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# Literacy Gaps by Educational Attainment: A Comparative Study of 19 Countries

## **Abstract**

Using data of literacy skills among adults aged 26 to 35 from the International Adult Literacy Survey, we compare the degree of literacy gaps between those who completed tertiary education and those who did not graduate from high schools across 19 countries. The result of ordinary least square regression shows that although those with a higher level of educational attainment tend to have a higher level of literacy skills in all countries, countries substantially vary in the degree of literacy gaps by educational attainment. The cross-national variation in the literacy gap is mainly driven by between-country differences in the level of literacy skills among those who did not graduate from high school. The result of two-level hierarchical linear models, furthermore, shows that the cross-national variation in the literacy gap by educational attainment is in part attributable to between-country differences in standardization of educational systems and the extent to which adult education and training are offered to the low educated. We discuss theoretical and policy implications of the findings for addressing inequality of literacy skills.

## **Keywords**

literacy skills, cross-national variation, educational attainment

## **Disciplines**

Demography, Population, and Ecology | Family, Life Course, and Society | Social and Behavioral Sciences | Sociology

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# **Literacy Gaps by Educational Attainment: A Comparative Study of 19 Countries**

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## **ABSTRACT**

Using data of literacy skills among adults aged 26 to 35 from the International Adult Literacy Survey, we compare the degree of literacy gaps between those who completed tertiary education and those who did not graduate from high schools across 19 countries. The result of ordinary least square regression shows that although those with a higher level of educational attainment tend to have a higher level of literacy skills in all countries, countries substantially vary in the degree of literacy gaps by educational attainment. The cross-national variation in the literacy gap is mainly driven by between-country differences in the level of literacy skills among those who did not graduate from high school. The result of two-level hierarchical linear models, furthermore, shows that the cross-national variation in the literacy gap by educational attainment is in part attributable to between-country differences in standardization of educational systems and the extent to which adult education and training are offered to the low educated. We discuss theoretical and policy implications of the findings for addressing inequality of literacy skills.

[Note: All tables appear at end of paper.]

## **Background**

Recent economic transformations in industrial nations as represented by changes in work organization, technological development, and globalization have increased the demand for highly skilled workers (OECD 2000). In contemporary economies, enhancing the levels of knowledge and literacy skills of the population is a critical national agenda. Literacy skills are important at the individual level as well because they are significantly associated with labor market outcomes such as earnings and income, even after educational qualifications are held constant (Kerckhoff et al. 2001). . Literacy skills are also relevant for individual's healthy aging, given that capacity for gathering medical information and applying the knowledge for health-related activities is essential for old adults to maintain their health.

The significance of literacy skills for the well-being of a society and an individual renders it of paramount importance to examine the level and the distribution of literacy skills among the population. In particular, cross-national comparisons offer an opportunity to assess how successful countries are in raising literacy skills whilst narrowing disparities in literacy among their population. Furthermore, comparative studies across a wide range of societies may shed light on structural factors that underlie differences in the distribution of literacy skills. Identifying structural factors responsible for the cross-national variation in the distribution of literacy skills can enhance our understanding of the nature and determinants of literacy proficiency. Although a substantial number of studies have examined literacy skills with a comparative perspective (e.g., Carbonaro 2006), the major focus of the literature was the cross-

national variation on the *impact* of literacy skills on labor market outcomes, leaving unexamined the cross-nationally varying distributions of literacy skills and their determinants.

The summaries of the basic findings from a large-scale international survey of literacy skills (International Adult Literacy Survey: IALS) show that countries vary substantially not only in the overall level but also in the dispersion of literacy skills (OECD 2000). For instance, Sweden shows significantly higher average scores on the scales of prose, document, and quantitative literacy skills than do the United States and Chile. Although the United States has a similar average score on the prose scale as Denmark, the range of scores between the bottom 5<sup>th</sup> and the top 5<sup>th</sup> percentile in the United States is twice as large as the corresponding range in Denmark.

In this study, we examine the distributions of literacy skills among adults aged 26-35 in 19 countries using data from the International Adult Literacy Survey (IALS). We focus on the literacy gap between those with high levels of formal educational attainment and those with low levels of educational attainment. A substantial amount of literacy skills are acquired through schooling (OECD 2000). Probably in most countries, those with more formal education have higher levels of literacy skills than do those with less education. However, the size of the literacy gap between people with different levels of educational attainment may vary across countries. In countries with large inequality in literacy skills, people with low educational attainment may be in ‘double jeopardy’ in that they have substantially lower literacy skills as well as a lower level of educational attainment. On the contrary, in countries where literacy differentials do not vary substantially by educational attainment, those with low educational attainment may not

face disadvantages as much as the low educated in societies where the literacy gap is significant.

This research question is relevant for understanding cross-national variations in social and economic inequalities. For instance, due to the significance of literacy skills for individuals' labor market outcomes, disparities in occupational outcomes between people with low and high levels of educational attainment are more likely to be smaller where literacy gaps between education groups are smaller. Previous literature, which has demonstrated the relevance of literacy skills for better health management and health outcomes, particularly among older adults (Berkman et al. 2004), suggests that disparities in health outcomes among populations should be narrower in societies where literacy gaps are smaller.

### **Sources of Cross-National Variation in Literacy Gaps**

Why do countries differ in the degree of disparities in literacy skills among different education groups? Why are some countries more successful than others in providing high literacy skills, especially to the less educated, so that the variation in literacy skills is relatively narrow? Comparative research across a wide range of societies may provide some insight into structural factors that are responsible for the cross-national variation in the literacy gap by educational attainment. We particularly focus on two country-level factors that may explain the cross-national variation: *relevance of educational systems* and between-country differences in *opportunities of post-schooling experiences*.

