations. Some part of the discrepant findings between IALSS and PISA may be due to such uneven data quality across countries, since non-response is not random (lower achievers are generally less likely to respond).

Finally, it must be noted that the PISA reading achievement assessments were based primarily on the IALSS prose and document measures (Scott Murray, personal communication). Hence the two measures have the same conceptual underpinnings, making it unlikely that the underlying skills measured in PISA and IALSS differ. The main difference between the two is that a multiple choice response format is used in PISA, while in IALSS the respondent writes a short answer. These answers are then subsequently coded into correct or incorrect responses by country coders. Norway was one country where the reliability of the assigned codes was not assessed by coders from another country. It remains possible that either the response format or systematic measurement error in classifying responses are part of the explanation for the inconsistent rankings.

## 9. Conclusions and recommendations

For reasons of public accountability, it is appropriate that provincial and international comparisons on student academic performance and skill acquisition be conducted. This report provides such comparisons using both PISA and IALSS literacy assessments. At the same time, comparative perspectives risk becoming invidious. It is for this reason that such comparisons need to adjust the results for extraneous factors over which educational authorities have little control. This was done by statistically controlling for student intake characteristics. Controlling for such characteristics generally decreased the provincial differences in literacy scores, corroborating that it is indeed important to provide estimates of net differences when accountability is the main focus. This raises the question of what factors should be controlled.

In this research, the decision was made to control both socio-demographic characteristics of students as well as their prior academic performance. The latter were held constant because in many instances students transfer into their high school from another school. The skills with which they arrive are therefore beyond the control of the high school. Yet in most cases the students received their prior education in the same province and therefore when the attention is on provincial differences, controlling for prior academic performance has the potential to mask these differences. The most dramatic manifestation of this concerns the performance of Quebec students. Employing the full set of controls had the effect of moving Quebec from fourth- to top-ranking province. Yet this improved rank had little to do with the socio-demographic characteristics of its students. Rather, it was due to prior academic factors such as being behind grade due to grade retention in primary school. For these reasons we recommend that where provincial comparisons

are to be made, models with two separate sets of controls—one on socio-demographic and the other on prior academic performance—be developed.

When public accountability is not the issue at hand, there is less justification for assessing provincial differences. Provincial differences in literacy skills are, from a statistical point of view, quite small despite being statistically significant. Additionally, with the possible exception of Quebec, provinces whose raw scores are particularly high (or low) remain above (or below) when estimating their net performance. The important question is not how to account for whatever provincial gaps remain, but rather what can be done to improve literacy regardless of provincial jurisdiction.

Collectively, school characteristics appeared to play a surprisingly small role in discriminating between schools with better or worse literacy skills. One possible reason for this is that some of the school context variability was siphoned off by provincial differences in these school contexts.<sup>15</sup> Additional analyses (not presented in this report) showed that this was indeed the case. Hence school context factors are somewhat more consequential than reported here. A second possibility is that school context variables are not captured well through principals' reports. One manifestation of this is the inconsistencies in school context estimates between the two PISA surveys. Additionally, a variety of analyses (not reported) also suggest that principals' reports are of dubious reliability and validity. Since school context factors are crucially important from a social policy perspective, possible improvements in educational delivery would be enhanced if more systematic and reliable information on school-level information were collected for every school and attached to the PISA-type surveys.

The analyses in this report reinforce the conclusion from other studies that no single factor under the control of educational authorities is likely to lead to major improvement in skill acquisition. Instead, this report suggests that a combination of changes in a number of different aspects of the structure of education and its delivery could have beneficial effects on student literacy. One such factor is whether the school has adopted a semester curricular structure. Semestered schools are estimated to have average reading achievement scores that are fully 16 points below that of schools that do not, even after controlling for a full set of other student and school characteristics. The reasons for this cannot be explored in this report, but the apparent effect is sufficiently large that it merits closer examination.

