

Literacy, Numeracy and Problem-Solving Skills of Canadian Youth

by:

*J. Douglas Willms
University of New Brunswick*

*Barry Watson
University of New Brunswick*

for:

*Learning Policy Directorate
Strategic Policy and Research
Human Resources and Social Development Canada*

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“The Learning Research Series” are research documents disseminated by the Learning related sections of Human Resources and Social Development Canada. The objective of the Learning Research Series is to publish research on lifelong learning, from childhood to late adulthood, occurring in all learning environments, learning institutions, homes, communities and workplaces. The series intends to build a body of evidence, through critical review, analysis of different data sources, replication and confirmation of results and disseminate the results for public debate and policy development. The series include internal research reports, commissioned research, syntheses, research symposia proceedings and annotated bibliographies.

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1. Introduction

In the new global economy, the ability of a labour force to adapt efficiently to technological development is essential (Passaris, 2003). While traditional neoclassical economic theory suggests that a nation's output is a function of labour and capital, contemporary economists argue that it is also a function of knowledge and skills, or "human capital". Productivity requires investments in human capital such as investments in formal education attainment, job-related training, and opportunities for informal learning (Becker, 1964; Mincer 1958; Romer, 1993).

Over the past two decades there has been a shift in employment away from manufacturing toward the information, technology, and service sectors. These sectors tend to require stronger literacy skills than manufacturing. In addition, the labour demand in most economies has shifted towards greater skill demand across all sectors (Dickerson & Green, 2004; Machin, 2001; Organisation for Economic Co-operation and Development & Statistics Canada, 1995, 2000). Workers with low levels of skills are therefore finding it increasingly difficult to find and secure gainful employment. Also, recent economic analyses have indicated that there is a premium for wages and employment associated with high literacy skills, over and above the effects of educational attainment (McIntosh & Vignoles, 2001), and that inequalities in literacy skills associated with family socioeconomic status, ethnicity, and sex contribute directly to inequalities in income and occupational status (Raudenbush & Kasim, 1998). Although a highly educated and skilled labour force is not the sole factor of economic growth, there is a significant relationship between human capital and economic performance (DesLauriers, 1990; Snow, Barnes, Chandler, Goodman, & Hemphill, 1991; Statistics Canada, 1991; Shapiro & Purpel, 1993; The Creative Research Group, 1987).

Literacy is a key component of human capital. For example, a recent study by Coulombe, Tremblay, and Marchand (2005) found that the average level of adult literacy skills explained over one-half of the differences in long-term growth rates in GDP per capita among 14 OECD countries. Literacy encompasses more than reading skills; it refers to the ability to understand, extrapolate, and communicate written material from several sources, and to use these skills in everyday life. It is conceptualized as a continuum of proficiency, and therefore simple classifications of adults as "literate" or "illiterate" are no longer appropriate.

The literacy skills of youth are particularly important for two reasons. One is that levels of youth literacy are largely attributable to the quality and quantity of learning experiences during early childhood, and the primary and secondary school years. Thus, it provides an indication of the success of investments in a wide range of programs, including formal schooling. Youth literacy is also important looking forward, as it is the present youth cohort that will have the longest and most direct impact on future economic performance. In Canada, this is especially important because as the baby-boom generation reaches retirement age, young workers will comprise an increasing proportion of the Canadian work-force, and their engagement as healthy, skilled workers will be critical to sustaining economic growth and productivity.

In 2003 the Adult Literacy and Life Skills Survey (ALL) was conducted in six countries: Canada, Bermuda, Italy, Mexico (Nuevo Leon), Norway, Switzerland, and United States. It was a large-scale co-operative initiative coordinated by Statistics Canada and Education Testing Service, in collaboration with several national and multi-lateral agencies. The study built upon the International Adult Literacy Study (IALS) which included data collection of adult's literacy skills from 1994 through 1998. This study uses data from ALL to examine the literacy skills of Canadian youth. It focuses on three sets of research questions:

- What is the level of performance in Prose, Document, Numeracy and Problem-Solving literacy among Canadian youth, aged 16-25? What is the correlation among these competencies at the individual level?
- What are the factors that explain the variation in literacy skills of Canadian youth? Is there a difference for those of high school age (16-19) compared to those of post secondary education age (20-25)? Are the rates similar or higher among youth who are still at school compared to those who are working? What is the role of a person's own education and parental educational attainment? What factors are associated with literacy performance for low income youth?
- To what extent do the effects of demographic characteristics vary among provinces and territories?

The next section presents a brief literature review relevant to these questions. This section is followed by four sections which respectively address each of the questions above. A discussion of the sample used for the study is presented at the beginning of the third section, and details of the analytic techniques are presented in each section. The paper concludes with a summary of the findings and discussion of their implications for social policy.

2. Literature Review

When one considers the literacy skills of youth, as they are measured in large-scale national or international studies such as the Programme for International Student assessment (PISA) or Adult Literacy and Life Skills Survey (ALL), it is tempting to view them as a measure of the quality of schooling, especially as it pertains to the skills acquired during secondary school. There is considerable evidence that schools vary in their learning climate and quality of instruction, and these factors directly affect literacy skills (Hill & Crevola, 1999; Scheerens, 1992; Willms, 2006). However, the literacy skills of young adults represent the cumulative result of life experiences since birth, or arguably since conception. Children begin hearing sounds in utero, during the third trimester of pregnancy (DeCasper, LeCauet, Busnel, Granier-Deferre, & Maugeais, 1994), and soon after birth they can distinguish their mother's voice from that of other females (Kisilevsky et al., 2003). During the first year, before infants say their first words, they perceive and attend to different sounds, and learn words that are part of their native language (Werker & Tees, 2002). Most children say their first words at about 12 months and soon thereafter there is a rapid, exponential growth in vocabulary. The rate of vocabulary growth during this period is related to children's exposure to a quantity and quality of language (Hart & Risley, 1995; Huttenlocher Haight, Bryk, & Seltzer, 1988; Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991), which continues to be important throughout the pre-school years. Studies of the effects of early childhood centres on children's early literacy skills also emphasise the importance of growing up in a nurturing and language-rich environment (Ramey & Ramey, 1998). After children enter school, the family environment continues to play a key role. Several studies have pointed to the effects of parental involvement and engagement (Epstein & Dauber, 1991; Ho & Willms, 1996; Pong, 1997; Stevenson & Baker, 1987) and parenting style (Chao & Willms, 2002; Fehrmann, Keith, & Reimers, 1987; Lamborn, Dornbusch, & Steinberg, 1996; Steinberg, Lamborn, Dornbusch, & Darling, 1992; Taylor, Hinton, & Wilson, 1995). Consequently, when one examines the variation among youth in their literacy skills, among jurisdictions or over time, it is important not to focus solely on the quality of secondary schools, as much of the variation in skills is also attributable to investments in early child development, and to parenting practices throughout childhood.