## Educational System

In contemporary societies, home and school are probably the two most relevant places where individuals acquire literacy skills, especially when we consider young people for whom the impact of working experiences on literacy skills after schooling can be more or less controlled (OECD 2000). Therefore, once family background is held constant, school plays the pivotal role in affecting literacy skills of individuals. It is possible that even if individuals in two different countries have the same kind of formal educational attainment, they may differ considerably in literacy skills, depending on how their educational systems are effective in improving their literacy skills. Therefore, examining structural features of educational systems that significantly affect learning opportunities of individuals may offer insights into potential sources of cross-national differences in the literacy gaps among different educational groups. This focus is in line with a growing body of research that has highlighted the relevance of institutional arrangements of educational systems for mediating educational stratification processes (Kerckhoff 1995; Buchmann & Dalton 2002).

Many different aspects of educational systems may affect the distributions of literacy skills by educational attainment. We are particularly interested in the role that educational standardization plays as an institutional feature of educational systems. In highly standardized systems, students receive a standardized and uniform curriculum. There is also a high degree of standardization in instruction, teacher's training and quality. In a comparative study of 15 countries, Stevenson and Baker (1991) found that in countries with national control over curricular issues (thus the higher level of standardization), the coverage of the mathematics curriculum was more uniform across



classrooms in different schools than in countries with local control over curricular issues. Along with the supposedly uniform access to academic subjects across schools, standardized educational systems have greater uniformity of instruction and teacher's quality across schools within countries.

The high degree of standardization in educational processes facilitates setting up nation-wide standards of education that require students to master the specific levels of literacy skills at a given age. Standardization expands access to a core academic curriculum to all students. Therefore, countries with more standardized curricula are more likely to succeed in preventing low achieving students from falling too far behind through the consistent standard of teaching and learning. Examining the consequences of educational reforms that increased the degree of curriculum standardization in Scottish secondary education, Gamoran (1996) found a marked increase in overall educational attainment. He attributed this increase to increased student exposure to academic subjects associated with the curriculum reform. Along with the overall increase, Gamoran also found reduction in inequality within schools in educational attainment, which was attributable to the increase of exposure to a core academic curriculum among low-achieving students.

In contrast, in localized and non-standardized systems, students even within the same school often take different curricula, in varying pace of instruction, quantity of content coverage, and teacher quality, depending on their ability (Oakes et al. 1992). Literature in the United States has shown that the important consequence of this within-school tracking is that because of low quality of instruction, low expectation, motivation, and the potential stigma, low-track students achieve significantly less than they could in a

different track or in an untracked system (Gamoran & Mare 1989). It means that students, especially those of lower ability, are less likely to realize their academic potential in systems with a high degree of within-school differentiation in learning and teaching.

The expected relative success in maintaining the reasonable levels of literacy skills among low-achieving students in systems with high degrees of educational standardization suggests narrower gaps among students in the acquisition of literacy during years of school in the system, *ceteris paribus*. This expectation is on the assumption that literacy skills should not be substantially different among high achieving students across countries with different degrees of educational standardization. If anything, literacy skills of high-achieving students are expected to be higher in countries with non-standardized systems than in countries with highly standardized systems. The highly standardized systems may have less flexibility in offering tailored curricula for high-achieving students.

### Opportunities of Adult Education and Training

The acquisition of literacy skills is not one-time event that occurs only in schools. Not only formal schooling but also post-schooling experiences such as job experiences, participation in adult education and training programs may affect adults' literacy skills (Behrman et al. 2006; Hauser et al. 2005). The opportunities of post-school learning should be particularly important for adults with low levels of formal educational attainment. By participating in adult education and training programs, those low educated can increase their literacy skills, which may compensate for their low levels of formal educational attainment. We expect that highly educated people can afford various

opportunities of adult education and training and therefore the availability of additional education may not be of significance as much as to the low educated. In fact, countries significantly differ in the extent to which they offer adult education and training that particularly help those with low levels of education to develop their literacy skills.

Therefore, we can expect that countries providing greater opportunities of adult education and training for low educated should show narrower literacy gaps between those with low levels of educational attainment and those with high levels than do countries with limited opportunities of adult education and training.

## **Data and Measures**

### Data

The data for this study come from the International Adult Literacy Survey (IALS). IALS administered tests on three kinds of literacy skills: prose, document, and quantitative skills among adults aged 16-65 across 19 countries in 1994-98: Belgium (Flemish), Canada, Chile, the Czech Republic, Denmark, Finland, Great Britain, Germany, Hungary, Ireland, Italy, the Netherlands, New Zealand, Norway, Poland, Slovenia, Sweden, Switzerland, and the United States. Applying comparable and sophisticated designs and measurement instruments, IALS attempted to produce reliable and comparable measures of literacy skills among adult populations across a large number of countries (OECD 2000).

In this study, we restrict our sample to those aged 26 to 35 because of our focus on the level of educational standardization as a major country-level factor. By excluding those aged 25 or under, we include only those who most likely completed their

educational careers. We recognize the possibility of significant changes in educational standardization over the last decade in some specific countries, which force us to focus on younger cohorts. The information on the level of educational standardization across our 19 countries, obtained from various kinds of literature, should be more reliable and accurate for younger cohorts rather than older cohorts.

### Dependent Variables

In our analyses, the outcomes of interest are the respondents' scores on tests of document and quantitative literacy skills. Document literacy indicates "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" (OECD 2000: 10). Quantitative literacy pertains to "the knowledge and skills required to apply arithmetic operations, either alone or sequentially, to numbers embedded in printed materials, such as balancing a checkbook, figuring out a tip, completing an order form or determining the amount of interest on a loan from advertisement" (OECD 2000: 10). Each literacy skill was measured on a scale ranged from 0 to 500.

