ESSENTIAL SKILLS ONTARIO

PIAAC IN ONTARIO:

An Analysis of Cognitive Skills in the Province

CONTENTS

INTRODUCTION

The economic and social well-being of Ontario depends heavily on a well-educated and skilled workforce. Ensuring that Ontarians are equipped with the vital skills required to fully participate in society is essential for the future prosperity of the province.[1] This challenge was highlighted after the release of the preliminary results from the Program for International Assessment of Adult Competencies (PIAAC). PIAAC assesses the information processing skills of youth and adults aged 16 to 65 in literacy, numeracy and problem solving in technology rich environments (PS-TRE). The results showed that 15% of Ontarians scored at the lowest levels in literacy, 22% at the lowest level in numeracy and 13% at the lowest levels in PS-TRE.[2,3] This may suggest that large segments of the population may not have a great deal of success completing complex tasks,[4] many of which are essential for activities at work and everyday life. The purpose of this paper is to further illuminate this issue in Ontario by examining regional differences in PIAAC scores and highlighted key factors that are correlated with cogitative ability.

[1] See: *Ontario in the Creative Age*. Martin Prosperity Institute (2009) http://martinprosperity.org/media/pdfs/MPI%20Ontario%20Report%202009%20v3.pdf

[2] *Skills in Canada: First Results from the Programme for the International Assessment of Adult Competencies (PIAAC).* Statistics Canada (2013).

[3] The proficiency scale designed for PIAAC aims to identify tasks that can be successfully completed by the individual being assessed. There are six proficiency levels in literacy and numeracy and four in PS-TRE. With the exception of the lowest level (below level 1), the tasks associated with a particular level can be successfully completed 50% of the time by a person who scores at the bottom of the range defining the level, most of the time by individuals at the top end of the range and about 67% of the time by those in the middle of the range. Though the tasks associated with each level vary by domain, tasks at the lowest levels involve simple technology, few steps and relatively simple cognitive processes, whereas the highest levels involve more complex technology, multiple steps and relatively complex cognitive processes.

[4] Example of complex tasks include tasks that involve integrating information across multiple dense texts, reasoning by inference, working with mathematical arguments, solving complex problems using information technologies that require navigation and the use of multiple tools. Those that score that the lowest proficiency levels have a much lower probability of successfully completing these tasks than those at higher levels.

METHODOLOGY & PROCEDURES

This section describes the methods and procedures used to define geographic boundaries, derive average scores and analyze the PIAAC data. It will be of interest to researchers interested in doing similar work or those who wish to vet the results more carefully.

Defining Geographic Boundaries

Defining the geographic boundaries required aggregating postal code information contained in the data set. For confidentiality reasons, the PIAAC data file does not contain variables indicating residing Census Divisions (CD) and Census Sub Divisions (CSDs). The data did, however, contain Forward Sortation Areas (FSAs),[5] which are the first three characters of the postal code for each respondent. The FSAs were matched with CDs and in some cases CSDs using FSA to CD concordance tables provided by Statistics Canada, so that each FSA was assigned a Census Division. For larger cities it was possible to assign each FSA to a Census Subdivision. The FSAs were also used to identify districts within the cities of Toronto and Ottawa using Canada Post-delivery area maps. For a complete list of geographies created see Appendix D.

Despite the large PIAAC sample in Canada,[6] the PIAAC survey was not designed to produce reliable estimates of proficiency for CDs and CSDs. The sample plan for the survey in Canada was designed to produce reliable estimates for each Province and Territory and for certain population subgroups (Aboriginal, Linguistic minorities, immigrants and young adults aged 16 to 24). For this reason, many of the estimates for CDs and CSDs were subject to a high degree of sampling error. In order to address this, certain CSDs were combined to ensure the samples were sufficient enough to produce meaningful results.

It should also be noted that the FSAs do not always match census boundaries. This is because many rural and small towns have the same FSAS, and in some cases these FSAs may overlap into two or three different census boundaries. As a result, some towns were included in CDs that are not the same as those that are assigned to them in the Census. In most cases these towns were very close to the border between two different CDs.[7] For this reason, the Census Divisions are referred to as “Agglomerated Areas” since the CDs defined are not identical to Statistics Canada defined boundaries.

Data Analysis

Due to the complex sample design, use of sampling weights and use of multiple imputed proficiency estimates or “plausible values”,[8] the PIAAC micro-data requires the use statistical

[5] Forward Sortation Areas (FSAs) are the first three characters of a postal code. They are associated with the postal facility from which mail delivery originates.
[6] The PIAAC sample in Canada consisted of about 27,000 adults (aged 16-65). This is the largest sample among all the countries included in the survey.
[7] For example, the town of Rosemount which is in Simcoe Census Division, is included in Peel- Dufferin-Halton for this map because its FSA is contained within Peel Census Division.
[8] Since the PIAAC survey was intended to produce reliable results for large populations and not individuals, the survey used a matrix sampling design (where respondents are asked to only respond to a subset of questions as opposed to the entire set for each domain), in order to save time and resources. This approach results in imprecise measurements of individual scores but allows for estimation of larger populations when responses are aggregated. However, the results of these aggregations can lead to biased estimates because individual scores are imprecise. To address this problem many cognitive skills surveys use multiple imputed

methods which take into account sampling error as well as measurement error in order to obtain reliable estimates. Though most statistical package software does not allow users to apply these methods directly, packages were developed for STATA, SPSS, SAS and R[9] to analyze PIAAC micro-data. All analysis for this project was conducted using the INTSVY package in R, which is specially designed to analyze international assessment data.[10]

In order to derive mean scores for each area on the map, separate data frames for each area were created. Weighted mean scores and associated standard errors for each area were then derived with the INSTVY package which uses a computational method to account for sampling error and measurement error using plausible values and replicate weights. The standard errors were then used to calculate 95% confidence intervals for each estimate. The margin of error varied for each domain because the sample size fluctuated between domains. The margin of error were larger in the PS-TRE domain because a number of respondents did not complete the PS-TRE assessment modules, due to the fact that they never used a computer, failed the computer based assessment given before the core assessment modules, refused to use a computer for the assessment modules or did not attempt the assessment for literacy related reasons.[11] The margin of error did not exceed ± 44 score points and most estimates were within ±15 score points.

In addition to deriving the margin of error for each estimate, the magnitude of sampling error for each estimate was assessed using coefficients of variation (C.V.) The C.V. is the standard error of an estimate as a percentage of the estimate. Statistics Canada recommends that readers should interpret estimates C.V.'s exceeding 16.5% with caution, since a large proportion of the estimate is subject to sampling error.[12] Since none of the estimates in this study had C.Vs exceeding 16.5%, they are not reported in this report.

The final phase of the analysis involved modeling the data to gain a better understanding how the factors which are associated with cognitive skills. This was accomplished using the INSTVY package in R which uses an ordinary least squares (OLS) method to perform linear regression analysis using plausible values and replicate weights. In order to estimate the specific effects of obtaining educational credentials, separate equations were run with dummy variables for each level of educational attainment. Since years of school and educational attainment are highly collinear a separate equation for each domain was run to estimate the effect of years of schooling. The equations took the form:

$$Y_i = \beta_0 + \beta_1 E_1 + X_i + \varepsilon_i$$

Where Y_i is the plausible values for each domain, E_1 is the level of educational attainment and X is a vector of control variables which influence proficiency scores (see Appendix A for a full list of control variables and definitions). The models were tested for colinearity using Pearson correlation coefficients, but no other regression diagnostics were performed due to the limitations of the regression package. This is a serious limitation of the research and the regression results should be viewed accordingly.

---

scores or "plausible values". In this approach all available data on populations are used to produce a "posterior distribution" of scores by randomly assigning multiple scores from this distribution (these scores are often referred to as plausible values). These values can then be aggregated to produce unbiased estimates for populations and subpopulations.

[9] STATA, SPSS, SAS and R are popular computer software programs used for statistical analysis.

[10] http://cran.r-project.org/web/packages/intsvy/intsvy.pdf

[11] PS-TRE could only be assessed using computer based modules because it was designed to assess the use of technology to solve common problems.

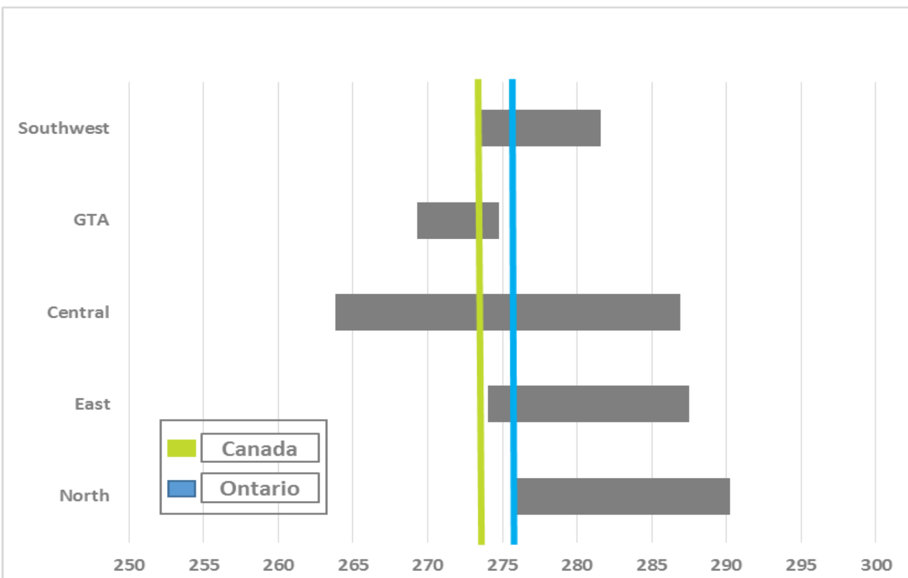
[12] *The Program for the International Assessment of Adult Competencies, 2012-User Guide*. Statistics Canada (2014).

MEAN PIAAC PROFICIENCY SCORES BY REGION AND CENSUS AREA

Literacy

The estimated average scores in literacy are summarized in Figure 1. Based on the 95% confidence levels, none of the regions are statistically different from each other. Certain regions are, however, statistically different than the Canadian average and/or the Ontario average. The average score in the GTA is statistically lower than the Ontario average, but not statistically different than the Canadian average. Conversely, Eastern Ontario is statistically higher than the Canadian average but not statistically different than the Ontario average. Respondents from Northern Ontario also fared well relative to the Canadian and Ontario average as the average score among Northern Ontario respondents is statistically higher than the Canadian and Ontario average.