An important predictor of the literacy scores of youth and older adults is their level of educational attainment. Several studies have noted in particular that youth who have not completed secondary school have lower skills than those who graduate from secondary school, and these students in turn have lower skills than those who complete some form of secondary school education (Chettri & Baker, 2005; Desjardins, 2003; Kapsalis, 1999; Willms 1997; Verner, 2005). However, level of education may be simply a proxy for several factors that contribute to literacy skill development throughout childhood; that is, youth that build strong literacy skills during childhood are more likely to stay on at school through to graduation and pursue post-secondary studies. Willms (2005) found that the level of literacy skills of Canadian youth aged 16 to 25 fell between 1994 and 2003, despite a substantial increase in the average socioeconomic background of parents, and Willms and Murray (2007) found that while levels of both formal and informal education and training had increased over that period, it did not result in increased literacy skills.

Another important predictor of youth literacy skills is family socioeconomic status. Willms (2006) argues that the relationship between literacy skills, and other social outcomes, and socioeconomic status (SES), referred to as a socioeconomic gradient or the “learning bar”, provides a useful framework for evaluating societal outcomes and assessing what kinds of interventions may be most beneficial in improving outcomes. In earlier work, Willms (1999, 2004a) compared the gradients in youth literacy for Canada and the United States, for both PISA and IALS, and found that the level of skills of Canadian youth is higher than that of their US counterparts, and in Canada there are fewer inequalities along socioeconomic lines. These results were apparent in the findings stemming from the first analyses of the ALL data (Statistics Canada & Organisation for Economic Co-operation and Development, 2005; Willms, 2005). Nevertheless, Canada has a large proportion of students with low literacy skills, at Level 2 or lower. Earlier work based on the IALS indicated that youth who have skills at or below Level 2 are less likely to pursue post-secondary training (Willms & Flanagan, 2002).

Also, the research based on PISA and IALS found large differences among provinces, which could not be fully explained by differences in socioeconomic status (Willms, 1997, 2004b).

Generally, when one assesses the relative impact of the constituent components of SES – parental education, parental occupation, and income – the level of mother’s education plays an important role (Desjardins, 2003; Kapsalis, 1999; Willms, 1997). Although few studies have measured both the parents’ level of literacy and that of their children, there is some evidence of a link between the mother’s literacy level and that of her children (Chettri & Baker, 2005). This is consistent with the early childhood literature Documenting the important role that mothers typically play in establishing early literacy skills. The prestige of the parents’ occupation also plays an important role, and Willms’s (2003) examination of the effects of family background on children’s academic achievement suggests that the level of parental occupation begins to play a more dominant role after children enter school. This could be because family income to some extent determines where the family resides, and therefore may be related to the nature of school a child attends. A few studies have also examined the effects of family structure. Studies conducted in the US suggest that children living with a single parent or step-parent tend to perform more poorly on standardized tests (Entwisle & Alexander, 1995; Pong, 1997), but the Canadian research suggests that much of the disadvantage associated with living in single parent families is attributable to low family income (Willms, 2003). Most studies of literacy skills also find a consistent but weak relationship between literacy skills and number of siblings in the household (Alwin, 1991; Blake, 1989; Downey, 1995; Retherford & Sewell 1992). This could be explained by the fact that when there are more siblings, children have less exposure, on average, to adult language in the home.

Another demographic factor that warrants consideration is whether the youth is an immigrant, and if so, how recently he or she immigrated. The evidence from IALS suggest that newly arrived immigrants tend to possess literacy scores that are substantially below the average of their native-born counterparts; however, the gap gradually decreases as immigrants are in the country, but even after 5 years there is still a substantial gap, almost a full standard deviation (Willms, 1999). After ten years in the country, though, only a small gap remains. Other research has also indicated that there is also a gap in literacy skills for those who learned

French or English as their second language compared with those for whom English is their first language (Desjardins, 2003).

Literacy scores are also strongly related to the extent that people engage in literacy activities outside of work. In his study based on the IALS, Willms (1999) found that youth engagement in literacy activities at home was positively associated with literacy scores, while there was a negative relationship with watching television. Indeed, the work suggested that there may be a cultural dimension to the way people spend their leisure time that affects overall literacy scores; the results found that while about one-half of the variation among states and provinces was attributable to parental education, immigrant status, and ethnicity, an additional 15% of the variation in youth scores was attributable to how youth spent their leisure time. A positive effect associated with engagement in literacy activities at home, and the negative effect for watching television, were also observed in the recent work based on ALL: Willms (2005) found that engagement in literacy activities at home is especially important for youth, while engagement in literacy activities at work becomes more important during middle and late middle age. Tramonte and Willms's (2007) argue that there are two types of "cultural capital" relevant to youth literacy – one that is static, representing the highbrow activities and practices of parents, and one that is dynamic, representing children's use of their cultural assets in everyday life. Their analysis of the relationship between reading literacy scores and these two types of cultural capital in 28 OECD countries found that dynamic cultural capital is a more important determinant of literacy skills than static cultural capital or SES. Other researchers have suggested that voluntary reading is the best predictor of literacy skills after controlling for SES (Desjardins, 2003; Krashen, 1993; Loertscher, 1993).

3. Levels of Literacy Performance of Canadian Youth

The Adult Literacy and Life Skills Survey (ALL), assessed skills in four literacy domains as follows:

“Prose literacy – the knowledge and skills needed to understand and use information from texts including editorials, news stories, brochures and instruction manuals.

Document literacy – the knowledge and skills required to locate and use information contained in various formats, including job applications, payroll forms, transportation schedules, maps, tables and charts.

Numeracy – the knowledge and skills required to effectively manage the mathematical demands of diverse situations.

Problem solving – Problem solving involves goal-directed thinking and action in situations for which no routine solution procedure is available.”

(Statistics Canada and Organisation for Economic Co-operation and Development, 2005, p. 16.

Each respondent was administered a “test booklet” which consisted of a randomly selected series of questions with a wide range of difficulty, pertaining to each domain. Statistics Canada & Organisation for Economic Co-operation and Development (2005) observe that proficiency in each domain was based on an 80% probability that the respondent would correctly answer additional items within this domain of equal difficulty. Furthermore, as opposed to there being only one score, ALL uses a set of plausible values which are derived from the respondents test scores and measurement error associated with the test. In essence, the plausible values are the set of scores the respondent may have achieved had they completed the entire set of questions from each domain.¹ The ALL scores for each proficiency scale were scaled to have a mean of 250 and a standard deviation of 50 for adults aged 16 to 65 across six countries that participated in the survey. This makes it possible to compare scores across countries and to some extent across domains. In addition, proficiency scores were categorized into levels. Prose, Document, and Numeracy literacy proficiency scales were categorized into 5 levels, while the Problem Solving scale was categorized into 4 levels.