### Individual-level Independent Variables

The focal independent variable is the respondent's educational attainment, which was classified according to the International Standard Classification of Education (ISCED). We grouped respondents into three categories: less than high school completed (ISCED 0-2), high school completed (ISCED 3), and college education (ISCED 5-7). We

are primarily interested in the literacy gap between those with less than high school and those with college educations.

In the analyses, we control for several variables: gender, nativity, employment status, and parental education. We distinguish native-born from non-native and those with missing information. Employment status has three categories: employed, unemployed, and not-employed.<sup>1</sup> Similar to respondent's own education, parental education is classified into three categories: less than high school, high school, and tertiary education. Table 1 presents weighted descriptive statistics of all the variables used in the analyses for each country, separately.

TABLE 1 ABOUT HERE

### Country-Level Variables

Our major interest is the extent to which countries vary in the degree of literacy gaps according to their levels of educational standardization and the extent of opportunities of adult education and training. In order to examine the relationship, we need country-level variables as well as individual-level variables. To categorize educational systems according to their levels of educational standardization, we focus on whether educational matters such as curricula, textbooks, instruction methods, and teachers' training are determined at the national or local level. Literature shows that educational standardization is generally higher when the educational system is more controlled at the national level (Kerckhoff 2001). To obtain information on the location of educational decisions, we consulted various reference sources, including the

International Encyclopedia of National Systems of Education (Postlethwaite 1995) and the Eurydice website ([www.eurydice.org](http://www.eurydice.org)), which provides detailed descriptions of educational systems of European countries. We divided our 19 countries into two groups depending on their levels of educational standardization.

In order to assess the extent to which opportunities of adult education and training are given to the low educated, we directly calculated from the IALS data the percentage of the low educated who received any education or training since the last year. Note that we do not use the percentage of all respondents but the percentage of the low educated specifically. As stated, we expect that countries that offer additional education and training specifically to the low educated should have narrower literacy gaps between low and high educated.

Finally, we control for the country's economic level by including the GDP per capita in models. Since Heyneman and Loxely (1982, 1983), who showed differences in the effects of family and school factors on students' academic performance between developing and developed countries, researchers have extensively examined the role of the country's level of economic development in mediating educational stratification. Obtained from the Penn World Table, we used the GDP per capita in the year of 1995, which was expressed in 1996 international dollars.<sup>2</sup> We also included a squared term of the GDP per capita to test the non-linear effect of the economic level. Table 2 presents descriptive statistics of country-level variables as well as mean scores of document and quantitative literacy skills for each country, separately.

TABLE 2 ABOUT HERE

## **Analytic Approach**

### OLS Regression Models

We, first, estimate ordinary least square (OLS) regression models predicting each of document and quantitative literacy skills by educational attainment, other individual-level characteristics (gender, nativity, employment status, and parental education), country dummy variables, and interaction terms between each of country dummy variables and each of two dummy variables for educational attainment, using the pooled data across all 19 countries. Because country dummy variables absorb all observed and unobserved effects associated with a specific country, the model is equivalent to a fixed-effect model. By assessing the extent to which each country dummy variable and each interaction term between the country dummy variable and educational attainment are statistically significant, we can determine how the literacy level of the low educated in a specific country (as represented by the country dummy variable) and the literacy gaps between the low and high educated (as represented by the interaction term between college and the country dummy variable) in the country differ from the overall level of the low educated and the gap by educational attainment in the reference country.

### Hierarchical Linear Models

The fixed-effect models are useful for examining the extent to which countries vary in the overall level of literacy skills among the low educated and in literacy gaps by educational attainment. From the results, we can rank countries according to the degree of literacy gaps by educational attainment. However, the fixed-effect models do not statistically test whether the cross-national differences are related to between-country

differences in the levels of educational standardization and opportunities of adult education and training. For the purpose, we use two-level hierarchical linear models (HLM). Compared to the traditional technique of ordinary least square regression, the HLM explicitly takes into account the multilevel data structure that individuals are nested within countries (Bryk & Raudenbush 1992). In the HLM framework, literacy gaps among people with different levels of education, which are estimated in the individual-level equation within a country, become dependent variables in the country-level equation to be predicted by the degree of educational standardization, opportunities of adult education and training, and the economic level of country. Specifically, in student-level equation, the literacy score for a respondent  $i$  in country  $j$  is predicted as follows;

$$(\text{Literacy})_{ij} = \beta_{0j} + \beta_{1j}(\text{College})_{ij} + \beta_{2j}(\text{HS})_{ij} + \sum_3^k \beta_{kj} X_{kij} + r_{ij} \quad (1)$$

where  $\beta_{0j}$  represents the average literacy score of the low educated (i.e., less than high school) in country  $j$  adjusted for other individual-level characteristics included in the model.  $\beta_{1j}$  is the slope of the dummy variable of college in country  $j$ , which indicates the literacy gap between those with college and those with less than high school. Similarly,  $\beta_{2j}$  indicates the literacy gap between those with high school diplomas and those with less than high school, and  $r_{ij}$  is the individual-specific error. The effects of other individual-level control variables including gender, nativity, employment status, and parental education are represented through  $\beta_{3j}$  to  $\beta_{kj}$ .<sup>3</sup>

In the two-level HLM, the estimates derived from the first-level model become dependent variables at the second-level. Thus, the country-level equations are:



$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{Standardization})_j + \gamma_{02}(\text{Training})_j + \gamma_{03}(\text{GDP})_j + \gamma_{04}(\text{GDP}^2)_j + u_{0j} \quad (2)$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{Standardization})_j + \gamma_{12}(\text{Training})_j + \gamma_{13}(\text{GDP})_j + \gamma_{14}(\text{GDP}^2)_j + u_{1j} \quad (3)$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}(\text{Standardization})_j + \gamma_{22}(\text{Training})_j + \gamma_{23}(\text{GDP})_j + \gamma_{24}(\text{GDP}^2)_j + u_{2j} \quad (4)$$

$$\beta_{kj} = \gamma_{k0} \quad (5)$$

In order to examine how country-level variables influence the literacy gaps by educational attainment, we model the slope of college ( $\beta_{1j}$ ) to be predicted by educational standardization, the percentage of the low educated who received any adult education or training, the GDP per capital and its squared term, and random errors ( $u_{1j}$ ). The literacy gap between those with high school diplomas and those with less than high school, represented by  $\beta_{2j}$ , is modeled in the same way. We also model the intercept ( $\beta_{0j}$ ), which indicates the adjusted mean score of those with less education in country  $j$ , to be predicted by the four country-level variables. Finally, we do not allow the effect of other independent variables to vary across countries, given the limited number of the second-level unit.