Figure 1: Mean PIAAC Literacy Scores by Region



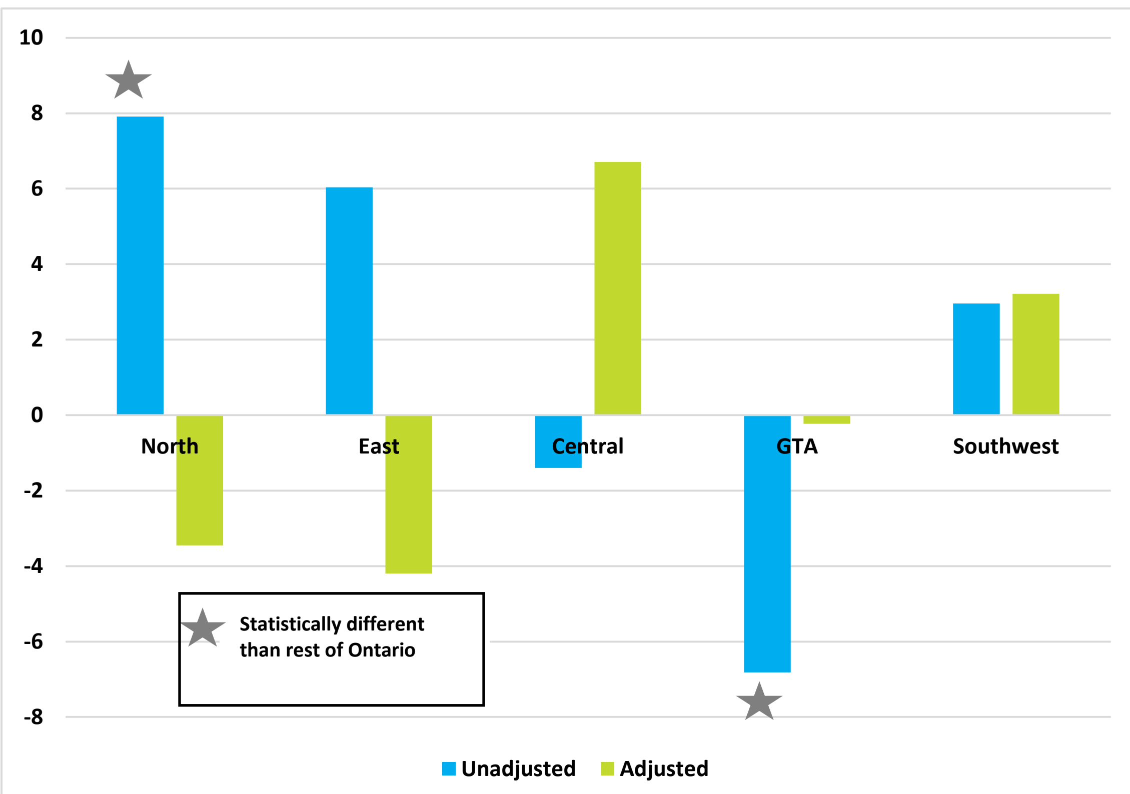
How to read chart

The above chart displays the 95% confidence intervals for PIAAC literacy scores for each region relative to the average scores in Canada and Ontario. The 95% confidence intervals (which are represented by the grey bars) reflect the score point range within which respondents from each area are likely to fall. For example, we can say we 95% confidence that the average score in literacy among GTA respondents is contained within the range 269 and 275.

The Canadian and Ontario averages are represented by the green and blue lines. If the score point range for a region falls outside of these lines (and the corresponding sampling errors which are not displayed on this chart), the average score in that area is statistically different than the Canadian or provincial average *at the 95% level. For example, the average score for the GTA in literacy is statistically lower than the Ontario average but not statistically different from the Canadian average.*

It is important to put these results in context when examining these results. There are several observable and non-observable factors which influence the difference in scores between regions. For example, the difference in scores between regions can be influenced by education attainment levels, income levels, employment levels and median age. When these variables are accounted for, there are no statistically significant differences between regions. This is shown in Figure 2, which shows the differences in average scores of each region from the rest of Ontario. The blue bars indicate differences in average scores per region and the green bars show differences when variables such as years of schooling, age, immigration levels and employment levels are accounted for (see Appendix A for a list of control variables and definitions). When control variables are accounted for the difference between Northern Ontario and the rest of Ontario average decreases and is no longer statistically significant. Similarly, in the GTA the average score in literacy is no longer statistically lower than the average for the rest of Ontario. In other words, there are likely no statistical differences between the regions and the Ontario average when the differences in the characteristics of region's populations that impact literacy are accounted for.[13]

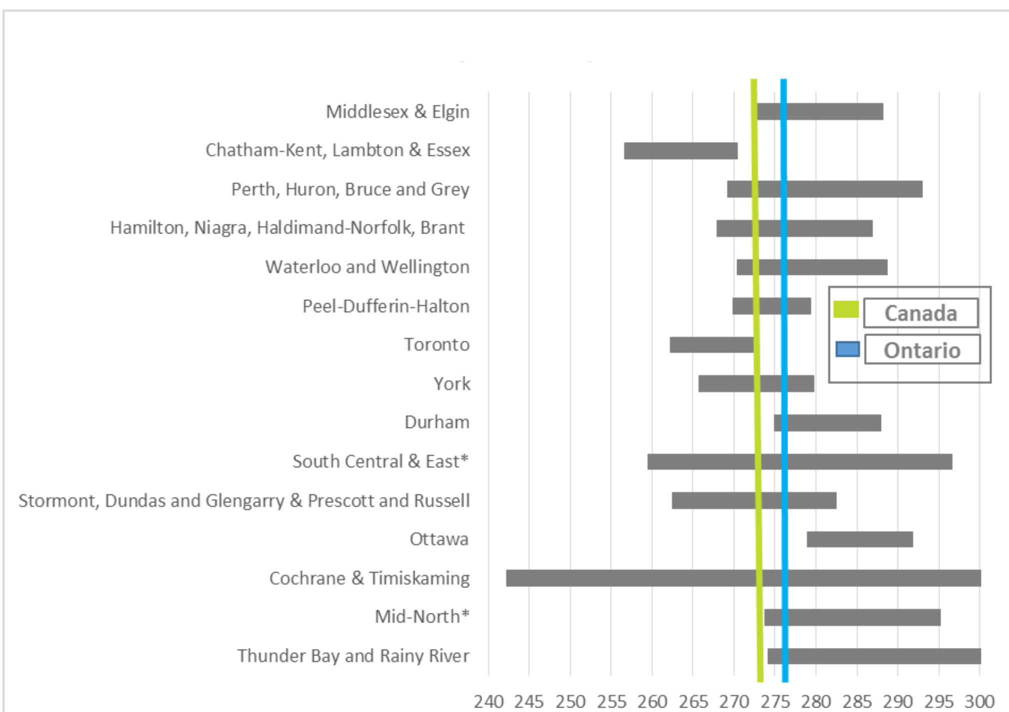
Figure 2: Regional PIAAC Literacy Score Differences



[13] The adjusted means were estimated using the years of schooling model. See Appendix C.

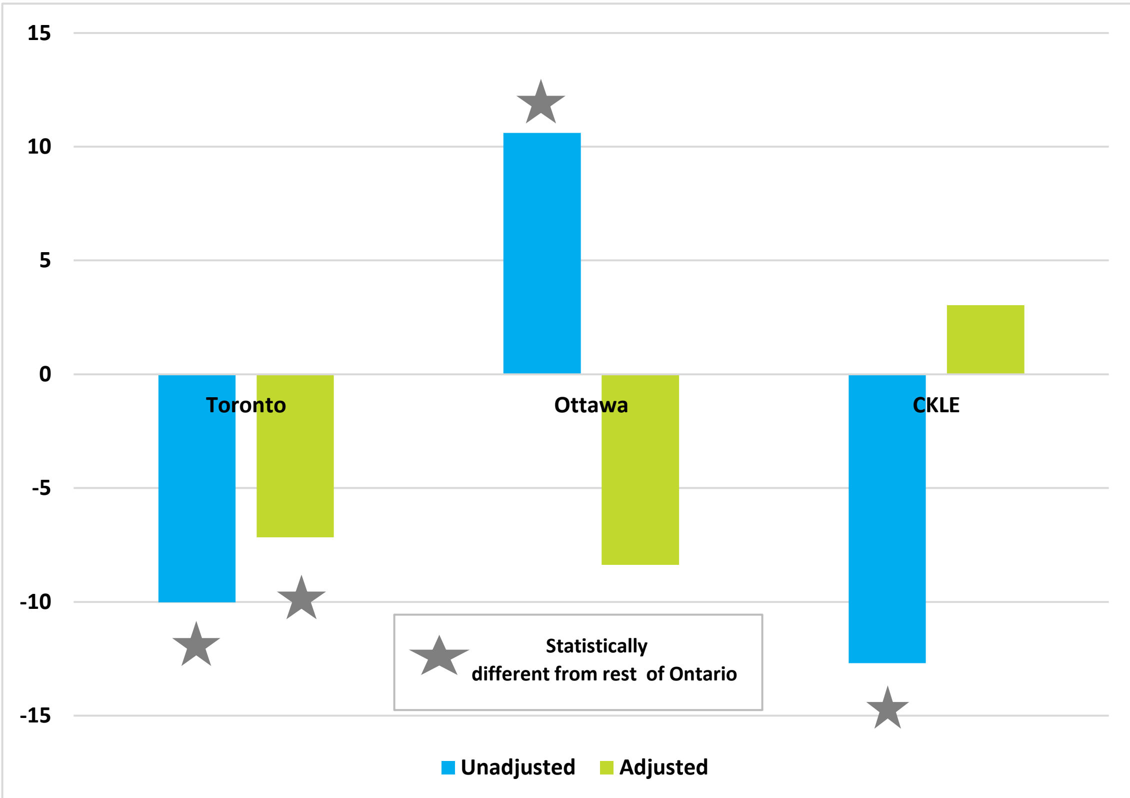
Figure 3 shows average literacy scores by agglomerated areas (roughly equivalent to grouped Census Divisions). Most areas do not vary statistically from the Ontario or Canadian average, with the exception of Chatham-Kent, Lambton and Essex, Ottawa and Toronto. Both Toronto and Chatham-Kent, Lambton and Essex have lower average scores than the Provincial average and Ottawa scored statistically higher than the Provincial average. For Chatham-Kent, Lambton and Essex and Ottawa the differences in scores are less pronounced when the averages are adjusted with socioeconomic controls. The average score among Ottawa respondents is about 11 score points higher than the rest of Ontario, but this difference decreases to -8 score points and it is no longer statistically significant after controls are introduced (see Figure 4). Among Chatham-Kent, Lambton and Essex respondents, the average score is about 13 points lower than the rest of Ontario, however, this difference is virtually eroded when socioeconomic factors are controlled. While socioeconomic differences largely explain score point differences between Ottawa and the Provincial average and Chatham-Kent, Lambton and Essex and the Provincial average, this is not the case for Toronto. The average score among Toronto respondents is about 10 score points lower than the rest of Ontario and this difference persists even when socioeconomic factors are accounted for (those the difference does decrease to about 7 score points lower than the rest of Ontario). This is a curious result; it is expected that most differences between regions and agglomerated areas would be explained by socioeconomic factors and it is unclear why this is not the case in Toronto. The result suggest that there are factors which are not included in the control variables (see Appendix A) which are contributing to the score point difference between Toronto respondents and the rest of Ontario. Additional research into these factors may be worthwhile.

Figure 3: Mean PIAAC Literacy Scores by Agglomerated Areas



** South Central and East includes: the agglomerated areas: Leeds & Greenville, Lanark, Lennox & Addington, Frontenac, Hasting, Prince Edward, Northumberland and Renew. Mid-North includes the Census Areas: Algoma, Sudbury, Greater Sudbury, Manitoulin, Nipissing & Parry Sound.*

Figure 4: PIAAC Literacy Score Differences in Agglomerated Areas with and without Socioeconomic Controls



Numeracy

The average scores by region in the numeracy domain reveal no significant differences between regions or between each region and the Ontario and/or Canadian average. This does not however, mean that no differences exist within the population, only that there are no differences given the margin of error for each region. Larger samples in each area could possibly reveal statistical differences between regions.