One of the stronger relationships concerns the amount of instructional time in language, math, and science classes: the greater the amount of instructional time, the higher are the skill scores. It is likely not a coincidence that students in Alberta perform exceptionally well while those in New Brunswick fare particularly poorly, since students in Alberta are exposed to the greatest amount of instructional time while those in New Brunswick have the least instructional time. Educational authorities might consider examining ways in which the instructional time to which students are exposed in these classes can be increased. There does not appear to be any advantage to increasing the number of weeks in the school year, however, since this variable has no additional positive effect on student literacy.

The use of teacher-developed tests appears to have salutary effects on literacy attainment. This is in contrast to reliance on any other forms of assessment (student portfolios, teacher judgment, standardized tests), which are unrelated to skill acquisition. Additionally, some schools may have emphasized assessments too much, since the use of many assessments is related to lower skill scores. The optimum number of assessments is certainly less than forty. A possible reason for this is that testing may compete with instructional time.

Schools in which teachers have exemplary behaviours (infrequently absent, etc.) are ones in which students perform better on skills tests, even after controlling for student intake characteristics and other educational practices. At the same time, a strong correlation was found between teacher and student behaviours ( $r = 0.59$ ). This suggests that student and teacher behaviours, both positive and negative, mutually reinforce

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<sup>15</sup> The focus in this report on providing estimates of net provincial differences has this somewhat unfortunate consequence, since province has to be entered into the equation prior to entering school context information.



each other. It is not possible with cross-sectional data to give causal priority to either the teacher or the student behaviour. However, it is likely that anything that can be done to improve teacher behaviours will also improve student behaviours and through these links improve the skill acquisition process.

Students in schools that offer additional math activities, such as competitions and clubs, have higher literacy skills than those that don't offer such activities. One might expect this for math achievement, but additional analyses (not reported here) show that this positive effect spills over to all skill domains. It is not clear what the mechanisms for this effect are, but it remains in the full model where all student intake characteristics and other educational practices and contexts have been held constant. Educational authorities would be well advised to consider developing such math activities.

While skill attainment is generally lower in rural schools (especially in reading and math), this is due to the student intake characteristics. Controlling for these, rural students score approximately the same as other students. Again this is so in all skill domains. The implication is that rural schools may have been somewhat neglected with respect to facilities and recruitment of teachers with good teaching practices.

While the focus of this report was on reading and prose skills, an important policy question is whether enhancement of these skills might undermine the development of other important skills, such as math and problem solving skills. Additional exploratory analyses parallel to those reported here were conducted on these other skills. Of considerable importance is the fact that educational contexts and practices that appear to improve reading skills are the same ones that are positively related to the acquisition of math, science, and problem-solving skills. This means that a practice that is beneficial for one skill is likely also beneficial for the others. In no instance was a factor found that increased skills in one domain but decreased them in another.

Taking a long-term view, there is increasing evidence that the development of a reading culture both at school and in the home is vital for augmenting human capital skills. Regardless of the number and types of variables held constant, the more books in a household, the higher the skill scores in all domains; indeed the effects on math, science, and problem solving are greater than for reading achievement. Additional detailed analyses (not presented in this report) showed that it was specifically the presence of books in the home, rather than other educational resources, such as computers or a study room of one's own, that was positively associated with literacy attainments. Likewise, enjoying reading had a huge effect on reading achievement, wiping out the rather large gender difference in reading achievement scores. Much attention and resources have been focused on providing homes and schools with computers and internet connections. This has had the consequence that students currently are attracted more to computers than to books, and actually believe that they learn more from computers than from books (Thiessen and Looker 2007). Yet evidence for any beneficial effects of computer use is sparse, whereas the evidence for the effect of a reading culture is both consistent and strong. We must keep in mind that the students of today will be the parents of tomorrow, and in that time perspective, the development and perpetuation of an appreciation of the written word is what educational authorities should be inculcating.

Provincial stakeholders involved in the study recommended that future data collection should provide sufficient information to allow analysis of Aboriginal status (particularly in the prairie provinces). This recommendation is endorsed by the researchers.