## **Results**

### OLS Regression Models

TABLE 3 ABOUT HERE

Table 3 presents the results of OLS regression models of document and quantitative literacy skills. Without controlling for any other independent variables,

Model 1 shows the gross differences in literacy skills between those with less than high school (the reference category) and those with college education (dummy variable, College) and between those with less than high school and those with high school (dummy variable, High School). Because the United States is the reference country, the intercept of 177.3 for document literacy represents the average score of those with less than high school education in the United States. The coefficients of 92.8 for High School and 127.4 for College mean that the average score of high school graduates in the United States is higher by 92.8 points than the average score of those who did not graduate from high school. Similarly, college graduates in the United States show the average score on the document literacy test 127.4 points higher than the average score of their counterparts who did not graduate from high school. The result for quantitative literacy is very similar to the result for document literacy.

A country dummy variable indicates the difference in the average score of those with less than high school between the United States and a specific country. For instance, those with less than high school in Belgium score 86 points higher in document proficiency than their counterparts in the United States. The positive coefficients of all the country dummy variables indicate that the average score of those with less than high school is lowest in the United States.

Interaction terms between each country dummy variable and the dummy variable, College, indicate the extent to which the literacy gap between those with college education and those with less than high school in the specific country is different from the literacy gap in the United States. For instance, the coefficient of College\*Belgium (-71.1) means that the literacy gap between the low and high educated in Belgium is

smaller by 71 points than the corresponding gap in the United States. Because the literacy gap in the United States is 127 points, the literacy gap in Belgium is 56 points (127-71). The coefficients of interaction terms are all statistically significant and negative, indicating that the literacy gap between the low and high educated is largest in the United States.

Model 2 shows the results when other individual-level characteristics are taken into account. Controlling for those variables reduces the literacy gap between those with less than high school and those with college (also between those with less than high school and those with high school diploma) in the United States. The differences in the literacy gap by educational attainment between the United States and other countries are also reduced. For instance, after gender, nativity, employment status, and parental education are taken into account, the documentary literacy gap between the low and high educated in the United States is reduced from 127 points in Model 1 to 97 points in Model 2. The difference in the literacy gap between the United States and Belgium decreases from 71 points to 54 points. Now the literacy gap in Belgium becomes 43 points (97-54). The differences in the literacy gap between the United States and a country such as Canada, Slovenia, Chile (for quantitative literacy), and Hungary (for quantitative literacy) become non-significant in Model 2. However, note that although reduced, the differences between the United States and any other countries are still statistically significant, indicating the relatively larger gap in the United States.

FIGURE 1A ABOUT HERE

FIGURE 1B ABOUT HERE

To see more clearly the cross-national variation in the literacy gaps by educational attainment, we present two figures that show the average scores of the three educational groups within countries for document and quantitative literacy, respectively, on the basis of the results of Model 2. Countries are sorted in descending order according to the degree of the literacy gap between the low and high educated. Although slightly different, Figure 1A and Figure 1B show a similar order of countries in terms of the literacy gap. The four countries that show the largest gap in both document and quantitative literacy skills are the United States, Canada, Chile, and Slovenia, while Germany, Denmark, and the Netherlands show the narrowest gap in both literacy skills.

Interestingly, the order of countries in the degree of literacy gap seems to be consistent with the order of countries in terms of educational standardization as shown in Table 2. The three countries (United States, Canada, Chile) showing the largest gap have non-standardized systems, while the three countries showing the narrowest gap have highly standard systems of education. In order to formally test associations of the literacy gaps with the levels of educational standardization, and the availability of adult education and training, we now move to the results hierarchical linear models

### Hierarchical Linear Models

Table 4 and 5 present the results for document and quantitative literacy skills, respectively. In addition to the final model that includes all four country-level variables simultaneously, we also estimated three additional models that included only one country-level variable, separately. Because the results for document and quantitative

literacy skills are generally similar, we focus our discussion on the result for quantitative literacy in Table 5.

TABLE 4 ABOUT HERE

TABLE 5 ABOUT HERE

Models 1 through 3 show that each of educational standardization, the availability of education or training, and the economic level of country is significantly associated with the increased score of those with less than high school (effects on the intercept). Specifically, those low educated in standardized systems score on average 19 points higher than do their counterparts in non-standardized systems. Similarly, an additional percentage increase in the proportion of the low educated who received any education or training is associated with about one point increase in the average score of the low educated. Finally, as the level of economic development increases, the average score of the low educated increases non-linearly.

The increase in the average score of those with less than high school, associated with educational standardization, opportunities of education or training, and the economic level, results in the decrease in the literacy gap between those with less than high school and those with college or those with high school. Specifically, countries with standardized systems show the gap in quantitative skills between the low and high educated, which is 18 point smaller, than do countries with non-standardized systems. Countries with one percent higher percentage of the low educated who received education or training tend to have the smaller literacy gap between the low and high

educated by 0.6 points. Countries with higher levels of economic development tend to show the smaller literacy gap although the relationship is not linear. Once four country-level variables are included simultaneously in Model 4, the effects of country-level variables become somewhat weaker, although most of them remain significant. However, the effects of the availability of education or training on the literacy gaps by educational attainment become non-significant.