Figure 5: Mean PIAAC Numeracy Scores by Region

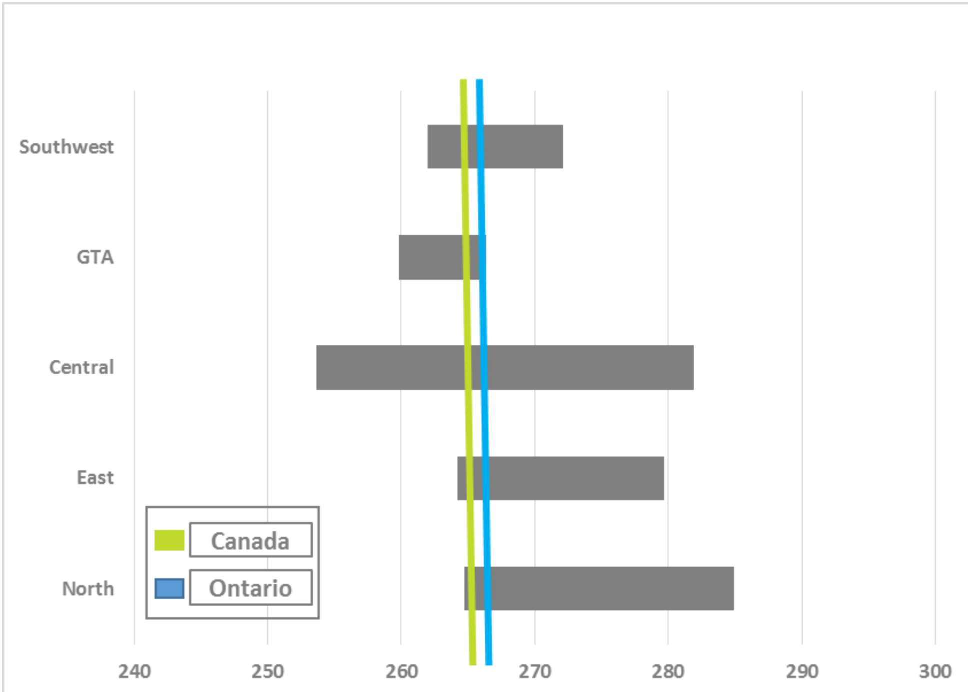
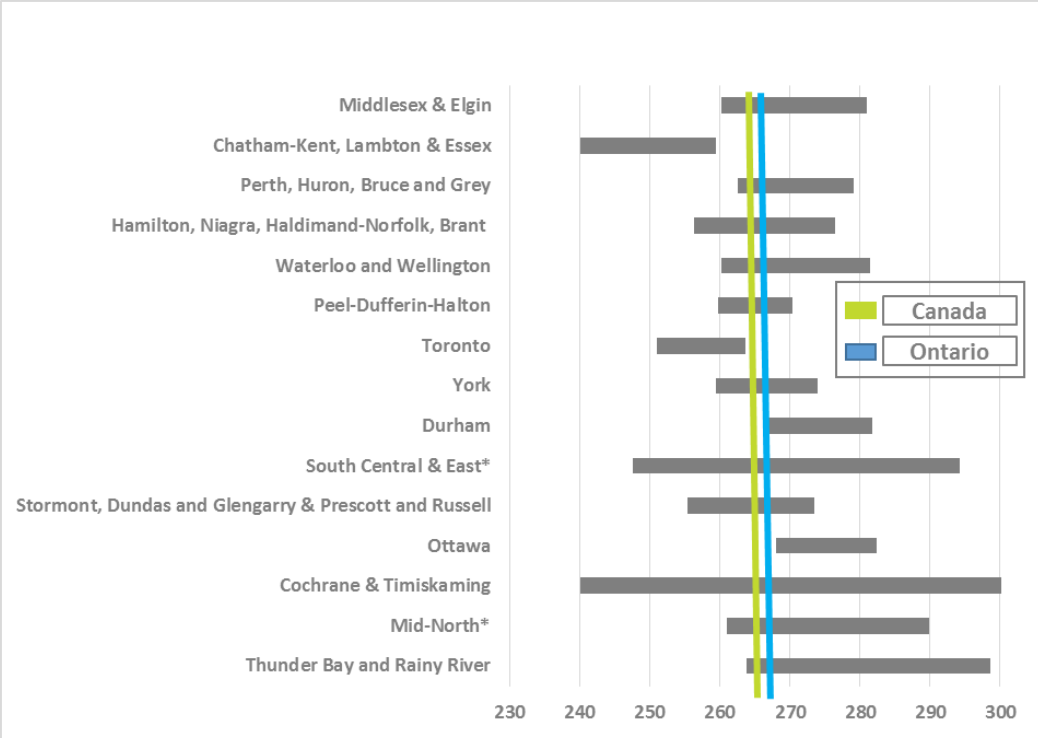


Figure 5 shows average numeracy proficiency scores by agglomerated areas. The results are very similar to the literacy results with respect to the score point differences between regions and the Ontario and/or Canadian average. The average score among Toronto respondents is statistically lower than the Ontario and Canadian average, and much like the literacy score, this is not fully explained by the socioeconomic factors included in the study (see Figure 7). The average numeracy score among Ottawa respondents is 10 score points higher than the rest of Ontario, but this difference decrease to -7 score points and is no longer statistically significant when socioeconomic factors are controlled (see Figure 7).

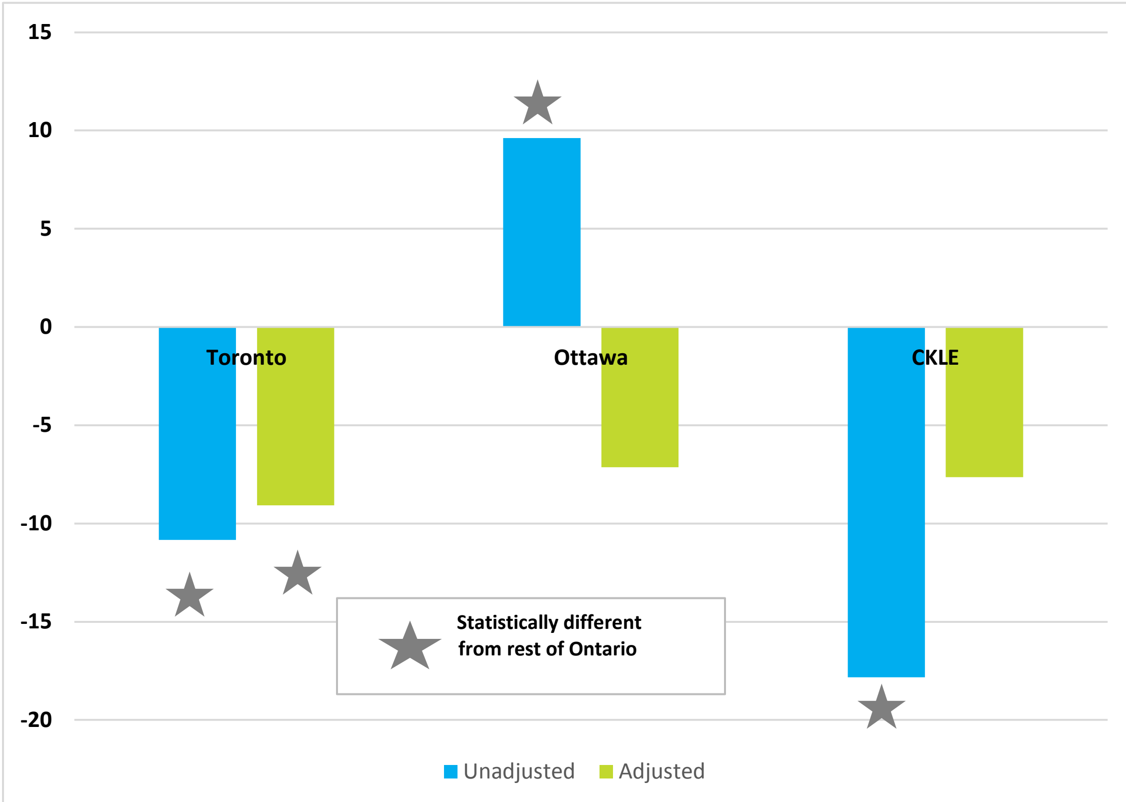
The average score in numeracy among respondents from Chatham-Kent, Lambton and Essex is statistically lower than the Canadian and Ontario averages. This difference is in large part explained by socioeconomic factors. When socioeconomic controls are included, the average score is 7 score points lower than the rest of Ontario, but this difference is no longer statistically significant (see Figure 7).

Figure 6: Mean PIAAC Numeracy Scores by Agglomerated Areas



** South Central and East includes: the agglomerated areas: Leeds & Greenville, Lanark, Lennox & Addington, Frontenac, Hasting, Prince Edward, Northumberland and Renew. Mid-North includes the Census Areas: Algoma, Sudbury, Greater Sudbury, Manitoulin, Nipissing & Parry Sound.*

Figure 7: PIAAC Numeracy Score Differences in Agglomerated Areas with and without Socioeconomic Controls



Problem Solving in Technology-Rich Environments (PS-TRE)

The results for PS-TRE are subject to a higher degree of error than the literacy and numeracy domains, due in large part to sample size restrictions. As a result, the margin of error for many of the Census Division estimates are quite large, and in some cases too large to make any meaningful inferences. This, coupled with the fact that PS-TRE is a new domain, and though it was tested rigoruously, may be subject to larger measurement error than the literacy and numeracy domains. For these reasons the results should be interpreted with caution.