¹ For more information on plausible values see Beaton (1987) and Wu and Adams (2002).

The first set of questions to be addressed in this study is: *What is the level of performance in Prose, Document, Numeracy and Problem-Solving literacy among Canadian youth, aged 16-25? What is the correlation among these competencies at the individual level?*

Table 1 provides a number of descriptive statistics for the scores of Canadian youth age 16 to 25, for each of the four literacy domains assessed in ALL. The mean scores range from 279.6 for Numeracy to 290.7 for Document literacy. The standard errors of these estimates are presented in parentheses.² Overall, Canadian youth on average scored above the international norms. The standard deviations are close to 45 for Prose, Document and Problem-Solving, while for Numeracy it is 50.9, indicating that the variation of scores is greater in this domain. The scores in all four domains are negatively skewed, ranging from -0.37 to -0.30. Skewness is an indicator of the extent to which a distribution is asymmetrical. Distributions that are negatively skewed have low scores that extend further below the mean than the high scores extend above it; the reverse is the case for positively skewed distributions.

Table 1				
Descriptive Statistics for Literacy Skills of Youth Age 16 to 25				
Source: ALL 2003				
	Prose	Document	Numeracy	Problem-Solving
Mean	288.0 (1.7)	290.7 (1.7)	279.6 (2.0)	284.6 (1.8)
Standard Deviation	46.5 (1.0)	46.4 (1.0)	50.9 (1.1)	44.5 (1.5)
Skewness	-0.37 (0.08)	-0.33 (0.08)	-0.31 (0.08)	-0.30 (0.10)
Percent at or below level 2 (or below Level 1 for Problem-Solving)	37.8 (2.1)	34.9 (2.0)	44.8 (1.6)	21.4 (1.3)
Correlations				
Prose	1.00	-	-	-
Document	0.90 (0.01)	1.00	-	-
Numeracy	0.78 (0.01)	0.82 (0.01)	1.00	-
Problem-Solving	0.83 (0.02)	0.81 (0.02)	0.71 (0.03)	1.00
Note 1: Standard errors are indicated in parentheses.				
Note 2: The unweighted sample size is 3,869.				

² Due to the nature of the sampling design and the use of multiple test booklets in ALL, the calculation of the standard errors requires special programming to use the replicate “jack-knife” design weights. Therefore, the standard errors cannot be obtained directly from most standard statistical packages.

The fourth row shows the percentage of youth that scored at or below Level 2 in Prose, Document and Numeracy, or at or below Level 1 in Problem-Solving. In the first three domains, scores below this level are at or below 275, while in Problem Solving they are at or below 250.³ About 35 to 38% of Canadian youth scored at Level 2 or lower in Prose and Document literacy, while about 45% scored at Level 2 or lower in Numeracy. For Problem Solving, 21.4% scored at or below Level 1. The estimate of the prevalence of youth scoring at or below Level 2 in Problem Solving is 61.4% (not shown in table).

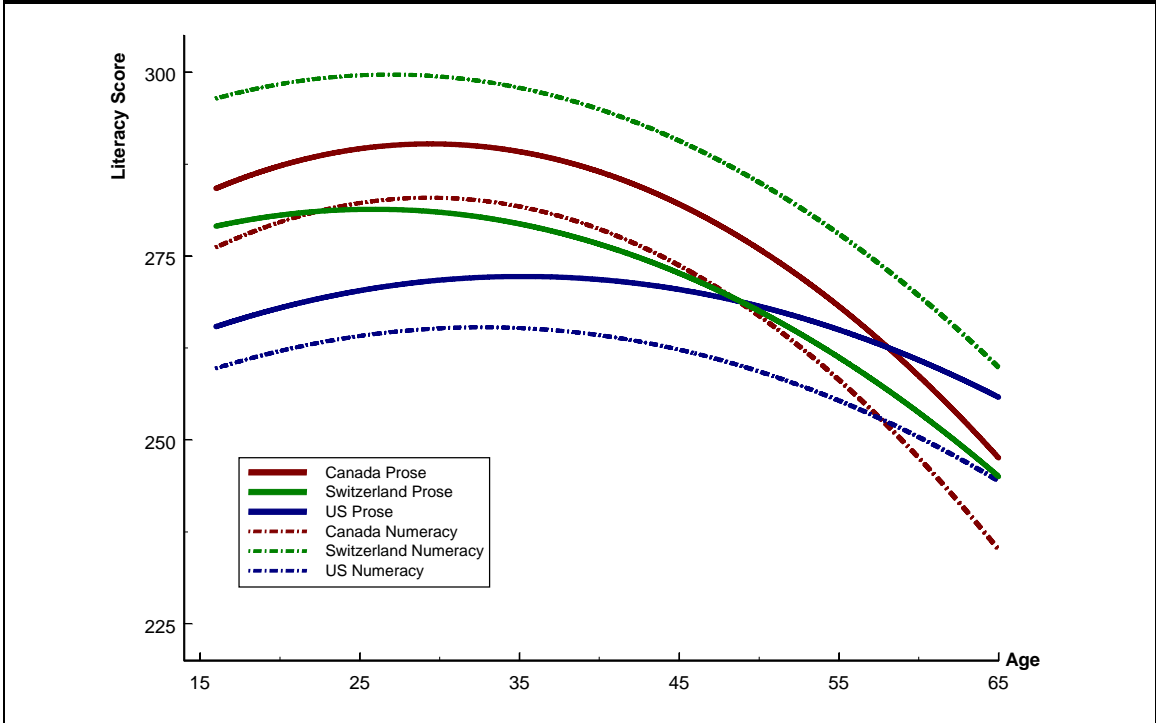
The bottom part of the table shows the correlations among the domain scores at the individual level. Prose and Document literacy scores are highly correlated, with a correlation of 0.90, and each of these measures are correlated highly with Problem Solving, 0.83 and 0.81 respectively. Numeracy scores are also highly correlated with scores in the other domains, although the correlations with Prose and Problem Solving are somewhat weaker – 0.78 and 0.71 respectively.

The international report indicated that for adults aged 16 to 65, Canada scored higher than Switzerland, United States and Italy on the Prose and Document literacy tests, but lower than Norway and Bermuda on the Prose literacy test, and lower than Norway on the Document literacy test. The pattern is different on the Numeracy and Problem Solving tests however. Canada scored lower than both Norway and Switzerland on these tests.