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Table 1: Logistic regression of top quintile reading achievement (PISA 2003)

	b		se	Odds ratio	b		se	Odds ratio	b		se	Odds ratio
Ontario	-1.37	***	0.087	0.25	-2.57	***	0.170	0.08	-2.77	***	0.207	0.06
Newfoundland and Labrador	-0.43	**	0.140	0.65	-0.35	**	0.129	0.71	-0.10		0.138	0.90
Prince Edward Island	-1.29	***	0.208	0.28	-1.09	***	0.168	0.34	-0.83	***	0.144	0.44
Nova Scotia	-0.65	***	0.119	0.52	-0.49	***	0.122	0.61	-0.32	*	0.127	0.73
New Brunswick	-0.82	***	0.120	0.44	-0.71	***	0.113	0.49	-0.47	***	0.119	0.63
Quebec	-0.08		0.127	0.93	0.52	***	0.122	1.68	0.60	***	0.123	1.82
Manitoba	-0.38	**	0.128	0.68	-0.32	*	0.127	0.72	-0.19		0.130	0.83
Saskatchewan	-0.66	***	0.133	0.52	-0.58	***	0.130	0.56	-0.45	**	0.142	0.64
Alberta	0.21		0.123	1.23	0.20		0.111	1.22	0.28	*	0.117	1.32
British Columbia	-0.11		0.109	0.89	-0.06		0.110	0.95	0.04		0.106	1.05
Female					0.59	***	0.057	1.81	0.61	***	0.058	1.83
Nuclear family					0.29	***	0.063	1.33	0.28	***	0.063	1.33
Repeated a grade in primary school					-1.67	***	0.343	0.19	-1.67	***	0.359	0.19
Took remedial classes					-0.77	***	0.109	0.46	-0.77	***	0.109	0.46
Took enriched/advanced classes					0.37	***	0.092	1.45	0.38	***	0.092	1.46
Had a tutor					-1.03	***	0.127	0.36	-1.05	***	0.126	0.35
Grade relative to modal grade					1.02	***	0.098	2.78	1.01	***	0.101	2.73
Immigrant youth					-0.28	*	0.134	0.76	-0.31	*	0.136	0.73
Home language same as test language					0.31	*	0.123	1.36	0.33	**	0.123	1.40
At least 100 books in the home					0.52	***	0.073	1.69	0.53	***	0.074	1.71
Parental education					0.02	*	0.012	1.02	0.02		0.012	1.02
Parental occupational status					0.01	***	0.002	1.01	0.01	***	0.002	1.01
Household educational resources					0.11	*	0.049	1.12	0.11	*	0.050	1.12
Index of home possessions					0.28	***	0.054	1.33	0.28	***	0.055	1.33
Instructional time					0.03	***	0.004	1.03	0.03	***	0.004	1.03
Instructional time not ascertained					-1.01	***	0.147	0.37	-1.00	***	0.150	0.37
School size (in hundreds)									0.03	**	0.009	1.03
Admission based on academic performance									0.16	*	0.078	1.17
Math activities									0.09		0.052	1.09
No classes grouped by ability									0.07		0.091	1.07
All classes grouped by ability									-0.27	**	0.099	0.76
Estimated percentage repeating a primary grade									-0.02		0.009	0.98
Student-teacher relationships									-3.78	**	1.233	0.02