Figure 8: PS-TRE Scores by Region

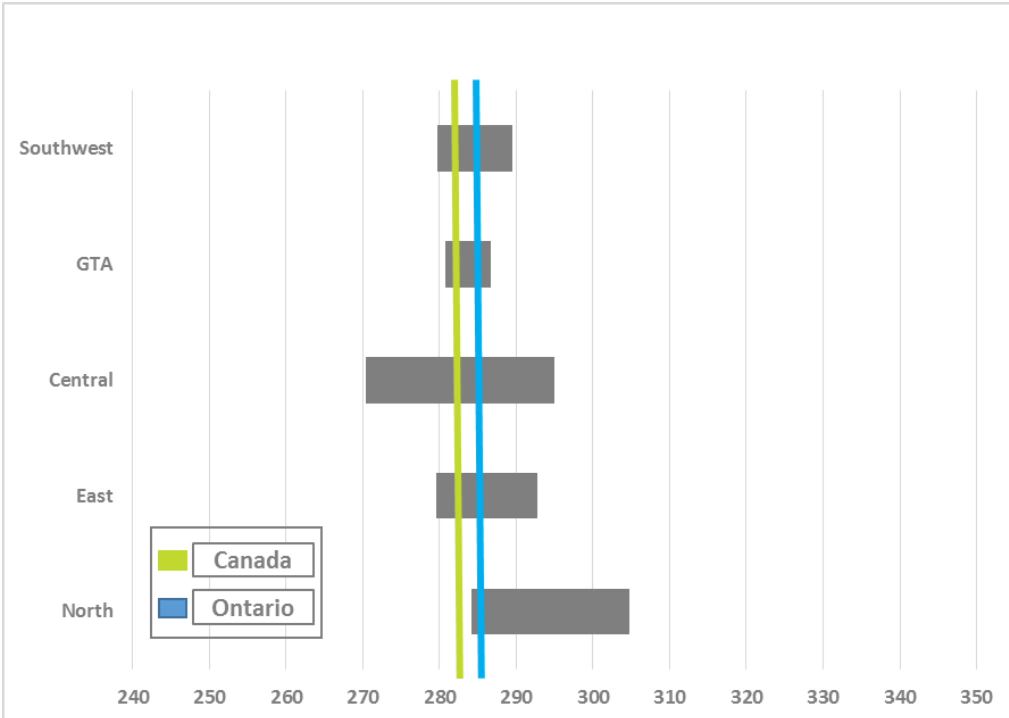
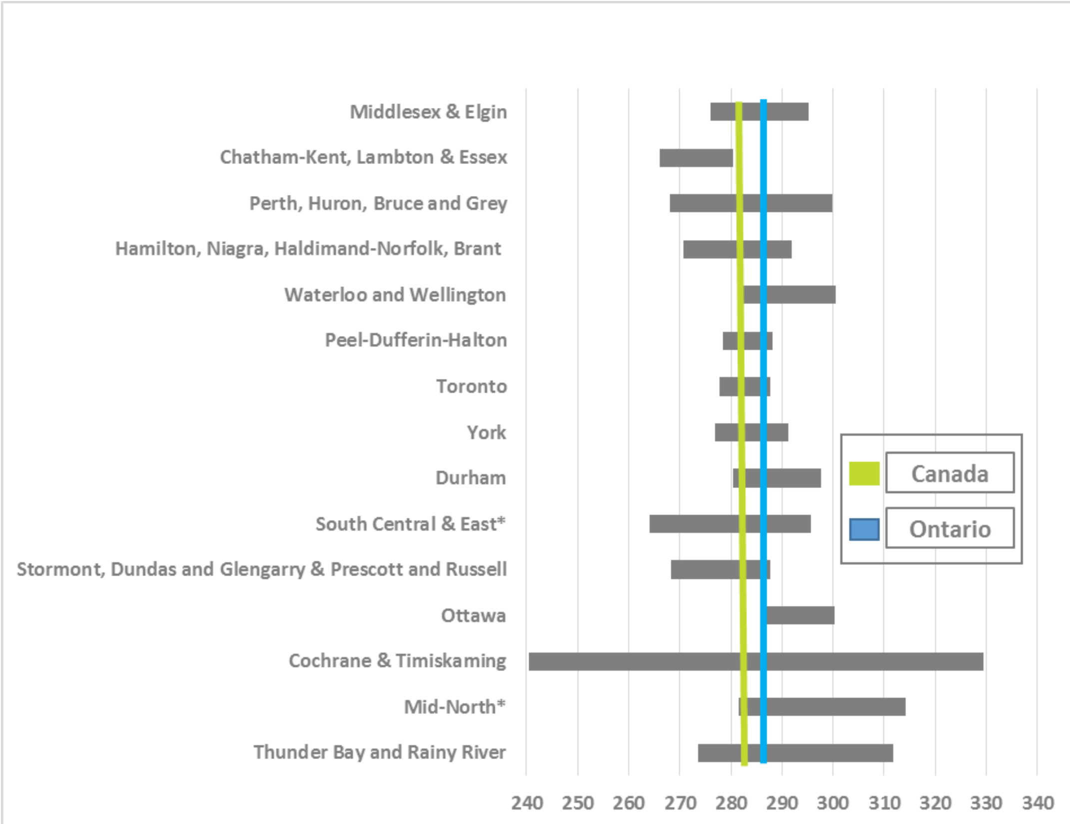


Figure 9: PS-TRE Scores by Census Divisions



** South Central and East includes: the agglomerated areas: Leeds & Greenville, Lanark, Lennox & Addington, Frontenac, Hasting, Prince Edward, Northumberland and Renew. Mid-North includes the Census Areas: Algoma, Sudbury, Greater Sudbury, Manitoulin, Nipissing & Parry Sound.*

FACTORS ASSOCIATED WITH PIAAC SCORES

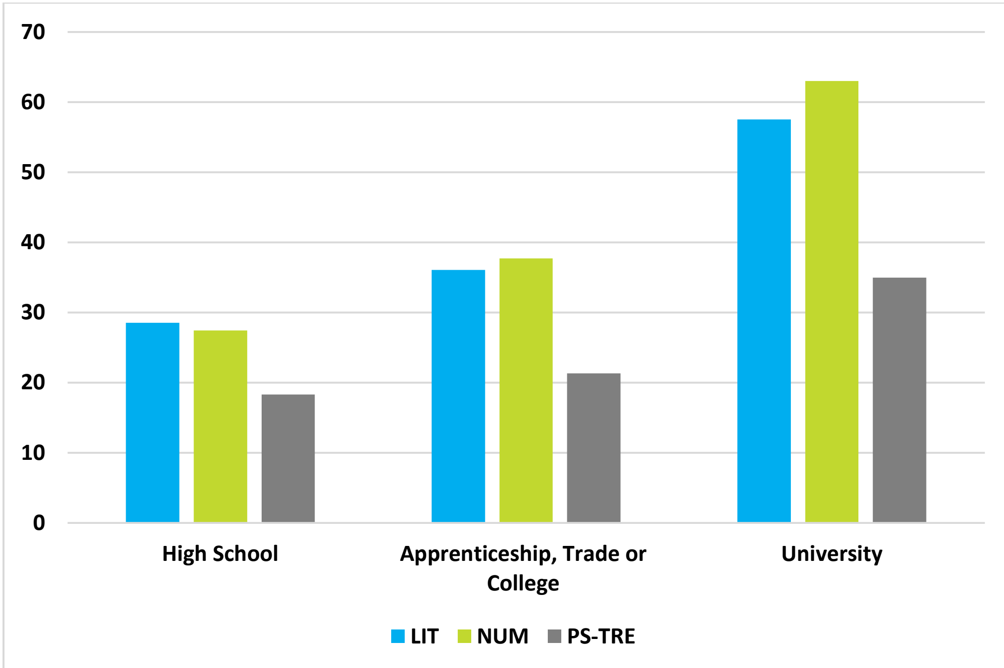
The second part of this research looks at the factors which are statistically associated with proficiency scores in the Ontario PIAAC sample. For this analysis, the entire Ontario sample in PIAAC was used (there were 5,236 Ontario respondents) to examine the factors associated with performance on the literacy, numeracy and PS-TRE assessments. This was accomplished by modeling the data using a linear regression approach (OLS), with proficiency scores as the dependent variables and a number of socioeconomic factors as independent variables (for more information on the methodology see the **Procedures and Methodology** section of this report). The results are discussed in this section.

The Impact of Educational Attainment

There is a clear linear association between educational attainment levels and proficiency scores in PIAAC among Ontario respondents. The results of the multivariate regression (see methodology and procedures section) confirm that obtaining higher levels of education is positively associated with cognitive ability as measured by the literacy, numeracy and PS-TRE domains in PIAAC.[14] Figure 8 shows the association between educational attainment on proficiency scores in each domain. More specifically, it shows the average increase in score points associated with each level of educational attainment *relative* those with less than a high school diploma, holding certain explanatory factors constant (see appendix A for a list of control variables). For example, respondents with a high school education scored, on average, 28.5 score points higher in literacy than those with less than a high school education. Those with apprenticeship, trade or college certificates scored, on average, 36 points higher on the literacy assessment than those with less than a high school diploma; and those with University degrees scored, on average, 57 score points higher on the literacy domain than those with less than high school. Figure 9 shows the same results with more detailed educational attainment levels. These results appear to confirm the notion that educational attainment has a strong positive association with cognitive skills regardless of socioeconomic status. However, these results should be interpreted with caution, as the relationship between educational attainment and skills is complex and may involve two-way causality. It is better to look at the general direction of the relationship rather the specific "learning gain" associated with each level of educational attainment.[15]

[14] Under the assumption that educational attainment levels influence cognitive skills and not the other way around.
[15] See: *OCED Skills Outlook 2013.* OECD (2013). Page 99 footnote 5.

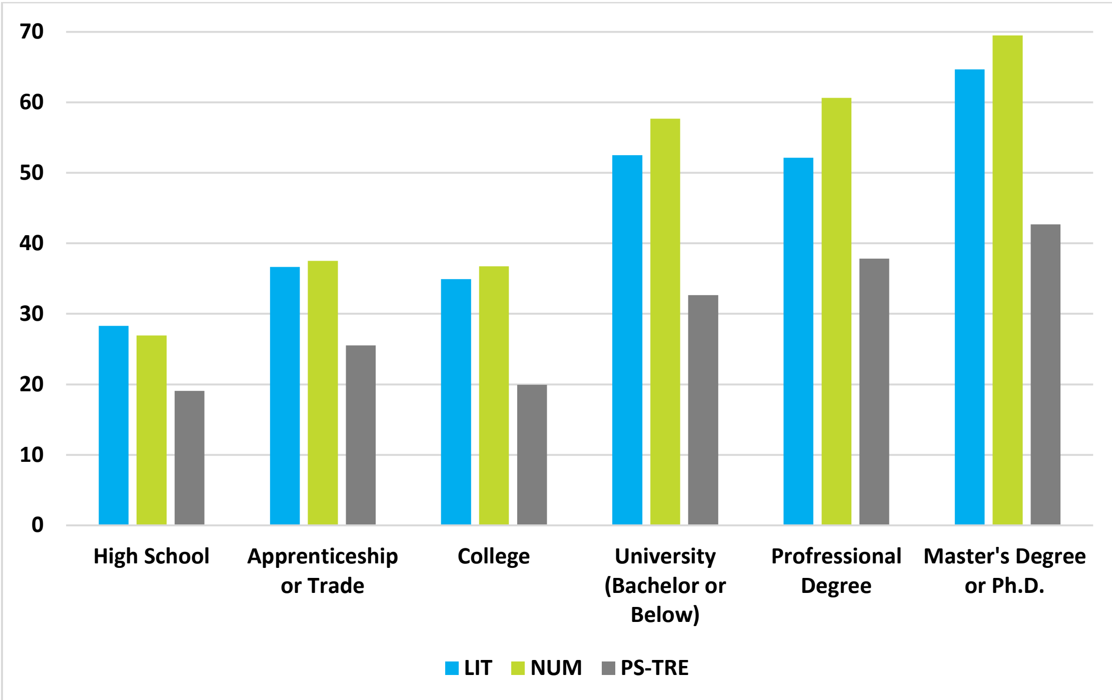
Figure 10: Association Between Educational Attainment Levels and Proficiency Scores in PIAAC



How to read charts

The charts in this section show the relationship between proficiency score in PIAAC and various socioeconomic factors. The axes represent the score point differences which are associated with each factor. In most cases these factors are specified as binary variables, that is, variables which take the value 1 if the condition is met and 0 if it is not. For example, the "High School" variable takes the value 1 when the respondent has a high school education and 0 if respondent's education takes any other value. For the educational attainment variables, "Less than High School" is the reference point. Therefore, it is important to interpret these results as relative to other conditions. In the case of High School in the literacy domain (represented by the blue bar in figure 8), the chart shows that those with high school scored on average 28.5 points higher than those with less than a high school education.

Figure 11: Association Between Educational Attainment Levels (Detailed) and Proficiency Scores in PIAAC



Statistically Significant Explanatory Factors

Figures 10, 11 and 12 shows the socioeconomic factors which are associated with proficiency scores in PIAAC. They show the coefficient produced by the linear regression model (see methodology and procedures). Only variables with a statistically significant (at the 95% level) relationship with proficiency scores are displayed on the charts. The results show that years of school, age of immigration, and whether the respondent is in a "skilled occupation", are statistically significant explanatory factors in all three PIAAC domains. With respect to years of schooling, the results indicate that a one year increase in schooling is associated with a 6.22 score point increase in the literacy assessment (a 6.89 score point increase in numeracy and 4.54 score point increase in PS-TRE). These result are similar to those calculated by the OECD, which estimated a 7 score point increase in literacy corresponding to one year of schooling.[16]

Whether or not the respondent was enrolled in an educational institution as a student also has a strong positive association with cogitative skills in each domain. The results estimate that students scored, on average 21 score points higher in literacy, 30 score points in higher in numeracy, and 18 score points higher in PS-TRE, than non-students.