The comparison with Switzerland is important, as it shows that Canada's scores on Numeracy literacy are relatively low, and that there is a large discrepancy between its scores in this domain compared with the other domains. Figure 1 shows the relationship between literacy and Numeracy scores and age for adults aged 16 to 65 in Canada, Switzerland and the US, based on the 2003 ALL. An important finding from this simple analysis is that literacy and Numeracy competencies vary considerably with age, and among countries. In Canada and the US, Prose literacy scores are on average about 8 points higher than Numeracy scores, and this gap is fairly consistent across the age range. However, in Switzerland, Numeracy scores are on average about 18 points higher than Prose literacy scores. These results are generally consistent with findings from the PISA: Canada youth at age 15 out-performed their peers in Switzerland and the United States in reading literacy, with an average score of 534 compared with 494 for Swiss students and 504 for US students, but in mathematics literacy Canadian students scores did not differ significantly from those of Swiss students, and were 40 points higher than those of US students.

³ The levels of proficiency for the Problem-Solving scale do not correspond to those of the other three domains. Level 1 in Problem-Solving skills includes scores up to 250, while level 2 includes scores above 250 and up to 300. In contrast, Level 2 in the other domains includes scores above 225 and up to 275. For this reason, Level 1 is used as the relevant cut-point for Problem-Solving.

Figure 1
Prose Literacy and Numeracy Skills with Age
IALLS 2003



4. Determinants of Youth Literacy Scores

The second set of research questions to be addressed in this study is: *What are the factors that explain the variation in literacy skills of Canadian youth? Is there a difference for those of high school age (16-19) compared to those of post secondary education age (20-25)? Are the rates similar or higher among youth who are still at school compared to those who are working? What is the role of a person's own education and parental educational attainment? What factors are associated with literacy performance for low income youth?*

Table 2 shows the relationship between the literacy scores of Canadian youth and six demographic characteristics. The analysis employed a multiple regression analysis, using the jack-knife weights and plausible values appropriate for Adult Literacy and Life Skills Survey (ALL). Plausible values within each domain are individually regressed on the set of variables using the jackknife weights. The final parameter estimates are then obtained by averaging the parameter estimates within each literacy domain. In addition, standard errors are computed by taking into account the variation between plausible value parameters estimates, within each domain, and the variation within specific plausible parameter estimates associated with each jackknife weight.

Table 2
Relationship between literacy scores and respondents' level of education,
adjusted for gender, employment status, years since migration,
language preference, and parents' level of education
Canadian youth aged 16 to 25, 2003

	Prose		Document		Numeracy		Problem-Solving	
	Coefficient	(SE)	Coefficient	(SE)	Coefficient	(SE)	Coefficient	(SE)
Female (vs. male)	11.57	(3.34)	1.98	(3.34)	-7.46	(3.22)	4.67	(2.84)
Education (vs. not graduated secondary school)								
Completed secondary school	17.68	(3.85)	18.37	(3.84)	19.59	(4.46)	19.45	(3.06)
Some college or university	27.59	(4.06)	24.33	(4.78)	23.38	(5.51)	23.87	(3.89)
Graduated with university degree	39.82	(6.81)	44.07	(6.82)	46.37	(7.65)	37.76	(7.00)
Employment Status (vs. not in labour force)								
Currently a student	7.39	(5.11)	9.49	(6.05)	10.35	(6.11)	8.21	(5.43)
Currently employed full-time	0.87	(4.96)	2.67	(5.54)	-2.61	(6.69)	1.38	(5.34)
Currently employed part-time	7.42	(5.50)	9.48	(4.87)	6.43	(6.95)	5.56	(5.13)
Years Since Immigration (vs. born in Canada)								
Immigrated within last 5 years	-49.37	(8.74)	-48.04	(9.51)	-41.87	(10.6)	-44.59	(7.70)
Immigrated 6 to 10 years ago	-30.03	(5.45)	-21.07	(5.61)	-22.53	(5.06)	-31.17	(6.14)
Immigrated 11 to 15 years ago	-21.16	(11.0)	-17.00	(12.1)	-20.41	(9.80)	-21.02	(10.2)
Immigrated 16 or more years ago	-12.24	(7.27)	-8.40	(7.43)	-2.44	(8.31)	-10.11	(6.82)
Francophone (vs. Anglophone)	-0.96	(2.47)	-2.47	(2.79)	3.76	(4.00)	2.11	(2.87)
Level of parents' education (years)	6.09	(0.70)	5.65	(0.76)	6.38	(1.05)	5.80	(0.86)
Note: Figures in bold text are statistically significant, p < 0.05.								

This analysis controls for the youth's employment status, including whether they were still at school, as well as immigrant status, level of education, and cultural background (Anglophone vs. Francophone). Thus, the coefficients are estimates of the net effects attributable to their respective covariates. The first five sets of variables are dummy variables, and the reference category is indicated for each set. With respect to education, youth currently enrolled in university and youth currently enrolled in or having completed a college program are grouped in the same category. Moreover, those who are studying in upper level programs (e.g. graduate school, professional programs, etc.) are categorized as having completed a university degree. The dummy variable for Anglophone vs. Francophone was determined based on the youth's language preference regarding the ALL background questionnaire, which, is offered in both official languages. Parents' education was computed as an average of the mother and father's years of education. If there was missing data on education for one of the parents, the variable then becomes equal to the years of education for the parent with valid data.

The analysis shows that females have a 12-point advantage over males in Prose literacy. This corresponds to an effect size of .24 standard deviations. (An effect size describes the magnitude of an effect as a fraction of a standard deviation. In the remainder of this discussion, the coefficients are not converted to effects sizes, as the effect size is simply twice the coefficient divided by 100.) Female youth scored lower than male youth by 7 points in Numeracy. There were no statistically significant sex differences in Document or Problem-Solving skills.

There are large and statistically significant effects associated with the respondents' level of education. Youth who had completed secondary school scored about 18 to 20 points higher across the four domains than those who had not completed secondary school. Youth who had completed some college or university scored about 23 to 28 points higher than those who had not completed secondary school. The "bonus" associated with some post-secondary training, either college or university, over high school completion is largest for Prose literacy (~10 points) and smallest for Numeracy and Problem-Solving (~ 4 points). Youth that had graduated from university had a 38 to 46 point advantage over those that had not finished secondary school. In this case, the bonus associated with post-secondary education is for Numeracy (~27 points). This analysis controls for the youth's employment status (including whether they were still at school), as well as immigrant status, level of education, and cultural background (Anglophone vs. Francophone). Thus, they are estimates of the net effects attributable to their level of education.