## **Conclusion**

In contemporary economies where information and knowledge are becoming more important, literacy skills, independent of formal educational attainment, are an essential asset for both the individual's and the society's economic prosperity. Literacy skills are also important for older people whose healthy aging likely depends on their ability to interpret health-related information and knowledge and apply them to their needs. In this regard, inequality of literacy skills should deserve more attention, besides formal educational attainment, occupation, or income, which studies of inequality have long focused on.

Our results reveal that although more educated individuals tend to have higher levels of literacy skills than do less educated individuals in all countries examined, countries significantly vary in the degree of literacy gaps by educational attainment. Our results of the fixed-effect models show that the literacy gap between the low and high educated is relatively large in the United States, Canada, Chile and Slovenia, while it is relatively small in Germany, the Netherlands, and Denmark. We can see the similar pattern of cross-national difference between document and quantitative literacy skills.

Our analyses, furthermore, reveal that the major reason for the relatively larger gap in the United States, Canada, and Slovenia than in Germany, the Netherlands, and Denmark is primarily attributable to the substantially lower level of literacy skills among the low educated in the former than the low educated in the latter. The cross-national variation in the level of literacy skills among the high educated is not substantial. In short, the major source of the cross-national variation in the literacy gap between the low and high educated is primarily driven by how countries are successful in maintaining reasonable levels of literacy skills among those with the lowest level of formal educational attainment.

We then move to hierarchical linear models in order to identify country-level factors that may account for the cross-national difference in the literacy gap by educational attainment. The results provide evidence that the cross-national variation in the literacy gap by educational attainment is, in part, accounted for by the levels of educational standardization. Countries that have more standardized educational systems tend to show a relatively small gap in literacy skills between the low and high educated. Although not directly tested, the finding is consistent with the expectation that the high level of educational standardization should prevent students with lower ability from falling too far behind through the consistent standard of teaching and learning. Note that countries vary mainly in terms of the level of literacy skills among those with the lower level of educational attainment.

Another factor that may explain some of the cross-national variation in the literacy gap by educational attainment is the extent to which countries offer opportunities of additional education and training for the low educated. The result supports the

expectation that the low educated should benefit from opportunities of additional education and training in increasing their levels of literacy skills and thus countries that offer greater opportunities should have smaller literacy gaps between the low and high educated.

The findings from this study provide important implications for policy efforts that address differentials in literacy skills among different educational groups. Considering that educational standardization and the provision of adult education and training could be modified to some extent by policy efforts, researchers and policymakers should pay more attention to the potentially positive impacts of these two macro-level factors for improving literacy skills of the low educated. Of course, using a cross-sectional, cross-national dataset, we are not in a position to ascertain the causal relationship between the two macro-level variables and the literacy gap (Raudenbush and Kim 2002). However, the systematic association found in this study suggests that future research, using better research designs and data, should continue to examine the roles of educational standardization and the provision of adult education and training.

In this study, we restricted our analysis to those of aged 26 to 35, considering potential variation across cohorts within countries in regard to educational systems. Gathering such information on specific changes in educational standardization during the last decades in each of 19 countries is challenging. Despite the difficulty, however, the research design that utilizes not only cross-national variation within a specific cohort but also variation across cohorts within countries would be more useful to assess the effects of educational standardization. Moreover, such research design will allow researchers to examine how the literacy gap by educational attainment varies across age groups,



addressing the issue of literacy gap as related to aging. In practical perspective, the combination of cohort and country increases the number of observations at the second level (e.g., 5 cohorts within a country X 19 countries = 95 observations compared to 19 observations used in the current study), which facilitates the multilevel analysis.

## ENDNOTES

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<sup>1</sup> The category of 'not employed' includes a very few of retired and students, and those with missing information as well as homemakers.

<sup>2</sup> Alen Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania, October 2002.

<sup>3</sup> Those control variables were centered around corresponding grand means.

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Table 1. Descriptive Statistics of Individual-level Variables

	Female	Educational Attainment			Nativity			Parental Education				Employment Status		
		LT HS	HS	College	Native	Nonnative	Missing	LT HS	HS	College	Missing	Employed	Unemployed	Notemployed
Belgium	0.50	0.26	0.41	0.33	0.96	0.03	0.01	0.49	0.24	0.19	0.08	0.81	0.09	0.10
Canada	0.50	0.23	0.38	0.39	0.85	0.15	0.00	0.38	0.32	0.25	0.05	0.71	0.07	0.21
Chile	0.49	0.49	0.29	0.22	0.99	0.01	0.00	0.67	0.17	0.09	0.07	0.64	0.10	0.26
Czech Republic	0.49	0.49	0.36	0.14	0.99	0.01	0.00	0.47	0.36	0.13	0.04	0.79	0.05	0.16
Denmark	0.49	0.19	0.53	0.29	0.99	0.01	0.00	0.25	0.49	0.26	0.00	0.78	0.06	0.16
Finland	0.49	0.15	0.60	0.25	0.96	0.04	0.00	0.40	0.32	0.27	0.02	0.76	0.09	0.15
Great Britain	0.51	0.54	0.23	0.24	0.90	0.10	0.00	0.68	0.06	0.13	0.13	0.74	0.10	0.16
Germany	0.53	0.57	0.27	0.16	0.95	0.05	0.00	0.72	0.10	0.10	0.08	0.63	0.08	0.29
Hungary	0.51	0.21	0.63	0.16	0.99	0.01	0.00	0.40	0.46	0.12	0.02	0.69	0.12	0.19
Ireland	0.51	0.46	0.33	0.21	0.92	0.08	0.00	0.70	0.13	0.09	0.08	0.65	0.10	0.25
Italy	0.50	0.45	0.44	0.11	0.96	0.04	0.00	0.76	0.18	0.07	0.00	0.71	0.08	0.21
Netherlands	0.50	0.29	0.48	0.23	0.91	0.09	0.00	0.57	0.24	0.15	0.03	0.74	0.06	0.21
Norway	0.48	0.08	0.60	0.32	0.91	0.09	0.00	0.27	0.44	0.26	0.02	0.83	0.05	0.12
New Zealand	0.52	0.47	0.25	0.29	0.66	0.15	0.19	0.36	0.12	0.21	0.31	0.57	0.05	0.37
Poland	0.49	0.56	0.26	0.18	1.00	0.00	0.00	0.72	0.17	0.10	0.02	0.70	0.13	0.18
Slovenia	0.49	0.23	0.55	0.22	0.91	0.09	0.00	0.46	0.39	0.11	0.03	0.89	0.06	0.04
Sweden	0.49	0.12	0.60	0.28	0.91	0.09	0.00	0.47	0.26	0.24	0.03	0.74	0.09	0.17
Switzerland	0.46	0.15	0.63	0.23	0.83	0.17	0.00	0.25	0.53	0.19	0.03	0.81	0.03	0.15
USA	0.55	0.14	0.43	0.43	0.81	0.18	0.02	0.18	0.42	0.31	0.08	0.79	0.05	0.16