---

[16] See: OCED(2012). *OECD Skills Outlook 2013: First Results from the Survey of Adult Skills* pg. 175 http://skills.oecd.org/OECD_Skills_Outlook_2013.pdf

Whether the respondent was an immigrant has a strong negative association with cognitive skills in each domain, however, that impact is largely associated with age of immigration and whether the highest level of education was completed outside of North America or Western Europe. This is evidenced by the fact that the effect of immigration is no longer statistically significant when age of immigration and foreign education are controlled. Age of immigration is a statistically significant explanatory factor of scores in all three domains. The exact extent of the relationship is difficult to interpret due to the way the variable was specified (see control variable definitions in Appendix A), but there is a clear negative association between age of immigration and score points. In other words, score points decrease on average as the age of immigration increases.

Foreign education is also negatively associated with proficiency scores in the literacy and numeracy domain. Those that obtained their highest level of education outside of North America or Western Europe scored, on average, 11 score points lower in literacy than those with non-foreign education and 10 score points lower in numeracy than those with non-foreign education.

The occupational classification of employed respondents is also associated with proficiency scores. Those that are employed in skilled occupations[17] scored, on average, 15 score points higher in literacy, 20 score points higher in numeracy and 12 score points higher in PS-TRE than those in other occupational categories.[18] This result is not surprising given that the objective of the survey was to assess skills commonly used at work or at home.

The results also suggest that respondent's gender is also associated with numeracy and PS-TRE proficiency scores. Males score 15 points higher on average in the numeracy domain and 8 points higher, on average, in the PS-TRE domain than female respondents. These results are consistent with recent results in PISA (2012)[19], which showed that boys in Ontario scored roughly 10 points higher (the equivalent to about 3 months of school) on the mathematics assessment than girls in 2012[20] and 11 points higher in the 2003 assessment.[21] Similar results are found in many other jurisdictions as well. However, many jurisdictions have seen a large reduction in the gender gap in mathematics between 2003 and 2012.[22] A recent report by the OECD also shows that in most jurisdictions, including Canada, a higher proportion of boys are low performers in math (below proficiency level 2).[23] These results suggest that women may be narrowing the gap in mathematics and men may be falling behind. It is, however, still surprising to see such a large gap in numeracy scores even after controlling for other socioeconomic

[17] The OECD derives occupational classifications from the International Standard Occupations 2008 (ISCO-08). Though their methodology is not completely defined, one can infer that skilled occupations refer to all occupations within ISCO-08 which fall into the mangers, professional and technicians and associate professionals categories. For more information on ISCO-08 occupational groups see page 66 of the International Standard Classicisation of Occupations: Structure, group definitions and correspondence tables. http://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_172572.pdf

[18] Other occupational categories include: semi-skilled white collar occupations, semi-skilled blue collar occupations, and elementary occupations.

[19] Program for International Student Assessment (OECD 2012) assessed math, reading and science competencies for over 51 000 15 year old students in 65 participating countries. See: http://www.oecd.org/pisa/keyfindings/pisa-2012-results-overview.pdf

[20] Though girls performed much better than boys on the reading assessments, scoring 36 score points higher on print reading, 20 points higher on digital reading, and 28 points higher on composite reading.

[21] See: Statistics Canada & CMEC (2013). *Measuring Up: Canadian Results of the OECD PISA Study: Performance of Canada's Youth in Mathematics, Reading and Science*.
http://cmec.ca/Publications/Lists/Publications/Attachments/318/PISA2012_CanadianReport_EN_Web.pdf

[22] In countries where there was a gender gap in favour of boys in 2003 the gap was reduced by 9 score points or more in Finland, Greece, Macao-China, the Russian Federation and Sweden. OECD 2015. *The ABC of Gender Equality in Education: Aptitude, Behaviour, Confidence.* http://www.oecd.org/pisa/keyfindings/pisa-2012-results-gender-eng.pdf

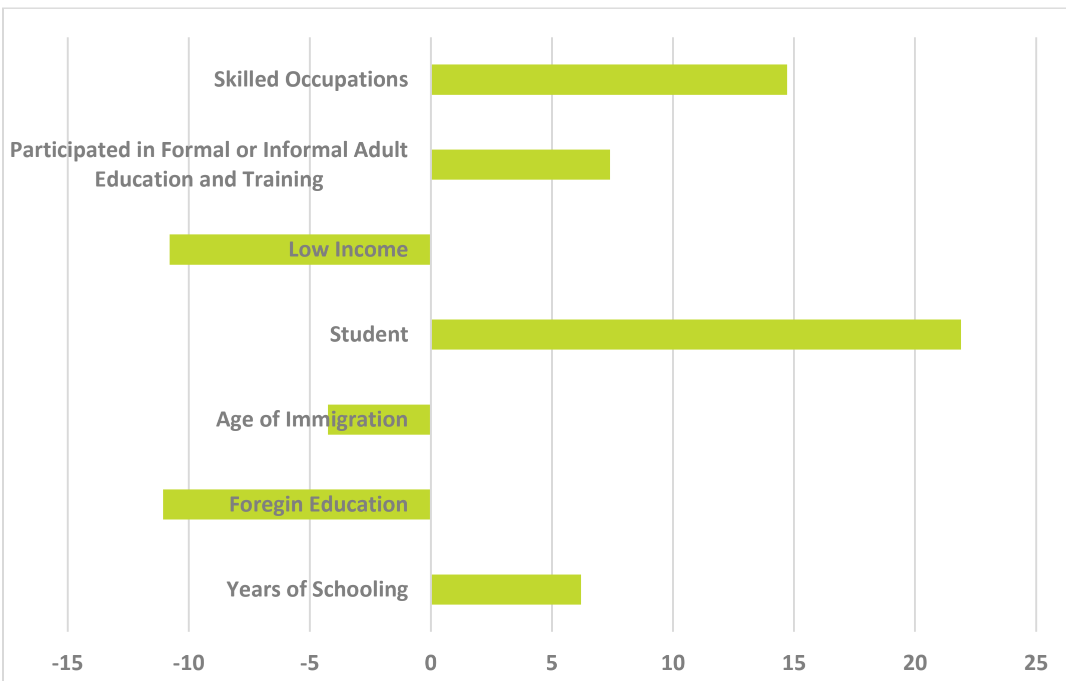
[23] OCED 2015. The ABC of Gender Equality in Education: Aptitude, Behaviour, Confidence."
http://www.oecd.org/pisa/keyfindings/pisa-2012-results-gender-eng.pdf

factors. Provided that the regression model did not omit any important explanatory factors; this result suggests the possibility that other “unobserved” factors, such as unconscious bias[24], are contributing to the gender gap.

Parent’s education is another significant factor in explaining score point differences in the numeracy and PS-TRE domain. A one level increase in parent’s education (less than high school to high school or high school to post-secondary) is associated with a 7 point score increase in numeracy and a 6 point score increase in PS-TRE. Interestingly, parent’s education is not significantly associated with literacy scores. This is an unexpected result and it could be due to the specification of the regression model, the way the variable was derived, or the high level of non-response to this question (many respondents did not answer this question).

The results also suggest that participation in formal or informal adult education and training has a positive association with literacy proficiency. Those that participated in formal or informal adult education and training scored, on average, seven score points higher in the literacy domain (the equivalent to about one year of school) than those that did not participate. This factor was not statistically significant in explaining numeracy or PS-TRE scores, the reason for this in unclear.

Figure 12: Key Correlations with Literacy Scores in PIAAC



[24] See Racusin et al (2012). *Science Faculty’s Subtle Gender Biases Favor Male Students*. Proceedings of the National Academy of Sciences, Vol 109 no 41. http://www.pnas.org/content/109/41/16474.full . For a discussion on unconscious gender bias in academic science.

Figure 13: Key Correlations with Numeracy Scores in PIAAC

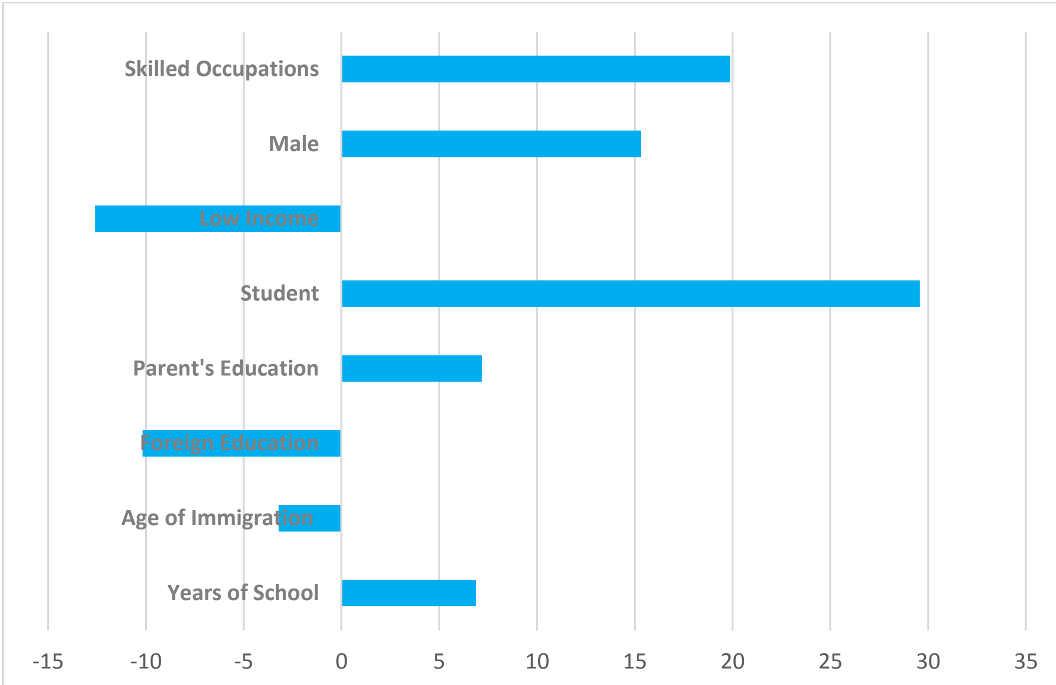
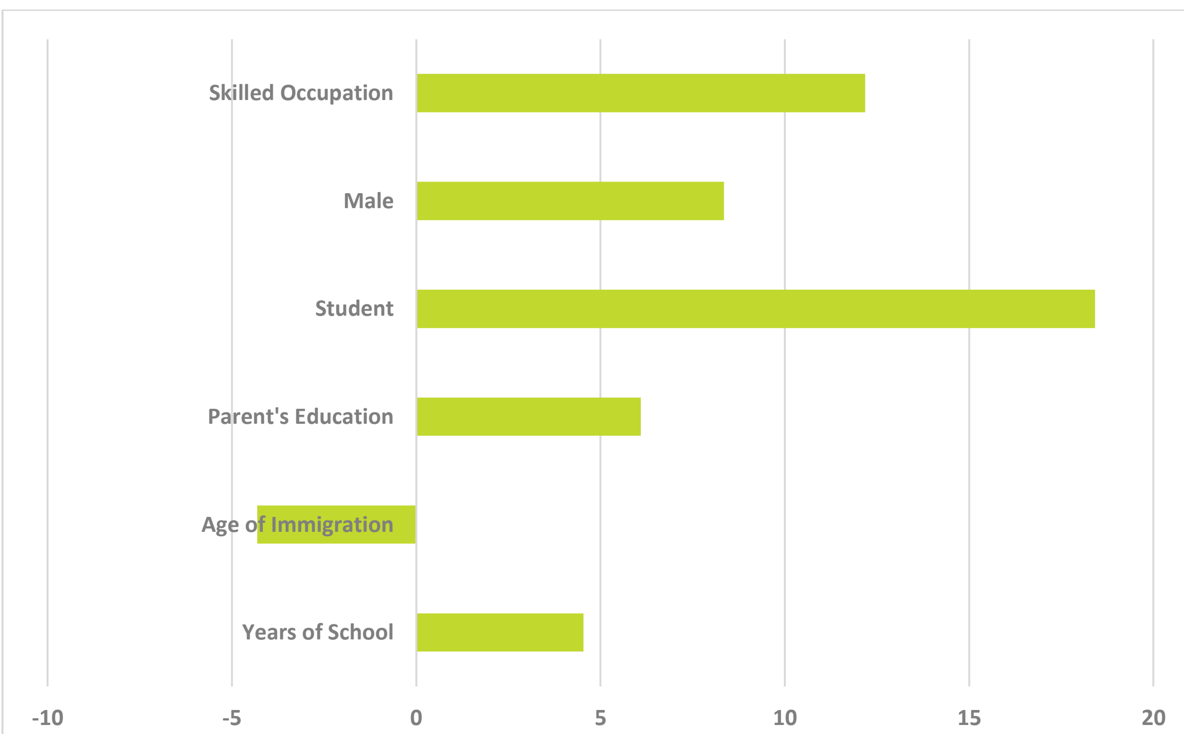