The effects associated with employment status were generally small, and with one exception, were not statistically significant. There was a positive effect of 9 points for Document literacy for youth who were employed part-time.

The findings pertaining to immigrant status are similar to those reported by Willms (1999) for the International Adult Literacy Study (IALS), with a large gap for recent immigrants, which declines with the length of time they live in Canada. These results suggest that after 10 years in the country a gap of about 20 points, or 0.40 of a standard deviation, remains. Youth who had immigrated at least 16 years previously would have spent the majority of their time in Canada, and thus, not surprisingly, the effect on literacy scores is small and statistically insignificant.

There were no statistically significant differences between Anglophone and Francophone youth in their literacy skills across the four domains. This is somewhat surprising, as the Programme for International Student assessment (PISA), data reveal a considerable advantage for students in Quebec at age 15, particularly in mathematics.

The effect of parental education was consistent across the four literacy domains: each additional year of parental education is associated with an increase in literacy scores of about 6 points. This is a considerable effect; it suggests that a youth whose parents had completed secondary school, but had not taken any further education, would score about 24 points lower than a youth whose parents had graduated from university. This is net of the other factors in the model.

The model presented in Table 3 was extended to include three variables describing youth's engagement in literacy activities at home and at work, and their level of television use. As part of the survey, respondents were asked how often they read or used information in various forms, and how often they wrote materials in these forms. The measure of engagement in literacy activities at home is a scale derived from respondents' reports of how often they read or used information from newspapers, magazines or books. The measure of engagement in literacy activities at work was split into two scales. One describes general literacy activities, which included letters, memos, or emails; reports, articles, magazines or journals; and manuals or reference books, including catalogues. The other pertains to technical literacy activities at work, which included diagrams or schematics; directions or instructions; and bills, invoices, and spreadsheets. The scales were constructed on a 10-point scale, such that one point represents 10 percentile points for the pooled international sample. The median score is 5.0 (see Willms, 2005).

Table 3								
Relationship between literacy scores and respondents' level of education, adjusted for gender, employment status, years since migration, language preference, and parents' level of education								
Canadian youth aged 16 to 25, 2003								
	Prose		Document		Numeracy		Problem-Solving	
	Coefficient	(SE)	Coefficient	(SE)	Coefficient	(SE)	Coefficient	(SE)
Female (vs. male)	9.14	(3.28)	0.4	(3.40)	-9.4	(3.29)	2.7	(2.89)
Education (vs. not graduated secondary school)								
Completed secondary school	14.3	(3.80)	15.2	(3.95)	16.5	(4.24)	17.0	(2.99)
Some college or university	21.4	(4.21)	18.8	(5.01)	17.1	(5.38)	19.5	(3.97)
Graduated with university degree	33.9	(6.46)	38.6	(6.93)	39.8	(7.23)	33.6	(7.46)

Table 3 (continued)
Relationship between literacy scores and respondents' level of education, adjusted for gender, employment status, years since migration, language preference, and parents' level of education
Canadian youth aged 16 to 25, 2003

	Prose		Document		Numeracy		Problem-Solving	
	Coefficient	(SE)	Coefficient	(SE)	Coefficient	(SE)	Coefficient	(SE)
Employment Status (vs. not in labour force)								
Currently a student	5.7	(4.71)	7.9	(5.75)	7.00	(5.83)	6.9	(5.23)
Currently employed full-time	-5.9	(5.04)	-5.3	(5.68)	-12.2	(7.50)	-4.0	(5.65)
Currently employed part-time	0.8	(5.50)	1.7	(5.06)	-2.3	(7.71)	0.9	(5.79)
Employment status is missing	-13.4	(3.74)	-17.7	(3.69)	-14.6	(5.03)	-8.7	(4.56)
Years Since Immigration (vs. born in Canada)								
Immigrated within last 5 years	-43.1	(8.34)	-41.9	(9.33)	-33.9	(9.33)	-39.3	(7.27)
Immigrated 6 to 10 years ago	-27.1	(5.18)	-18.3	(5.09)	-20.9	(4.95)	-28.4	(5.63)
Immigrated 11 to 15 years ago	-19.8	(11.3)	-15.5	(12.3)	-18.1	(10.2)	-20.0	(10.3)
Immigrated 16 or more years ago	-14.5	(7.02)	-10.1	(7.34)	-4.2	(8.08)	-10.9	(6.59)
Francophone (vs. Anglophone)	-0.2	(2.40)	-2.3	(2.66)	4.3	(3.86)	2.8	(2.98)
Level of parents' education (years)	5.2	(0.77)	5.0	(0.79)	5.5	(1.06)	5.1	(0.88)
Level of Engagement								
In literacy activities at home	17.2	(3.10)	12.7	(2.89)	10.0	(3.74)	13.3	(2.92)
In literacy activities at work	4.00	(2.46)	3.1	(2.73)	2.7	(2.60)	-0.0	(1.95)
In technical activities at work	1.7	(2.57)	2.6	(2.74)	5.7	(2.94)	6.8	(2.69)
Television use								
Watches TV 2 to 5 hours per day	-6.1	(2.78)	-6.8	(2.80)	-12.3	(4.68)	-0.8	(3.37)
Watches TV over 5 hours per day	-13.2	(5.72)	-8.8	(5.02)	-25.6	(7.27)	-10.6	(5.66)
Note: Figures in bold text are statistically significant, $p < 0.05$.								

The strongest effect of these engagement variables is associated with literacy practices at home. The effect ranged from 10 points for Numeracy to 17 points for Prose literacy. Also, youth who watched television more than 2 hours per day had weaker literacy skills in Prose, Document, and Numeracy. The negative effects were generally larger for those watching more than 5 hours of television, but because the sample size for this sub-population is small, the effects were statistically significant for only Prose literacy and Numeracy.

The measure of general literacy activities at work was not significantly related to any of the measures of literacy. Engagement in technical literacy activities at work was positively related to Numeracy and Problem-Solving scores, with effects of about 6 to 7 points.