Table 2. Country-Level Variables

	Mean score Document	Mean score Quantitative	Educational standardization	% of low educated who received any training or education since last year	GDP per capita (international \$)
Belgium	293	299	1	10.9	20915
Canada	292	291	0	24.9	22944
Chile	226	216	0	9.6	8487
Czech Republic	295	309	1	26.6	12909
Denmark	308	307	1	49.4	23661
Finland	310	300	1	37.4	18789
Great Britain	278	277	0	35.0	19610
Germany	295	301	1	16.1	21028
Hungary	259	276	1	11.7	8641
Ireland	266	270	0	16.6	17268
Italy	255	262	1	13.0	20292
Netherlands	299	298	1	33.5	20881
Norway	308	304	1	32.3	23890
New Zealand	275	275	0	40.1	17420
Poland	237	246	1	9.2	7282
Slovenia	251	259	1	18.4	12729
Sweden	319	317	1	42.8	20865
Switzerland	287	292	1	27.5	24535
USA	272	278	0	22.8	28410

Table 3. Regression Analysis of Literacy Skills

	Document Literacy		Quantitative Literacy	
	M1	M2	M1	M2
Intercept	177.293 ***	183.318 ***	187.854 ***	197.865 ***
Respondent's Education (reference: Less than High School)				
High School	92.733 ***	65.580 ***	84.797 ***	60.553 ***
College	127.416 ***	97.332 ***	125.427 ***	97.887 ***
Country (reference: USA)				
Belgium	86.314 ***	65.982 ***	82.037 ***	62.551 ***
Canada	56.380 ***	42.328 **	45.732 **	32.941 *
Chile	18.447 ^	-0.064	-10.709	-28.876 *
Czech Republic	98.678 ***	72.844 ***	100.652 ***	75.802 ***
Denmark	100.462 ***	72.569 ***	92.128 ***	66.126 ***
Finland	96.108 ***	72.970 ***	81.021 ***	60.080 ***
Great Britain	77.771 ***	63.162 ***	64.546 ***	50.757 ***
Germany	106.566 ***	90.122 ***	103.461 ***	87.673 ***
Hungary	43.315 **	21.759 *	39.944 **	20.833 ^
Ireland	61.706 ***	48.949 ***	54.390 ***	41.970 ***
Italy	51.025 ***	33.097 **	45.312 ***	27.647 *
Netherlands	89.433 ***	75.281 ***	78.564 ***	64.779 ***
Norway	83.980 ***	65.548 ***	76.130 ***	59.406 ***
New Zealand	71.639 ***	71.188 ***	61.346 ***	58.876 ***
Poland	35.239 **	14.750	33.948 **	14.167
Slovenia	21.280 ^	3.808	16.826	0.177
Sweden	101.213 ***	86.490 ***	90.489 ***	76.038 ***
Switzerland	44.358 **	37.794 **	46.447 **	41.149 **
High School*Country				
HS*Belgium	-66.057 ***	-44.171 ***	-64.017 ***	-44.266 **
HS*Canada	-37.368 *	-19.162	-26.954	-10.969
HS*Chile	-49.881 ***	-27.320 **	-28.803 *	-7.707
HS*Czech Republic	-61.630 ***	-40.144 ***	-51.514 ***	-30.977 **
HS*Denmark	-63.119 ***	-42.667 ***	-57.246 ***	-38.464 **
HS*Finland	-56.141 ***	-34.960 **	-54.034 ***	-35.708 **
HS*Great Britain	-57.435 ***	-37.291 **	-47.267 **	-30.599 **
HS*Germany	-74.647 ***	-50.207 **	-69.174 ***	-47.375 ***
HS*Hungary	-52.769 ***	-34.273 **	-31.950 *	-16.012
HS*Ireland	-47.930 ***	-28.067 **	-37.951 **	-20.060 *
HS*Italy	-48.517 ***	-28.146 **	-36.539 **	-17.565
HS*Netherlands	-50.482 ***	-33.382 **	-45.631 **	-30.020 **
HS*Norway	-52.779 **	-37.508 **	-53.100 **	-40.176 **
HS*New Zealand	-51.311 **	-22.575 ^	-43.823 **	-17.599
HS*Poland	-45.456 ***	-24.310 **	-36.506 **	-16.670
HS*Slovenia	-36.371 *	-20.043 ^	-25.160	-10.551
HS*Sweden	-54.961 **	-36.913 **	-51.171 **	-34.471 **
HS*Switzerland	-21.763	-17.244	-21.358	-18.349