Figure 14: Key Correlations with PS-TRE Scores in PIAAC



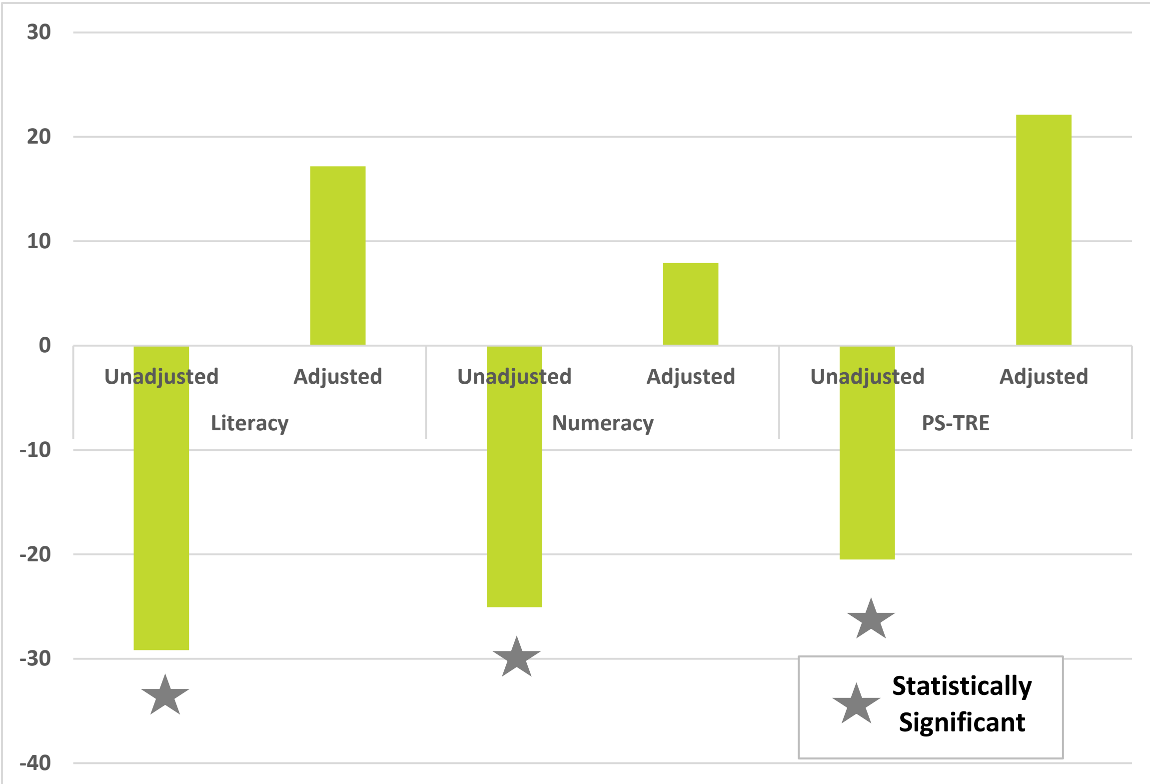
Non-Statistically Significant Explanatory Factors

Examining the factors which are not statistically significant also yields interesting insights about the factors which influence cognitive skills. Some explanatory variables significantly impact proficiency scores on their own, but are no longer significant when other socioeconomic factors are accounted for.

A good example of this is found in average scores among Immigrant respondents. Figure 13 shows the average differences between immigrant and non-immigrant respondents in each domain and what happens to this difference when socioeconomic factors are controlled. For example, in the Literacy domain the differences between immigrant and non-immigrant averages is -29.17 and this differences is statistically significant- in other words immigrant respondents scored, on average, 29 points less in the literacy domain than non-immigrant respondents. However, when other explanatory factors are accounted for the difference becomes positive, with Immigrant respondents scoring, on average, 17 score points higher in literacy (though this result is not statistically significant and is subject to a very high standard error).[25] In other words, whether is respondent is an immigrant or not does not appear to have an isolated effect on proficiency scores independent of other socioeconomic variables such as education, age of immigration, and whether the respondent's highest level of education was completed outside of North America or Western Europe. This suggests that immigration status alone is not sufficient in explaining variation in scores, and other factors, such as age of immigration and foreign education, should also be considered in this type of analysis.

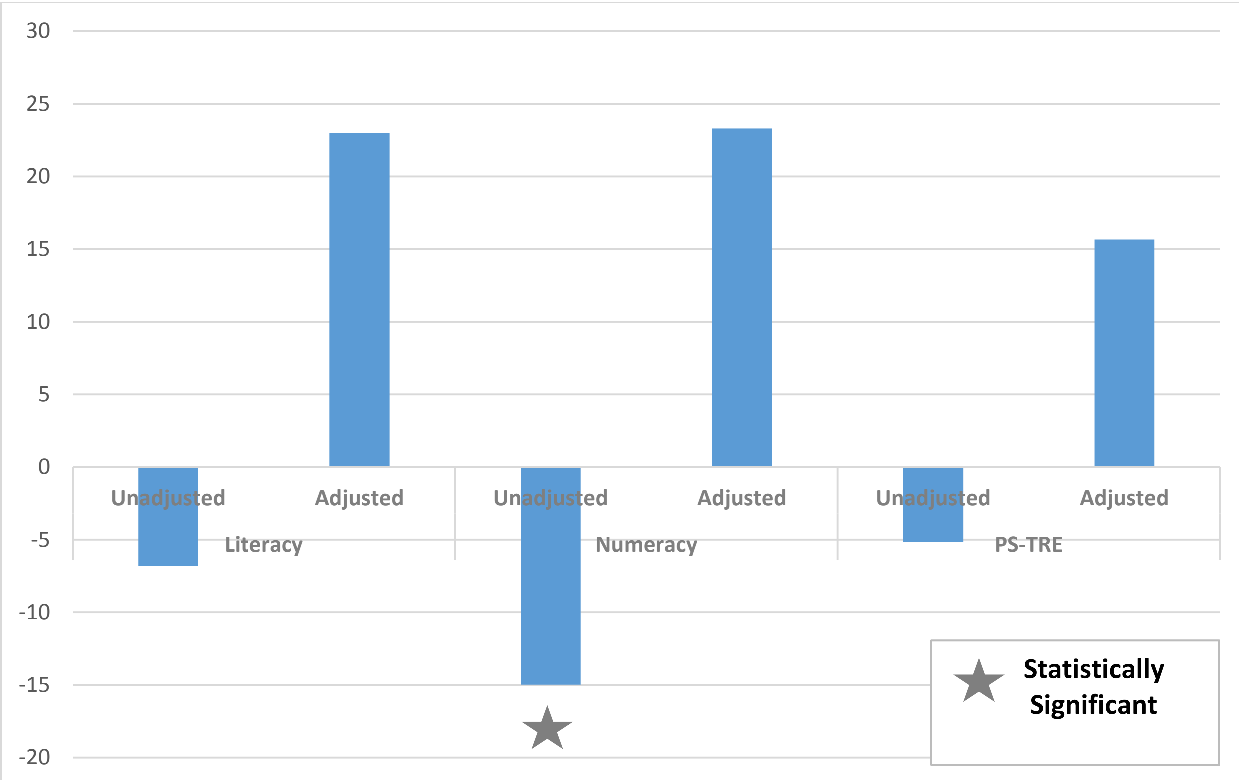
[25] When the individual result of a regression equation are not statistically significant it could mean that the result is biased in some way (usually sample error). These results should not be interpreted with the same level of confidence as the statistically significant results. All results for this research were tested using critical T values at the 95% level of confidence.

Figure 15: Average PIAAC Score Differences Among Immigrant and Non-Immigrant Respondents with and without Socioeconomic Controls



Similar results are found for Aboriginal respondents. Figure 14 shows the differences in average scores of Aboriginal respondents and non-Aboriginal respondents (similar to Figure 13). The average score among Aboriginal respondents in numeracy is about 15 points lower than the average among non-Aboriginal respondents (the results for literacy and PS-TRE are not statistically significant). However, when other socioeconomic variables are accounted for this difference is no longer statistically significant. This suggests that the differences between numeracy scores among Aboriginal and non-Aboriginal respondents may be attributed to years of school, income, parent's education, occupational classification and other statistically significant explanatory factors.

Figure 16: Differences in Average PIAAC Scores Among Aboriginal and Non-Aboriginal Respondents with and without Socioeconomic Controls



Limitations

The last section of this report will outline some of the limitations of the research methods and subsequent findings. Like most studies that use OLS to model a dataset, this research may be subject to various types of bias associated with the way the model was designed. This bias can arise from the fact that certain explanatory variables were omitted from the analysis (omitted variable bias). In this case, the most obvious variable which was not included in the regression estimates was income. In the current model there is no estimate of respondent income, instead income was included as a discrete variable which took the value of 1 if the respondent's earnings were in the lowest three deciles and 0 for all other respondents. The main reason the income variable was not included is because of the way respondents were asked to report income. The survey asked respondents to report their salary interval (hourly, weekly, monthly) and then asked to report their salary based on this answer (those that answered hourly salary intervals reported hourly wage, weekly age intervals reported weekly income etc…). Inclusion of this data would have required a method to standardize these reported incomes, which was avoided in the interest of time. The inclusion of a continuous income variable would have also required changing the functional form of the regression equation by putting the income and proficiency scores (dependent variable) in log form- and this would have made interpretation of other variables less straightforward.

Another limitation of the research is the issue of endogentiy caused by omitted unobserved variables. Important unobserved variables can cause biased results because the effect of these variables is hidden in the error term of the regression equation. This is problematic because the error term and each explanatory variable in a regression equation must be uncorrelated, otherwise the variations in the explanatory variable and the error term cannot be independently estimated. An example of an unobserved variable which may influence proficiency scores in PIAAC is intrinsic ability. This variable was not measured in the PIAAC survey and was therefore not included in the regression model. If intrinsic ability is an important explanatory factor in explaining proficiency scores, its effect is captured in the error term. This would in turn bias the regression estimates which are correlated with intrinsic ability, since the regression model would attribute the variations in intrinsic ability to each explanatory factor it is correlated with. For example, if years of schooling is correlated with intrinsic ability, the regression estimates for years of schooling may include the effect of intrinsic ability as well.