Table 4 shows estimates for the same model for Prose literacy and Numeracy, estimated separately for youth aged 16 to 19 and 20 to 25. These two domains are chosen, as the pattern of effects was generally similar for the other two domains. Most of the estimated effects are similar for the two age groups. However, there are a few noteworthy differences. The effect of attending some college or university is slightly larger for the older age group, but this is likely due to the small number of youth 16 to 19 who were in attending post-secondary. With respect to employment status, there is a large effect associated with being a student for youth 20 to 25, which is not apparent for the younger youth, as most of the younger group is still in school. Similarly, there is a negative effect of full-time work for the younger group, which is statistically significant for Numeracy only, as most of these youth have left school before age 19 to take up full time employment. The results indicate that the effects of immigrant status are slightly larger for the older youth than the younger youth. This is apparent for those who had immigrated in the past five years, and for those that had immigrated within the past 10 years. It appears that the younger children are when they immigrate to Canada, the more quickly they learn English or French. This is very evident given the negative effect of being a recent immigrant on literacy scores is greater for the older cohort (age 20-25) than it is for the younger cohort (age 16-19). The effects of parental education also differ for the two cohorts; it is somewhat weaker for the older youth. The effects of engagement in literacy activities at home is stronger for youth age 20 to 25, while the negative effects of watching television is more pronounced for youth age 16 to 19.

Table 4
Relationship between literacy scores and respondents' level of education,
adjusted for gender, employment status, years since migration,
language preference, and parents' level of education
Canadian youth aged 16 to 19 and 20 to 25, 2003

	Prose				Numeracy			
	Age 16 - 19		Age 20 - 25		Age 16 - 19		Age 20 - 25	
	Coefficient	(SE)	Coefficient	(SE)	Coefficient	(SE)	Coefficient	(SE)
Female (vs. male)	7.5	(3.52)	10.3	(4.48)	-9.0	(4.57)	-9.5	(5.04)
Education (vs. not graduated secondary school)								
Completed secondary school	15.3	(5.13)	17.6	(6.71)	20.7	(6.61)	18.7	(6.75)
Some college or university	16.2	(10.3)	24.3	(6.33)	9.9	(13.9)	21.9	(7.93)
Graduated with university degree			36.6	(7.38)			44.9	(8.40)
Employment Status (vs. not in labour force)								
Currently a student	-4.00	(6.71)	15.9	(6.56)	-4.0	(9.63)	17.9	(7.65)
Currently employed full-time	-24.5	(13.4)	5.3	(5.69)	-37.9	(17.8)	3.4	(5.89)
Currently employed part-time	-6.9	(8.10)	7.1	(7.42)	-13.3	(12.0)	7.3	(7.66)
Employment status is missing	-12.2	(5.46)	-12.1	(5.98)	-20.6	(7.48)	-6.8	(7.07)
Years Since Immigration (vs. born in Canada)								
Immigrated within last 5 years	-39.1	(12.1)	-44.0	(12.4)	-28.8	(12.2)	-36.8	(14.6)
Immigrated 6 to 10 years ago	-19.8	(8.57)	-32.04	(6.41)	-13.7	(7.20)	-23.5	(7.41)
Immigrated 11 to 15 years ago	-15.8	(12.3)	-21.4	(15.7)	-10.9	(12.9)	-19.9	(14.7)
Immigrated 16 or more years ago	-15.5	(13.4)	-14.3	(7.94)	-5.5	(15.7)	-3.9	(9.24)
Francophone (vs. Anglophone)	1.7	(4.05)	-0.6	(2.89)	4.3	(5.97)	4.5	(4.34)
Level of parents' education (years)	6.1	(1.32)	4.3	(0.91)	6.8	(1.88)	4.2	(1.17)

Table 4 (continued)
Relationship between literacy scores and respondents' level of education, adjusted for gender, employment status, years since migration, language preference, and parents' level of education
Canadian youth aged 16 to 19 and 20 to 25, 2003

	Prose				Numeracy			
	Age 16 - 19		Age 20 - 25		Age 16 - 19		Age 20 - 25	
	Coefficient	(SE)	Coefficient	(SE)	Coefficient	(SE)	Coefficient	(SE)
Level of Engagement								
In literacy activities at home	14.3	(4.96)	19.9	(3.54)	7.8	(6.23)	11.3	(3.78)
In literacy activities at work	0.4	(4.27)	6.3	(3.67)	5.6	(4.88)	3.00	(3.76)
In technical activities at work	3.4	(4.41)	-0.2	(3.07)	4.0	(5.80)	5.2	(3.46)
Television use								
Watches TV 2 to 5 hours per day	-10.9	(4.44)	-1.00	(2.98)	-13.9	(6.53)	-9.3	(5.07)
Watches TV over 5 hours per day	-13.7	(9.29)	-12.5	(6.71)	-27.3	(12.1)	-23.0	(8.11)
Note: Figures in bold text are statistically significant, $p < 0.05$.								

Finally, the model presented in Table 3 is extended to include the respondents' level of personal income before taxes. As most of the youth age 16 to 19 were still at school, this analysis is limited to those age 20 to 25. The coefficients are presented in Table 5. The other coefficients in the model are not shown in this table, as they are virtually identical to those presented in Table 3. The reference category for this comparison is youth with annual incomes below \$8,000, and they comprise about one-third of the sample. The effects of income are in the expected direction, with higher literacy scores for those with higher incomes. However, the effects are not statistically significant (with one exception – Problem-Solving for those earning \$25,000 to \$50,000). This is likely due to two factors. First, the reference category includes youth who have low incomes because they are attending post-secondary, or have not yet found a job. Although they are “living in poverty” in a technical sense, their daily lives are quite different from older adults living in poverty. Second, the sample size of youth earning high salaries – above \$50,000 – is quite small, and thus the estimates are not accurate enough to be statistically significant.

Table 5

Relationship between literacy scores and personal income, adjusted for gender, respondents' level of education, employment status, years since migration, language preference, and parents' level of education, and engagement in literacy activities at home and at work Canadian youth aged 20 to 25, 2003

	Prose		Document		Numeracy		Problem-Solving	
	Coefficient	(SE)	Coefficient	(SE)	Coefficient	(SE)	Coefficient	(SE)
Personal Income (vs. less than \$8,000 per annum)								
\$8,000 to \$25,000	2.7	(5.69)	2.8	(5.79)	2.1	(5.38)	3.7	(5.09)
\$25,000 to \$50,000	6.2	(5.97)	6.2	(6.23)	10.5	(6.74)	12.6	(6.26)
Over \$50,000	20.2	(11.7)	19.7	(10.9)	18.8	(13.9)	22.9	(12.3)

5. Variation Among Provinces and Territories

The final analysis examines whether the pattern of effects observed for demographic factors differs among the 10 provinces and 3 territories. The model that included the main demographic factors is estimated and presented in Table 2. However, the employment status variables, the variable denoting those who had immigrated more than 16 years previously, and the variable indicating whether the respondent was Anglophone or Francophone were excluded, as these variables were not statistically significant. In addition, immigrants who arrived 16 or more years ago have been grouped with native-born Canadians for the following analysis. A hierarchical linear model is estimated, with youth nested within provinces and territories. In this analysis, the variable denoting immigrants who have lived in Canada for 16 years or more is excluded, and therefore this group is treated the same as native-born Canadians. This model allows one to discern whether the relationships vary significantly among provinces or territories. The results are presented in Table 6.