College*Country				
College*Belgium	-71.073 ***	-53.900 ***	-64.555 ***	-48.292 **
College*Canada	-31.693 ^	-15.832	-33.658 ^	-19.390
College*Chile	-49.581 ***	-30.101 **	-22.344	-3.738
College*Czech Republic	-71.984 ***	-53.031 ***	-67.436 ***	-49.190 ***
College*Denmark	-76.532 ***	-56.089 ***	-82.136 ***	-63.096 ***
College*Finland	-68.737 ***	-49.140 ***	-75.307 ***	-58.059 ***
College*Great Britain	-63.742 ***	-42.920 ***	-58.780 ***	-40.221 **
College*Germany	-85.638 ***	-67.791 ***	-89.733 ***	-73.228 ***
College*Hungary	-47.549 **	-31.989 *	-33.261 *	-19.456
College*Ireland	-68.431 ***	-52.507 ***	-64.337 ***	-49.364 ***
College*Italy	-64.216 ***	-47.216 ***	-58.821 ***	-41.072 **
College*Netherlands	-74.228 ***	-60.604 ***	-68.754 ***	-56.147 ***
College*Norway	-55.854 **	-40.521 **	-58.838 **	-44.958 **
College*New Zealand	-71.821 ***	-42.409 ***	-70.987 ***	-43.944 ***
College*Poland	-58.352 ***	-40.796 ***	-58.245 ***	-40.740 **
College*Slovenia	-31.977 *	-20.503	-25.744	-13.840
College*Sweden	-62.853 ***	-50.734 ***	-61.323 ***	-49.502 ***
College*Switzerland	-37.216 **	-30.493 *	-47.886 **	-43.664 ***
Female		3.288		-2.956
Nativity (reference: Native)				
Nonnative		-47.950 ***		-45.815 ***
Missing native		-71.809 ***		-60.568 ***
Employment Status (reference: Not Employed)				
Employed		16.736 ***		15.511 ***
Unemployed		1.707		-4.334
Parental Education (reference: Less than High School)				
High School		17.860 ***		13.995 ***
College		20.218 ***		17.830 ***
Missing		-8.627		-6.617

\*\*\* p <.001 \*\* p <.01 \* p<.05 ^ p<0.1



Table 4. Hierarchical Linear Models of Document Literacy Skills

	Model 1	Model 2	Model 3	Model 4
<b>Student-Level Equation</b> ( <i>Effects of other student-level variables are not shown</i> )				
Intercept	270.071 (8.222) <sup>***</sup>	279.706 (3.758) <sup>***</sup>	279.708 (3.230) <sup>***</sup>	271.216 (0.976) <sup>***</sup>
College	66.292 (6.864) <sup>***</sup>	56.626 (3.100) <sup>***</sup>	56.646 (2.696) <sup>***</sup>	64.835 (3.070) <sup>***</sup>
High School	43.916 (4.049) <sup>***</sup>	35.934 (2.139) <sup>***</sup>	36.039 (2.007) <sup>***</sup>	43.293 (2.497) <sup>***</sup>
<b>Country-Level Equation</b>				
<i>Effects on the Intercept</i>				
Educational Standardization	14.340 (10.094)			12.483 (3.326) <sup>**</sup>
Availability of Adult Training/Education		1.253 (0.297) <sup>**</sup>		0.707 (0.263) <sup>*</sup>
GDP per capita (\$1,000 unit)			14.946 (2.773) <sup>***</sup>	11.308 (2.288) <sup>***</sup>
GDP per capita <sup>2</sup>			-0.386 (0.081) <sup>***</sup>	-0.298 (0.061) <sup>***</sup>
<i>Effects on the Slope of College</i>				
Educational Standardization	-14.313 (8.317)			-12.427 (4.804) <sup>*</sup>
Availability of Adult Training/Education		-0.304 (0.191)		-0.101 (0.249)
GDP per capita (\$1,000 unit)			-9.540 (2.673) <sup>**</sup>	-8.672 (2.676) <sup>**</sup>
GDP per capita <sup>2</sup>			0.283 (0.080) <sup>**</sup>	0.259 (0.074) <sup>**</sup>
<i>Effects on the Slope of High School</i>				
Educational Standardization	-11.778 (5.021) <sup>*</sup>			-10.972 (3.504) <sup>**</sup>
Availability of Adult Training/Education		-0.195 (0.150)		-0.103 (0.201)
GDP per capita			-5.174 (1.722) <sup>**</sup>	-4.311 (1.678) <sup>*</sup>
GDP per capita <sup>2</sup>			0.154 (0.054) <sup>*</sup>	0.129 (0.046) <sup>*</sup>