**Table 2: Logistic regression of bottom quintile reading achievement (PISA 2003)**

	b		se	Odds ratio	b		se	Odds ratio	b		se	Odds ratio
Ontario	-1.72	***	0.086	0.18	-0.94	***	0.124	0.39	-0.82	***	0.143	0.44
Newfoundland and Labrador	0.55	***	0.131	1.74	0.50	***	0.117	1.64	0.23		0.126	1.26
Prince Edward Island	1.44	***	0.225	4.24	0.75	***	0.189	2.11	0.52		0.188	1.69
Nova Scotia	0.62	***	0.114	1.86	0.44	***	0.123	1.56	0.25		0.130	1.28
New Brunswick	0.84	***	0.111	2.31	0.68	***	0.108	1.97	0.42	***	0.114	1.53
Quebec	0.46	**	0.151	1.58	-0.62	***	0.143	0.54	-0.67	***	0.139	0.51
Manitoba	0.51	***	0.136	1.67	0.29	*	0.123	1.34	0.15		0.125	1.16
Saskatchewan	0.64	***	0.137	1.90	0.44	***	0.128	1.55	0.28	*	0.134	1.33
Alberta	0.16		0.157	1.17	-0.01		0.135	0.99	-0.02		0.136	0.98
British Columbia	0.12		0.110	1.12	0.04		0.114	1.04	-0.09		0.112	0.91
Female					-0.84	***	0.061	0.43	-0.85	***	0.062	0.43
Nuclear family					-0.32	***	0.060	0.73	-0.32	***	0.061	0.73
Repeated a grade in primary school					1.00	***	0.125	2.71	1.01	***	0.128	2.76
Took remedial classes					0.59	***	0.071	1.80	0.59	***	0.072	1.80
Had a tutor					0.54	***	0.093	1.72	0.58	***	0.096	1.79
Grade relative to modal grade					-0.97	***	0.069	0.38	-0.94	***	0.072	0.39
Immigrant youth					0.14		0.101	1.15	0.17		0.108	1.18
Home language same as test language					-0.56	***	0.092	0.57	-0.58	***	0.093	0.56
At least 100 books in the home					-0.27	***	0.065	0.77	-0.27	***	0.066	0.76
Parental education					-0.01		0.014	0.99	-0.01		0.014	0.99
Parental occupational status					-0.02	***	0.002	0.98	-0.02	***	0.002	0.98
Household educational resources					-0.09	*	0.044	0.92	-0.09		0.044	0.92
Index of home possessions					-0.33	***	0.056	0.72	-0.32	***	0.058	0.72
Instructional time					-0.04	***	0.004	0.96	-0.04	***	0.004	0.96
Instructional time not ascertained					1.13	***	0.076	3.09	1.12	***	0.078	3.06
Occupational status not ascertained					0.41	**	0.129	1.51	0.41	**	0.134	1.50
School size (in hundreds)									-0.05	***	0.009	0.95
Admission based on academic performance									-0.19	*	0.086	0.83
Estimated percentage repeating a primary grade									0.03	**	0.009	1.03
Student-teacher relationships									4.54	***	1.091	93.28
Teacher behaviours									-0.13	*	0.056	0.88

Table 3: Logistic regression of top quintile reading achievement (PISA 2000)