Table 6								
Variation among provinces and territories in the relationship between literacy scores and gender, respondents' level of education, years since migration, and parents' level of education								
Canadian youth aged 16 to 25, 2003								
	Prose		Document		Numeracy		Problem-Solving	
	Coefficient	(SE)	Coefficient	(SE)	Coefficient	(SE)	Coefficient	(SE)
Adjusted Mean	285.4	(1.48)	287.9	(1.59)	276.0	(2.13)	281.4	(1.58)
Female (vs. male)	11.7	(3.64)	2.15	(2.80)	-6.5	(2.50)	4.6	(2.10)
Education (vs. not graduated secondary school)								
Completed secondary school	16.7	(2.40)	17.2	(2.76)	16.7	(3.17)	17.9	(2.88)
Some college or university	24.8	(2.86)	21.9	(3.15)	21.2	(4.08)	21.5	(3.00)
Graduated with university degree	38.8	(5.24)	42.8	(5.26)	43.2	(3.54)	35.8	(4.36)

Table 6 (continued)
Variation among provinces and territories in the relationship between literacy scores and gender, respondents' level of education, years since migration, and parents' level of education
Canadian youth aged 16 to 25, 2003

	Prose		Document		Numeracy		Problem-Solving	
	Coefficient	(SE)	Coefficient	(SE)	Coefficient	(SE)	Coefficient	(SE)
Years Since Immigration (vs. born in Canada)								
Immigrated within last 5 years	-48.6	(4.11)	-47.5	(5.62)	-40.8	(7.68)	-44.3	(3.21)
Immigrated 6 to 10 years ago	-28.6	(3.42)	-19.3	(5.21)	-20.6	(4.17)	-29.9	(4.16)
Immigrated 11 to 15 years ago	-20.1	(4.87)	-16.0	(6.04)	-18.7	(5.76)	-20.2	(5.07)
Level of parents' education (years)	6.3	(0.58)	6.1	(0.56)	6.9	(0.91)	6.2	(0.66)
Variation Among Provinces and Territories								
Adjusted Mean	7.0		8.9		15.4		3.8	
Female	34.3		23.2		23.1		10.5	
Completed secondary school	15.8		19.3		29.6		32.7	
Some college or university	35.2		27.5		54.5		33.5	
Graduated with university degree	44.7		45.3		37.5		18.4	
Level of parents' education	0.9		1.4		3.3		0.5	
Note: Figures in bold text are statistically significant, $p < 0.05$.								

The results in the top part of the table present the average within-province relationships. These are very similar to those presented in Table 2. The bottom part of the table provides estimates of the variation in effects of the demographic factors across provinces and territories. The results indicate that there is statistically significant variation among provinces and territories in their adjusted mean literacy scores for all domains. There is relatively small variation in the literacy scores for Prose, Document, and Problem-Solving literacy scores. For example, the variance in Document literacy scores is about 9 points, which is equivalent to a standard deviation of 3 points. Thus the range in literacy scores for the provinces and territories is about (plus or minus two standard deviations) 12 points. The largest variation among the provinces and territories is in youth Numeracy skills, with a variance of nearly 16 points, corresponding to a standard deviation of 4 points.

The model also shows that the effect associated with sex varies among provinces and territories. For example, on average, across the provinces and territories, females score about 11.7 points higher than males. However, this difference is much larger in some provinces and territories than in others. The variance in the sex effect is 34.3, which corresponds to a standard deviation of 5.85, or nearly 6 points. This suggests that the difference between males and females is likely to span about 24 points. In the model presented in Table 6 the variable female is centred on the national average, such that the estimate of the variance in the sex difference is the average for males and females. The model presented in Table 6 is estimated again with the variable denoting sex centred on males (male=0, female=1) and on females (female=0; male=1), which allowed to determine the estimates of the adjusted differences separately for each province. These are shown in Table 7, which shows the adjusted provincial average and the deviation from the average for each province.

Table 7								
National adjusted mean scores for males and females, and provincial and territorial differences from the national mean, adjusted for respondents' level of education, years since migration, and parental education								
	Prose		Document		Numeracy		Problem-Solving	
	Female	Male	Female	Male	Female	Male	Female	Male
Adjusted Mean	297.7	286.0	295.5	293.3	279.1	285.6	291.6	287.0
Differences from Mean								
Newfoundland	1.2	-3.5	-1.1	-2.5	-1.2	-2.9	-1.4	-4.1
Prince Edward Island	0.3	-1.4	-0.4	-3.1	-0.3	-1.5	-1.1	-3.2
Nova Scotia	-1.1	2.2	-1.3	0.6	-1.1	-2.7	-0.6	-0.8
New Brunswick	0.9	-6.1	-1.4	-5.3	-0.3	-3.7	-1.3	-3.5
Quebec	-2.3	4.0	-3.3	1.4	-0.4	5.6	1.4	1.0
Ontario	-0.4	-6.1	0.1	-5.3	-1.7	-4.2	-0.8	-1.9
Manitoba	2.2	1.0	2.6	-1.8	-1.5	-2.4	1.5	1.5
Saskatchewan	5.6	-4.0	4.8	0.2	3.8	4.6	0.1	-0.1
Alberta	0.0	6.5	1.4	6.6	2.3	4.3	0.8	2.9
British Columbia	-0.3	4.5	-0.7	4.3	0.7	1.8	0.4	2.7
Yukon	0.7	-0.0	-0.3	-1.2	-0.3	0.5	-0.3	-1.7
Northwest Territories	-3.1	1.1	-4.0	-1.5	-3.4	-3.9	-0.4	-2.8
Nunavut	-10.0	-10.8	-14.2	-14.6	-8.3	-12.2	-2.1	-13.4

There are two important findings from this analysis. First, the variation in adjusted female scores is relatively small across the provinces and territories. For example, for Prose literacy the average national score, which is adjusted for level of education and immigration status, is 297.7 for females and 286.0 for males. However, the scores range from -10.0 points below the national mean in Nunavut to 5.6 points above the mean in Saskatchewan; however, the adjusted mean for all other provinces and territories are within about 3 points of the national average. In contrast, the adjusted scores for males differ considerably from the national average. Males in New Brunswick and Ontario, for example, score over 6 points below the national average, while males in Alberta score 6.5 points above the average.