\*\*\* p < .001 \*\* p < .01 \* p < .05 ^ p < 0.1

Table 5. Hierarchical Linear Models of Quantitative Literacy Skills

	Model 1	Model 2	Model 3	Model 4
<b>Student-Level Equation</b> ( <i>Effects of other student-level variables are not shown</i> )				
Intercept	269.962 (8.679) <sup>***</sup>	282.656 (4.006) <sup>***</sup>	282.667 (3.454) <sup>***</sup>	270.984 (2.958) <sup>***</sup>
College	70.400 (7.862) <sup>***</sup>	58.468 (3.477) <sup>***</sup>	58.365 (3.129) <sup>***</sup>	69.260 (3.015) <sup>***</sup>
High School	45.447 (4.155) <sup>***</sup>	36.521 (2.504) <sup>***</sup>	36.533 (2.308) <sup>***</sup>	45.088 (2.030) <sup>***</sup>
<b>Country-Level Equation</b>				
<i>Effects on the Intercept</i>				
Educational Standardization	18.716 (9.915) <sup>^</sup>			17.118 (4.430) <sup>**</sup>
Availability of Adult Training/Education		0.953 (0.318) <sup>**</sup>		0.468 (0.249) <sup>^</sup>
GDP per capita (\$1,000 unit)			12.937 (3.119) <sup>**</sup>	10.135 (2.343) <sup>**</sup>
GDP per capita <sup>2</sup>			-0.340 (0.085) <sup>**</sup>	-0.268 (0.061) <sup>**</sup>
<i>Effects on the Slope of College</i>				
Educational Standardization	-17.619 (9.527) <sup>^</sup>			-15.970 (5.346) <sup>*</sup>
Availability of Adult Training/Education		-0.641 (0.275) <sup>*</sup>		-0.261 (0.291)
GDP per capita (\$1,000 unit)			-11.272 (4.025) <sup>*</sup>	-9.514 (3.737) <sup>*</sup>
GDP per capita <sup>2</sup>			0.310 (0.111) <sup>*</sup>	0.262 (0.099) <sup>*</sup>
<i>Effects on the Slope of High School</i>				
Educational Standardization	-13.137 (5.455) <sup>*</sup>			-12.715 (3.517) <sup>**</sup>
Availability of Adult Training/Education		-0.417 (0.209) <sup>^</sup>		-0.139 (0.258)
GDP per capita			-6.403 (2.208) <sup>*</sup>	-5.327 (2.261) <sup>*</sup>
GDP per capita <sup>2</sup>			0.168 (0.062) <sup>*</sup>	0.138 (0.058) <sup>*</sup>

\*\*\* p <.001 \*\* p <.01 \* p<.05 ^ p<0.1

Figure 1A. Differences in Document Literacy Skills by Educational Attainment (Age 26-35)

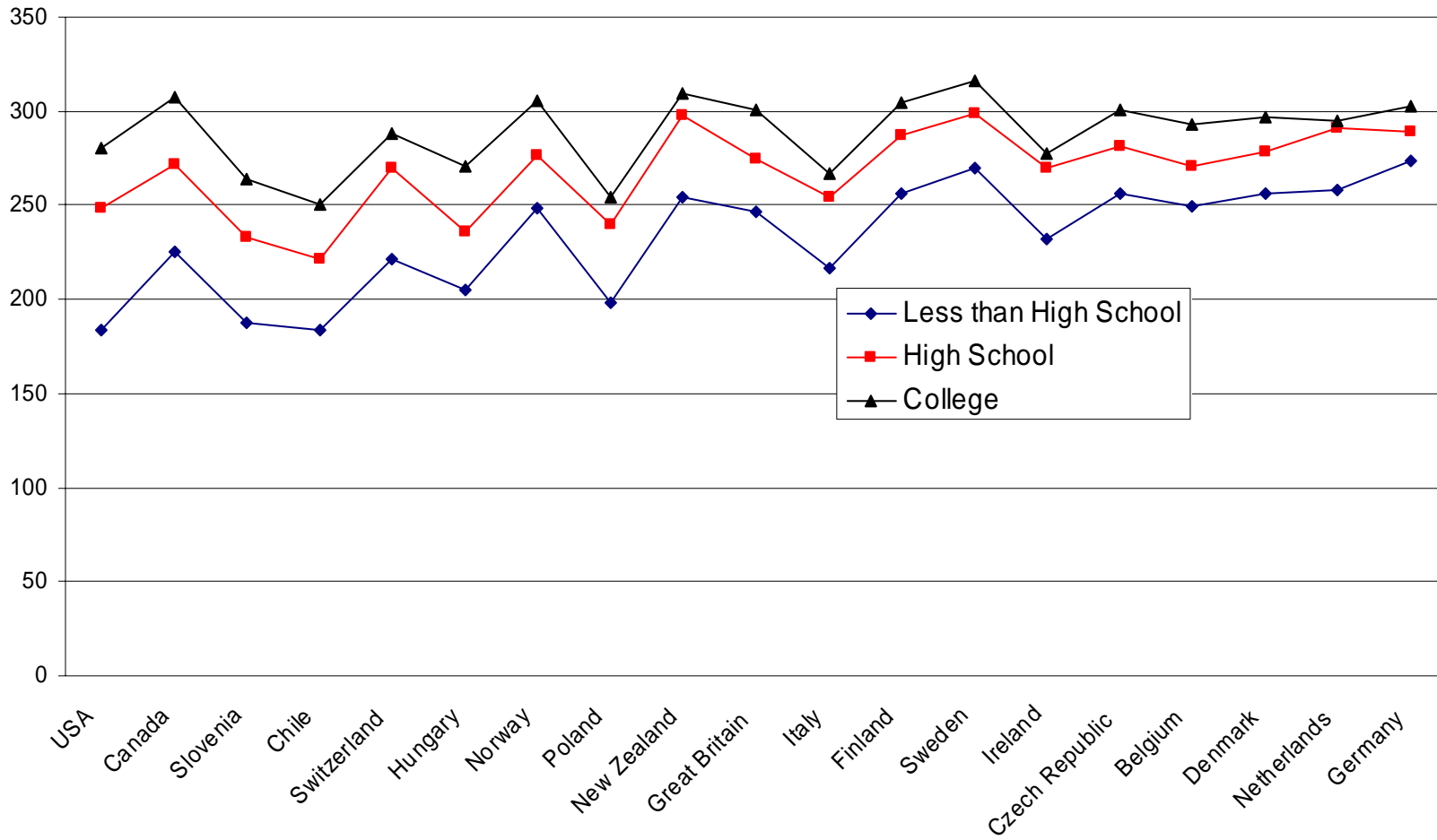


Figure 1B. Differences in Quantitative Literacy Skills by Educational Attainment (Aged 26-35)