	b		se	Odds ratio	b		se	Odds ratio	b		se	Odds ratio
Ontario	-1.41	***	0.061	0.25	-3.32	***	0.147	0.04	-3.06	***	0.163	0.05
Newfoundland and Labrador	-0.32	*	0.152	0.73	-0.87	***	0.158	0.42	-0.89	***	0.155	0.41
Prince Edward Island	-0.50	**	0.168	0.61	-0.70	***	0.137	0.50	-0.62	***	0.127	0.54
Nova Scotia	-0.23	*	0.108	0.79	-0.64	***	0.111	0.53	-0.68	***	0.119	0.51
New Brunswick	-0.56	***	0.100	0.57	-0.95	***	0.103	0.39	-0.90	***	0.104	0.41
Quebec	-0.06		0.088	0.95	0.51	***	0.102	1.66	0.25	*	0.110	1.28
Manitoba	0.02		0.106	1.02	-0.24	*	0.111	0.78	-0.19		0.109	0.83
Saskatchewan	-0.22	*	0.096	0.80	-0.65	***	0.108	0.52	-0.52	***	0.111	0.59
Alberta	0.31	***	0.093	1.37	-0.06		0.098	0.94	0.01		0.096	1.01
British Columbia	0.11		0.085	1.12	-0.38	***	0.092	0.68	-0.43	***	0.096	0.65
Female					0.48	***	0.048	1.62	0.48	***	0.048	1.62
Number of siblings					-0.05	**	0.021	0.95	-0.05	*	0.021	0.95
Nuclear family					0.13	*	0.059	1.13	0.12	*	0.059	1.13
Immigrant					-0.14		0.113	0.87	-0.18		0.113	0.83
Home language same as test language					0.50	***	0.087	1.66	0.53	***	0.087	1.69
Number of school moves					0.08	***	0.016	1.08	0.07	***	0.016	1.08
Years of parental education					0.14	***	0.014	1.15	0.14	***	0.014	1.15
Income (in quintiles)					0.02		0.019	1.02	0.02		0.019	1.02
Household educational resources					-0.02		0.026	0.98	-0.02		0.027	0.98
Parental occupational status					0.01	***	0.002	1.01	0.01	***	0.002	1.01
At least 100 books in the home					0.53	***	0.052	1.71	0.54	***	0.052	1.71
Francophone					-0.20	*	0.089	0.82	-0.22		0.087	0.80
Repeated a grade in primary school					-1.44	***	0.172	0.24	-1.45	***	0.172	0.23
Remedial classes					-1.13	***	0.064	0.32	-1.13	***	0.064	0.32
Enriched classes					0.60	***	0.051	1.83	0.59	***	0.051	1.80
Grade 10 math					0.29	*	0.141	1.34	0.29	*	0.141	1.33
Grade 10 language					0.14		0.132	1.15	0.14		0.132	1.15
University preparatory math					0.86	***	0.067	2.36	0.87	***	0.068	2.38
Instruction time					0.06	***	0.013	1.06	0.08	***	0.013	1.08
Occupational status not ascertained					-0.70	*	0.284	0.49	-0.70	*	0.289	0.50
Instructional time not ascertained					-0.65	***	0.090	0.52	-0.71	***	0.085	0.49
School size									0.00	*	0.000	1.00
Semestered									-0.38	***	0.073	0.69
Programs for gifted students									0.05		0.028	1.05
Alternative programs									-0.16	**	0.063	0.85

**Table 4: Logistic regression of bottom quintile reading achievement (PISA 2000)**

	b		se	Odds ratio	b		se	Odds ratio	b		se	Odds ratio
Ontario	-1.30	***	0.080	0.27	0.01		0.137	1.01	-0.21		0.164	0.81
Newfoundland and Labrador	0.39	**	0.133	1.48	0.85	***	0.112	2.33	0.96	***	0.125	2.60
Prince Edward Island	0.78	***	0.184	2.18	0.62	**	0.213	1.85	0.61	**	0.198	1.84
Nova Scotia	0.15		0.125	1.16	0.29	*	0.126	1.33	0.39	**	0.136	1.47
New Brunswick	0.52	***	0.111	1.68	0.87	***	0.112	2.38	0.81	***	0.116	2.26
Quebec	-0.15		0.124	0.86	-1.35	***	0.136	0.26	-1.01	***	0.139	0.36
Manitoba	0.10		0.122	1.10	0.17		0.105	1.18	0.13		0.111	1.14
Saskatchewan	0.01		0.110	1.01	0.42	***	0.109	1.52	0.33	**	0.118	1.39
Alberta	-0.26	*	0.126	0.77	-0.17		0.116	0.84	-0.18		0.112	0.83
British Columbia	-0.10		0.106	0.91	0.26	*	0.103	1.30	0.37	***	0.108	1.45
Female					-0.62	***	0.046	0.54	-0.62	***	0.047	0.54
Number of siblings					0.05	*	0.020	1.05	0.04	*	0.020	1.04
Nuclear family					-0.01		0.052	0.99	-0.01		0.053	0.99
Immigrant					0.31	**	0.102	1.37	0.36	***	0.102	1.43
Home language same as test language					-0.62	***	0.073	0.54	-0.65	***	0.075	0.52
Number of school moves					-0.06	***	0.016	0.94	-0.06	***	0.016	0.94
Years of parental education					-0.09	***	0.013	0.92	-0.08	***	0.013	0.92
Income (in quintiles)					-0.02		0.020	0.98	-0.02		0.020	0.98
Household educational resources					-0.10	***	0.025	0.91	-0.09	***	0.025	0.91
Parental occupational status					-0.01	***	0.002	0.99	-0.01	***	0.002	0.99
At least 100 books in the home					-0.24	***	0.047	0.78	-0.25	***	0.048	0.78
Francophone					0.18		0.118	1.20	0.15		0.109	1.16
Repeated a grade in primary school					1.01	***	0.074	2.75	1.03	***	0.075	2.81
Remedial classes					1.04	***	0.053	2.84	1.06	***	0.054	2.88
Enriched classes					-0.42	***	0.052	0.66	-0.40	***	0.053	0.67
Grade 10 math					-0.23	*	0.110	0.79	-0.23		0.112	0.79
Grade 10 language					-0.52	***	0.112	0.60	-0.51	***	0.113	0.60
University preparatory math					-0.97	***	0.063	0.38	-0.98	***	0.064	0.38
Instruction time					-0.05	**	0.015	0.96	-0.06	***	0.015	0.94
Occupational status not ascertained					0.81	***	0.138	2.26	0.81	***	0.142	2.25
Instructional time not ascertained					0.83	***	0.075	2.29	0.86	***	0.074	2.36
School size									0.00		0.000	1.00
Semestered									0.45	***	0.082	1.58
Arts programs									-0.07		0.039	0.93
Programs for gifted students									-0.10	**	0.031	0.91
Alternative programs									0.24	**	0.082	1.27
Student-teacher relationships									0.07	*	0.035	1.07