The results also show that the sex differences vary considerably across the provinces and territories. Continuing with the example for Prose literacy, the difference between males and females is less than 5 points in 8 of the 13 jurisdictions, while in Saskatchewan it is nearly 10 points favouring females, while in Quebec it is about 6 points favouring males. The same pattern is evident for the other literacy domains, including Numeracy, where the average for males is higher.

Taking these two findings together, they suggest that the average literacy scores of females are quite similar, while those of males differ considerably across the provinces and territories.

The effects associated with levels of education also vary among the provinces and territories.

6. Summary and Policy Implications

This study examines the literacy scores of Canadian youth based on data from the Adult Literacy and Life Skills Survey (ALL), which was conducted in 2003 in six countries: Canada, Bermuda, Italy, Mexico (Nuevo Leon), Norway, Switzerland, and United States. The analyses presented in this paper focused on three sets of research questions. The findings from each set of questions and their policy implications are discussed below.

1. What is the level of performance in Prose, Document, Numeracy and Problem-Solving literacy among Canadian youth, aged 16-25? What is the correlation among these competencies at the individual level?

Canadian youth scored on average above the international norms in all four literacy domains. However, its comparative advantage in Numeracy is not as great as its advantage in the other three domains. Compared with Switzerland, for example, the literacy scores of Canadian youth are higher than their Swiss counterparts in Prose literacy, but considerably lower in Numeracy. The scores for the four domains are highly correlated, above 0.80 among the set of Prose, Document and Problem-Solving. Numeracy tends to stand apart, with weaker correlations with Prose literacy and Problem-Solving. The results also indicated that the distributions of literacy scores in all four domains are negatively skewed, with skewness ranging from -0.37 to -0.30. This means that there is a disproportionate number of youth with very low literacy scores.

These findings are consistent with earlier work done with data from the Programme for International Student assessment (PISA), which showed that Canada fared well in reading literacy, but was not as strong in mathematics. These results emphasise the importance of considering both Prose literacy and Numeracy separately, as there are many youth who differ substantially in their Prose and Numeracy Scores. This discrepancy has implications for post-secondary education and for future employment, as the demand for literacy scores is increasing, and for many occupations the demand is especially acute for technical literacy skills.

The high proportion of youth with very low literacy skills is also disconcerting, as these youth are prone to being unemployed, participating in “risky behaviours” such as alcohol and drug abuse, and suffering health problems. One cannot discern from these data when children fall “off track” in their literacy development. Willms (2005) argues that a crucial point is the transition from learning-to-read to reading-to-learn, which typically happens at about age 8 or 9. The majority of children who do not make this transition successfully tend to struggle at school through to the secondary school years. This is probably the case also for Numeracy skills as well. These findings provide further evidence that national surveillance efforts need to accurately track the literacy skills of children from an early age through to about age 10.

2. What are the factors that explain the variation in literacy skills of Canadian youth? Is there a difference for those of high school age (16-19) compared to those of post secondary education age (20-25)? Are the rates similar or higher among youth who are still at school compared to those who are working? What is the role of a person's own education and parental educational attainment? What factors are associated with literacy performance for low income youth?

The findings regarding the determinants of Prose and Document literacy skills is largely consistent with earlier works based on the 1994 IALS. Although the 1994 International Adult Literacy Study (IALS), test of quantitative literacy skills is not comparable to the Numeracy test in ALL, the results for this domain are also comparable. Problem-Solving was a new domain introduced in ALL. Females score considerably higher in Prose literacy, but lower in Numeracy. There are very large effects associated with completing secondary school, ranging from 18 to 20 points. Youth who had completed some college or university had higher scores than secondary school graduates, with the advantage larger in Prose literacy than in Numeracy. Youth who had graduated from secondary school had on average the highest scores, with average scores ranging from 38 to 46 points above their peers who had not completed secondary school.

One cannot claim that completing secondary school or attending post-secondary programs *cause* higher literacy scores, as some of the observed effects are likely the result of selection processes that occur throughout the period of formal schooling. It is expected that there are both selection effects and true education effects. The effect of secondary school completion and further education could be more accurately estimated with data from PISA and the Youth-in-Transition Survey (YITS). The effects of further education could also be understood better with some "true" experiments with samples of students who finish secondary school but do not quite have the credentials, financial resources, or motivation to pursue a post-secondary education. Nevertheless, in the absence of this further research, the findings provide a reasonably strong case for increasing investments in further education, especially for those pursuing careers that require strong Numeracy skills.

The findings also show that there is a substantial skill gap between immigrants and non-immigrants, and that this declines steadily with the length of time immigrants live in Canada. However, the gap does not disappear until after about 15 years after immigration. The question that needs to be asked is whether the learning curve could be steepened dramatically with intensive language programs for new immigrants.

The effects of employment or engaging in literacy activities at work were not strong for youth age 16 to 25. However, there were strong effects associated with engaging in literacy activities at home, and these effects tended to be stronger for youth aged 20 to 25. Hours spent watching television has a deleterious effect on literacy scores, particularly for youth aged 16 to 19. From a social policy perspective, it is a considerable challenge to affect a shift in the way people spend their leisure time, moving one from a nation of TV-watchers to a nation of readers. Economic incentives for reading, such as subsidising books, or disincentives for watching television, such as increasing taxes for cable and satellite programs, are not likely to be effective and probably would not be politically feasible. It is not known whether a mass media campaign aimed at encouraging

greater literacy engagement at home would be effective, and the irony is that the best way to reach youth would be with television advertisements. The results do call for more detailed study of adolescent time use.

3. To what extent do the effects of demographic characteristics vary among provinces and territories?

The analysis of variation in literacy scores among provinces and territories yielded two important findings. One is that there is relatively little variation in the scores of females across provinces and territories, while male scores vary substantially. The second finding is that the literacy gap between males and females varies considerably across these jurisdictions.

These findings suggest that the success of provinces in attaining high levels of youth literacy depends a great deal on the skill levels of males. It also reinforces the point made earlier that one needs to better understand *when* and *why* children fall off track in their literacy development. One hypothesis is that a higher proportion of boys than girls fail to make the transition from learning-to-read to reading-to-learn transition at age 8 or 9, and thereafter do not become strong readers. Another hypothesis is that male youth are more enticed by local employment opportunities than are females, and therefore do not achieve comparable levels of educational attainment. This analysis controlled for levels of educational attainment, but there may still be a residual “discouraged worker” effect. The findings on inter-provincial and territorial differences are particularly important as they suggest that the relatively low levels of literacy in some jurisdictions are probably not simply due to lower quality schooling; rather it is more complex question concerning youth’s engagement in literacy activities at home and at work.

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