Readers should also be aware of the some of the variables in the PIAAC database are not completely enumerated, as not all questions were answered by respondents. For each question in the background questionnaire there are options where respondents refused to answer, didn't know the answer, or skipped the question because it did not pertain to them. Some variables had large numbers of respondents non answer for one of those reasons. For example, the parent's education variable had approximately 450 non-answers. These non-responses may bias the regression results in certain ways. If, for example, those that did not answer the parent's education question were more likely to have parents with lower levels of education (or higher levels) the exclusion of these individuals from the analysis may cause over or under estimation of the effect of parents education.

The final limitation to consider is the fact that the regression model was not tested for common types of specification bias such as heteroskedascity.[26] Though robust test for these issues exists, the regression program used to analyze the PIAAC data did not include these tests.

[26] Heteroskesdascity refers to bias caused by an error term variance that is not constant. This often occurs in datasets with there is a large disparity between the largest and smallest values.

CONCLUSION

There is a growing recognition of the vital role cognitive skills play in the social and economic development of individuals in knowledge based economies. As Ontario continues to transitions towards a less labour intensive economy, the Province will need to ensure that Ontarians are equipped with the relevant cognitive abilities needed at work and at home. In order to develop a better understanding of these challenges, this paper attempts to examine the distribution of cognitive abilities across regions in Ontario and identify relevant factors which are associated with cognitive skills using the results from the 2012 PIAAC survey. The result show that most of the regional differences in scores are attributed to education levels and immigration levels in each area, and more specifically, the age of immigration and whether the individual's highest level of education was completed outside North America or Western Europe. The research also estimates the association between educational attainment on cognitive ability by examining the increase in score points associated with various levels of education. The results indicate that score points increase significantly as education levels rise. Finally, the paper looks at factors which are associated with proficiency scores in PIAAC. The results suggest that there are a number of independent factors which can influence cognitive ability, including; years of school, gender, occupational class, age of immigration and parent's education.

APPENDICES

APPENDIX A: LIST OF CONTROL VARIABLES AND DEFINITIONS

Variable	Definition
High School	The respondent's highest level of education is a high school diploma or equivalent.
Trade, Apprenticeship, Post-Secondary	The respondent's highest level of education is less than a trade, apprenticeship or College diploma.
University	The respondent's highest level of education is less than a university degree.
Years of Schooling	Total years of schooling during lifetime.
Immigrant	The respondent is not born is Canada
Age of Immigration	The age of immigration for all respondents not born in Canada categories in 4 year intervals and coded into a numeric variable in the following way: 1= Aged 0-5 2=Aged 6-10 3= Aged 11-15 4= Aged 16-20 5= Aged= 21-25 6= Aged= 26-30 7= Aged 31-35 9= Aged 36-40 10= Aged 41 or Older NA= Valid skip, Don't know or Refused
Foreign Education	Region where highest level of education obtained is not North America or Western Europe.
Parent's Education Index	The educational attainment of respondent's male and/or female guardian expressed as a numeric value and ranked in the following way: 1= Neither parent has attained upper secondary, 2= One parent obtained secondary or post-secondary non tertiary, 3= At least one parent has obtained tertiary, NA= Don't Know, Refused, or Not Stated
Student	The respondent is a full time student working towards a diploma, degree or certificate.
Unemployed	The respondent is unemployed.
Out of the Labour Force	The respondent is out of the labour force
Native Language not the Same as Test Language	The respondent's native language is not the same as the test language.
Unable to work due to disability	The respondent is not working because he or she is permanently disabled.
Low Income	Respondents who are in the lowest, 9th and 8th declines in terms of hourly earnings excluding bonuses.
Aboriginal	Respondent is an Aboriginal person; either First Nation, Metis or Inuit. Includes status and non-status.
Parents Immigrant	Respondents who were born in Canada and both

Variable	Definition
	parents were not born in Canada or one parent was not born in Canada.
Retired	Respondent who are not working because they are retired.
Perceived Poor Health	Respondent who reported that their health is poor when asked about their general state of health.
Age	Respondent’s age
Age^2	Polynomial of respondent’s age.
Assistance with Skills Assessment	Respondent received assistance when answering questions in the skills assessment.
Male	Respondent identifies as male.
Participated in Formal or Informal Adult Education and Training	Respondent who participated in formal or informal adult education and training within 12 months of the assessment.
Skilled Occupation	The respondent’s current of last occupation is a skilled occupation as defined by the International Standard Occupations 2008 (ISCO-08), these include: managers, professionals and technicians and associate professionals.

APPENDIX B: REGRESSION RESULTS EDUCATIONAL ATTAINMENT MODEL

The regression results for the educational attainment regression is presented in the following table. The table shows regression coefficients followed by critical t values in parenthesis. * Denotes significance at the 90% level, ** marks significance at the 95% level and *** shows significance at 99%.

	Literacy	Numeracy	PS-TRE
c	210.11 (7.35)***	178.22 (5.4)***	210.33 (6.16) ***
High School	28.29 (4.53)***	26.92 (3.59)***	19.09 (1.93)*
Trade or Apprenticeship	36.63 (3.58)***	37.49 (2.99)***	25.53 (1.73)*
College	34.92 (4.67)***	36.72 (4.37)***	19.95 (1.99)**
University	52.51 (7.98)***	57.66 (7.9)***	32.66 (3.34)***
Professional	52.12 (5.27)***	60.65 (5.97)***	37.81 (3.14)***
Masters or PHD	64.67 (7.88)***	69.47 (7.92)***	42.7 (3.96)***
Immigrant	10.52 (0.47)	1.94 (0.07)	20.88 (0.72)
Age of Immigration	-3.81 (-3.9)***	-2.95 (-2.61)***	-3.71 (-2.85)***
Foreign Education	-12.06(-2.95)***	-10.41 (-2.27)***	-10.55 (-1.95)*
Parent's Education	4.21 (1.73)*	7.44 (2.64)***	6.22 (2.15)***
Student	21.92 (3.72)***	30.24 (3.97)***	12.31 (1.74)*
Unemployed	9.38 (1.66)*	3.66 (0.51)	0.64 (0.1)
Out of the Labour Force	-9.69 (-1.76)*	-11.84 (-2.13)***	2.97 (0.57)
Native language not the	-6.43 (-1.62)	-2.23 (-0.53)	-2.98 (-0.65)

same as test language			
Cannot work due to disability	-14.93 (-1.09)	-13.9 (-0.96)	-28.2 (-1.25)
Low income	-12.58 (-2.33)***	-14.59 (-2.57)***	-2.3 (-0.37)
Aboriginal	22.06 (1.41)	22.47 (1.17)	15.35 (1.08)
Both Parents Immigrant	12.34 (1.35)	13.9 (1.35)	11.24 (1.08)
Retired	12.91 (1.35)	12.41 (1.1)	8.32 (0.65)
Perceived Poor Health	-14.17(-1.12)	-15.71 (-1.15)	-1.21 (-0.07)
Age	0.6 (0.6)	1.06 (0.98)	1.12 (0.96)
Age^2	-0.01 (-0.81)	-0.01 (-1.13)	-0.02 (-1.55)
Assistance with assessment	-9.26 (-1.02)	-4.05 (-0.39)	-2.87 (-0.23)
Male	2.59 (0.95)	16.12 (5.13)***	9.07 (2.75)
Participated in formal or informal adult education or training	8.8 (2.68)***	4.65 (1.11)	4.17 (0.98)
Skilled Occupation	15.15 (4.38)***	20.04 (5.81)***	10.8 (2.89)***
R^2	0.38	0.38	0.26

APPENDIX C: REGRESSION RESULTS YEARS OF SCHOOL MODEL

The regression results for the years of school regression is presented in the following table. The table shows regression coefficients followed by critical t values in parenthesis. * Denotes significance at the 90% level, ** marks significance at the 95% level and *** shows significance at 99%.

	Literacy	Numeracy	PS-TRE
c	152.74 (5.39)***	110.9 (3.31)***	173.17 (5.23) ***
Years of School	6.22 (7.4)***	6.89 (8.59)***	4.54 (5.66)***
Immigrant	17.16 (0.74)	7.92 (0.29)***	22.11 (0.78)
Age of Immigration	-4.24 (-4.21)***	-3.22 (-2.89)***	-4.31 (-3.57)***
Foreign Education	-11.05 (-2.63)***	-10.18 (-2.19)***	-8.14 (-1.59)
Parent's Education	3.98 (1.64)*	7.18 (2.57)***	6.09 (2.12)***
Student	21.9 (3.56)***	29.58 (3.72)***	13.07 (1.78)*
Unemployed	10.66 (1.95)*	4.79 (0.65)	1.53 (0.23)
Out of the Labour Force	-10.07 (-1.85)*	-11.29 (-1.95)*	2.2 (0.42)
Native language not the same as test language	-5.87 (-1.53)	-1.26 (-0.31)	-2.64 (-0.58)
Cannot work due to disability	-12.38 (-0.91)	-13.94 (-0.97)	-20.36 (-0.94)
Low income	-10.79 (-2.03)***	-12.6 (-2.29)***	-1 (-0.16)
Aboriginal	23 (1.31)	23.29 (1.11)	15.65 (1.12)

Both Parents Immigrant	14.64 (1.68)*	15.95 (1.61)	11.52 (1.12)
Retired	10.46 (1.03)*	10.21 (0.84)	9.35 (0.7)
Perceived Poor Health	20.38 (-1.64)	-21.53 (-1.55)	-12.06 (-0.91)
Age	0.84 (0.84)	1.43 (1.28)	1.1 (1)
Age^2	-0.01 (-1.01)	-0.02 (-1.38)	-0.02 (-1.61)
Assistance with assessment	-7.1 (-0.79)	-1.44 (-0.14)	0.21 (0.02)
Male	2.02 (0.73)	15.31 (4.97)***	8.35 (2.56)***
Participated in formal or informal adult education or training	7.41 (2.45)***	3.28 (0.83)	2.75 (0.7)
Skilled Occupation	14.72 (4.03)***	19.88 (5.42)***	10.86 (2.82)***
R^2	0.36	0.36	0.27

APPENDIX D: GEOGRAPHY DEFINITIONS

The following tables show the definitions for each of the geographic areas analyzed. The tables show the name of each area, the major census areas that are encapsulated and the FSAs which cover the area. In each case the geographies were created using the FSAs included in the PIAAC data.