**Table 5: Multiple regression of reading achievement of language groups (PISA 2003)**

	b		se	b		se	b		se
Anglophone in unilingual province	529.72	***	3.002	502.56	***	4.906	497.917	***	4.936
Anglophone outside of Quebec	5.53		4.374	1.09		3.259	-0.657		3.097
Anglophone in Quebec	-4.32		7.426	8.50		5.000	12.094	*	4.683
Francophone in Quebec	-5.12		6.680	24.41	***	3.873	25.394	***	3.990
Francophone outside of Quebec	-35.92	***	5.727	-24.72	***	4.369	-20.412	***	4.216
Female				26.35	***	1.764	26.321	***	1.762
Nuclear family				11.00	***	1.839	10.877	***	1.842
Grade retention				-34.32	***	3.870	-34.168	***	3.887
Remedial classes				-25.48	***	2.709	-25.353	***	2.700
Enriched classes				6.62	***	2.513	6.886	**	2.503
Tutor				-27.52	***	2.699	-27.930	***	2.698
Extra classes				1.47		2.637	1.164		2.631
Grade relative to modal grade				36.27	***	2.238	34.945	***	2.233
Immigrant youth				-7.63	*	3.631	-7.971	*	3.724
Home language same as test language				17.61	***	3.568	18.095	***	3.549
At least 100 books in the home				13.38	***	1.896	13.452	***	1.896
Parental education				0.67		0.443	0.569		0.445
Parental occupational status				0.50	***	0.066	0.479	***	0.066
Household educational resources				3.76	*	1.526	3.693	*	1.525
Index of household possessions				10.86	***	1.680	10.712	***	1.688
Instruction time (in hours/week)				1.22	***	0.128	1.217	***	0.127
Instruction time not ascertained				-39.70	***	3.505	-39.029	***	3.514
Parental occupational status not ascertained				-23.08	***	4.876	-22.585	***	4.905
School size (in hundreds)							1.426	***	0.253
At least 40 assessments per academic year							-6.415		3.519
Admission based on academic performance							5.135		2.628
All classes grouped by ability							-5.706		3.126
Estimated percentage repeating a primary grade							-1.005	**	0.318
Poor student-teacher relations							-158.997	***	39.619
Index of teacher behaviours							3.549	*	1.584
Number of teacher-developed tests							0.977		0.515
Explained variance	0.004			0.308			0.322		



**Layout**

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