Regions

Geography	Areas Included	FSAs Included	Sample Size
North	Sudbury, Greater Sudbury, Manitoulin, Timiskaming, Cochrane, Algoma, Thunder Bay, Rainy River, Kenora, Parry Sound, Nipissing	P0T P7B P7A P7C P7L P7J P7K P7E P7G P9A P0W P0X P0V P8N P9N P8T P0Y P0E P0A P0G P2A P0H P1B P1C P2B P1A P0M P0P P5E P3G P3E P3A P3B P3C P3L P3N P3P P3Y P0J P0K P2N P0N P0L P5N P4N P4P P4R P0R P5A P0S P6A P6B P6C	580
East	Ottawa, Stormont, Dundas, Glengarry, Prescott and Russell, Leeds, Grenville, Lanark, Lennox, Addington, Frontenac, Hastings, Prince Edward, Northhumberland, Renfrew	K0A K1C K2W K2S K0K K6A K7K K2M K4A K2G K0C K6H K0B K7M K8H K6J K1J K7C K1R K1P K1B K1V K1T K8P K4B K1W K2E K7S K8N K2J K1S K1G K7R K1Z K1K K8A K4C K1N K7H K4M K8V K1Y K7A K2K K2P K0E K2B K2H K0J K4K K2C K1L K0G K2L K4R K7P K1A K1H K6K K7V K0H K2T K1E K2A K7L K1M K4P K8R K2V K7N K9A L1A	953
Central	Peterborough, Kawartha Lakes, Haliburton, Muskoka, Simcoe	L0K P0E P1L P1P P0B P1H P0C L0M L0L L0K L4M L3V L4R L9Y L9J L4N L9M L9R L3Z L9S L9Z L0M L9R N0C K0L K9H K9J K0M L0A K9K K9L K9V	173

Geography	Areas Included	FSAs Included	Sample Size
GTA	Durham, York, Toronto, Peel, Halton	M1B M1C M1E M1G M1H M1J M1K M1L M1M M1N M1P M1R M1S M1T M1V M1W M1X M2H M2J M2K M2L M2M M2N M2P M2R M3A M3B M3C M3H M3J M3K M3L M3M M3N M4A M4B M4C M4E M4G M4H M4J M4K M4L M4M M4N M4P M4R M4S M4T M4V M4W M4X M4Y M5A M5B M5C M5E M5G M5H M5J M5K M5L M5M M5N M5P M5R M5S M5T M5V M5W M5X M6A M6B M6C M6E M6G M6H M6J M6K M6L M6M M6N M6P M6R M6S M7A M7Y M8V M8W M8X M8Y M8Z M9A M9B M9C M9L M9M M9N M9P M9R M9V M9W L4T L4V L4W L4X L4Y L4Z L5A L5B L5C L5E L5G L5H L5J L5K L5L L5M L5N L5P L5R L5S L5T L5V L5W L0P L6P L6R L6S L6T L6V L6W L6X L6Y L6Z L7A L0G L0J L0N L7C L7E L7K L9W L6H L6J L6K L6L L6M L7L L7M L7N L7P L7R L7S L7T L9T L7J L7G L0H L4G L3X L0E L0V L3P L3T L3Y L3R L4B L4H L3S L4C L4A L4P L4J L4E L7B L9N L4K L4L L6B L4S L6A L6C L6E L6G L0B L1S L9L L1T L1H L1G L0C L1V L1Z L1M L1W L1N L1J L1B L9P L1X L1P L1K L1C L1Y L1R L1L L1E	2335

Geography	Areas Included	FSAs Included	Sample Size
Southwest	Wellington, Hamilton, Niagara, Haldimand-Norfolk, Brant, Waterloo, Perth, Huron, Oxford, Elgin, Chatham-Kent, Essex, Lambton, Middlesex, Bruce, Grey	N0N N0M N5Z N5P N8W N0R N8X N0P N1S N0H N4K N2L N2K N5R N9E N0G N1E N6G N3A N0L N1A N0B N0A N8P N7G N5W N1H N9H N2M N2A N5X N1M N8T N1T N8Y N9K N3P N2J N6E N7L N3S N5A N4W N7V N7S N8N N2T N3C N6K N6H N5V N1L N0K N6B N1G N8S N3H N9A N9G N8A N5Y N8R N9J N3T N1P N3R N6J N7M N3B N2H N9V N2E N6M N7T N2V N6A N6C N9C N2B N2N N1R N2P N7A N2G N3W N6L N9B N2C N1C N5L N2R N1K N0E N3V N6P L0R L9G L8E L8G L8H L8J L8K L8L L8M L8N L8P L8R L8S L8T L8V L8W L9A L9B L9C L9G L9H L9K L0S L0R L2A L3B L2E L2P L3M L3K L3C L2G L2R L2M L2S L2H L2N L2V L2J L2T L2W	1240

Census Areas

(roughly equivalent to Statistics Canada Census Division and Subdivisions)

Area	FSAs Included	Sample Size
Thunder Bay and Rainy River	P0T P7B P7A P7C P7L P7J P7K P7E P7G P9A P0W	108
Algoma, Sudbury, Greater Sudbury, Manitoulin, Nipissing & Parry Sound	P0R P5A P0S P6A P6B P6C P0M P0P P5E P3G P3E P3A P3B P3C P3L P3N P3P P3Y P0H P1B P1C P2B P1A P0A P0G P2A P0H P0M	321
Cochrane & Timiskaming	P0J P0K P2N P0N P0L P5N P4N P4P P4R	151
Ottawa	K1B K1C K1E K1G K1H K1J K1K K1L K1M K1N K1P K1R K1S K1T K1V K1W K1X K1Y K1Z K2A K2B K2C K2E K2G K2H K2J K2K K2L K2M K2P K2R K2S K2T K2V K2W K4A K4B K4C K4M K4P	495
Stormont, Dundas and Glengarry & Prescott and Russell	K0C K6H K6K K6J K0A K4R K0B K6A K4K	246
Leeds and Grenville, Lanark, Lennox & Addington, Frontenac, Hastings, Prince Edward, Northumberland & Renfrew	K0E K0G K6V K7A K7G K7H K7C K6T K0H K7K K7L K7M K7P K7N K7R K0K K8N K8P K8R K8V K9A L1A K1A K0J K7V K8A K7S K8B K8H	212
Peterborough & Kawartha Lakes & Haliburton	K0L K9H K9J K0M L0A K9K K9L K9V	93 (insufficient)
Simcoe	L0M L0L L0K L4M L3V L4R L9Y L9J L4N L9M L9R L3Z L9S L9Z	67 (insufficient)
Muskoka	P0E P1L P1P P0B P1H P0C	13 (insufficient)
Durham	L0B L1S L9L L1T L1H L1G L0C L1V L1Z L1M L1W L1N L1J L1B L9P L1X L1P L1K L1C L1Y L1R L1L L1E	199
York	L0J L0H L0G L4G L3X L0E L0V L3P L3T L3Y L3R L4B L4H L3S L4C L4A L4P L4J L4E L7B L9N L4K L4L L6B L4S L6A L6C L6E L6G	359
Toronto	M1B M1C M1E M1G M1H M1J M1K M1L M1M M1N M1P M1R M1S M1T M1V M1W M1X M2H M2J M2K M2L M2M M2N M2P M2R M3A M3B M3C M3H M3J M3K M3L M3M M3N M4A M4B M4C M4E M4G M4H M4J M4K M4L M4M M4N M4P M4R M4S M4T M4V M4W M4X M4Y M5A M5B M5C M5E M5G M5H M5J M5K M5L M5M M5N M5P M5R M5S M5T M5V M5W M5X M6A M6B M6C M6E M6G M6H M6J M6K M6L M6M M6N M6P M6R M6S M7A M7Y M8V M8W M8X M8Y M8Z M9A M9B M9C M9L M9M M9N M9P M9R M9V M9W	981

Peel-Dufferin-Halton	L4T L0P L0N L4V L6P L9W L9V L4W L6R L4X L6S L4Y L6T L7C L4Z L6V L7E L5A L6W L7K L5B L6X L5C L6Y L5E L6Z L5G L7A L5H L5J L5K L5L L5M L5N L5P L5R L5S L5T L5V L5W M7R L6H L6J L7L L7J L6K L7M L9T L7G L6L L7N L6M L7P L7R L7S L7T	796
Waterloo and Wellington	N0B N1C N1H N1E N1M N1G N1K N1L L8E L8G L8H L8J L8K L8L L8M L8N L8P L8R L8S L8T L8V L8W L9A L9B L9C L9G L9H L9K N2H N1R N1P N2A N2J N3H N2B N2K N2N N1S N2C N2L N3A N3B N2V N1T N2E N2T N2G N3C N3E N2M N2P N2R	420
Oxford	N4G N0J N5C N4S N4T N4V	0 (insufficient)
Chatham-Kent, Lambton & Essex	N0R N8M N9J N9A N8N N8H N9V N9H N8P N9Y N8R N8T N8S N9K N8V N8W N8X N8Y N9B N9C N9E N9G N0P N7L N7M N8A N0N N7T N7S N7V N7W N7X	256
Hamilton, Niagara, Haldimand-Norfolk and Brant	L8E L8G L8H L8J L8K L8L L8M L8N L8P L8R L8S L8T L8V L8W L9A L9B L9C L9G L9H L9K L0S L0R L2A L3B L2E L2P L3M L3K L3C L2G L2R L2M L2S L2H L2N L2V L2J L2T L2W N0A N0E N1A N3T N3W N3Y N4B N3L N3P N3R N3S N3V	423
Middlesex & Elgin	N5V N0M N7G N5W N5X N5Y N6A N5Z N6M N6G N6N N6H N6B N6K N6C N6E N6P N6J N6L N5H N0L N5P N5R N5L	195
Perth, Huron, Bruce and Grey	N4Z N4X N0K N5A N4W N7A N0G N0H N2Z N4N N0C N4K N4L	103

Cities and Districts

Area	FSAs Included	Sample Size
Thunder Bay	P7A P7B P7C P7E P7G P7J P7K	102
Greater Sudbury	P3A P3B P3C P3E P3G P3L P3N P3P P3Y	131
Old City of Ottawa	K1L K1M K1G K1N K1P K1R K1S K1Y K1Z K2A K2B K2C K2P K1H	152
Gloucester, Cumberland, Osgoode-Rideau	K1J K1K K1T K1V K1W K1X K4A K4B K4C K4P K4M K1B K1C K1E	220
Nepean, Kanata, Goulbourn	K2E K2G K2H K2J K2R K2K K2L K2M K2T K2V K2W K2S	123
Scarborough	M1B M1C M1E M1G M1H M1J M1K M1L M1M M1N M1P M1R M1S M1T M1V M1W M1X	236
North York	M2P M4A M6L M2K M2L M2M M2N M3A M3B M3C M3H M3J M3K M3L M3M M2H M6B M3N M6A M2J M2R M5M M9L M9M	236
Etobicoke & Rexdale	M8V M8W M8X M8Y M8Z M9A M9B M9C M9P M9R M9V M9W	131
York and North York	M2P M4A M6L M2K M2L M2M M2N M3A M3B M3C M3H M3J M3K M3L M3M M2H M6B M3N M6A M2J M2R M5M M9L M9M M9N M6N M6M M6C M6E	303
Old Toronto	M5A M5B M5C M5E M5G M5H M4P M5J M5K M5L M4R M5N M5P M5R M5S M5T M5V M6P M6R M6S M6K M6J M6H M4S M4T M4V M4W M5W M4X M5X M4Y M4J M4B M4C M4E M4G M4H M4K M4L M4M M4N M6G M7A M7Y	311
Vaughan	L6A L4H L4L L4K L4J L0J	98
Markham & Richmond Hill	L3P L3R L3S L3T L6B L6C L6E L6G L4B L4C L4E L4S	167
Mississauga	L4T L4V L4W L4X L4Y L4Z L5A L5B L5C L5E L5G L5H L5J L5K L5L L5M L5N L5P L5R L5S L5T L5V L5W	364
Brampton	L6P L6R L6S L6T L6V L6W L6X L6Y L6Z L7A	216
Kitchener & Waterloo	N2A N2B N2C N2E N2G N2H N2J N2K N2M N2N N2P N2R N2L N2T N2V	115
Windsor	N8P N8R N8S N8T N8W N8X N8Y N9A N9B N9C N9E N9G N9H N9J	99