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Home literacy environments and children's reading performance: a comparative study of 25 countries

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Using data for 4th graders in primary schools from the Progress in International Reading Literacy Study (PIRLS), I compare across 25 countries the ways in which home literacy environments influence children's reading performance. Examined are three indicators: early home literacy activities, parental attitudes toward reading, and number of books at home. The Ordinary Least Squares (OLS) regression analyses show that the 3 measures of home literacy environments positively affect children's reading performance in almost all countries, while the strength of the effects varies substantially across countries. The extent to which the effect of parental education on children's reading is mediated by home literacy environment is only modest except for a few countries. Finally, multilevel models show that the effects of early home literacy activities and parental reading attitudes vary across countries according to their levels of economic development, while the effect of number of books shows the U-shaped relationship with the economic level.

Keywords: home literacy environments; early home literacy activities; parental attitudes toward reading; number of books at home; reading achievement; cross-national research

Background

Researchers have long been interested in sources of educational differences between children from poor and rich families. Cultural capital theory has extended our understanding of the ways in which cultural resources at home, independently from and interactively with financial resources of the family, enhance children's education (Bourdieu, 1973; De Graaf, 1986; DiMaggio, 1982). High levels of cultural resources that privileged parents possess and pass on to their child account for a significant portion of educational differences among students from different socioeconomic origins.

However, researchers often disagree on which kinds of cultural resources are more relevant for affecting children's education. The traditional view of cultural reproduction has emphasized parental participation in and knowledge on highbrow culture such as visiting museums, art galleries, or attending symphony concerts (Bourdieu, 1984; De Graaf, De Graaf, & Kraaykamp, 2000). Researchers in this line of research measure the levels of cultural capital by counting the degree of participation in high-culture activities.

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In comparison, a different perspective pays more attention to parental reading behaviors and other indicators of home reading climates than to parental participation in high culture as an important cultural resource that affects children's education. According to this perspective, what is important for developing children's language and cognitive skills, which ultimately leads to educational success, is how much parents stimulate the child's intellectual development by offering favorable reading climates at home (Crook, 1997; De Graaf et al., 2000; Farkas, 1996). For instance, De Graaf et al. found that in the Netherlands, parental reading habits had stronger effects on children's educational attainment than did parental participation in beaux arts.

Although not directly influenced by cultural capital theory, a great deal of research on child development especially in the USA has also highlighted the importance of home literacy environments that stimulate the development of the child's cognitive and language skills (Bradley, 1985; Farkas & Beron, 2004). Researchers have found substantial differences in home literacy environments between children from high and low socioeconomic families, which in turn explain educational differences between the two groups of children (Brooks-Gunn, Klebanov, & Duncan, 1996; Duncan, Brooks-Gunn, & Klebanov, 1994). In short, poor home literacy environments of low socioeconomic families are an important mechanism leading to educational disadvantages of children from poor socioeconomic backgrounds.

Despite the significant contribution of previous studies to understanding how cultural resources matter for children's education, there remains an important gap in the literature. Most of the studies looking at the effects of cultural resources have so far been single-country studies, primarily limited to Western advanced countries. We know little about to what extent countries vary in the effects of cultural resources and what explains such cross-national variation, if any. Are there systematic associations between the magnitude of the effects and any specific country-level factors? Examining how national contexts mediate the relationships between cultural resources and children's educational outcomes will help understand better the mechanism through which family's cultural resources reproduce educational inequality.

Research questions

In this paper, I aim to extend the literature on home literacy environments and children's education in two significant ways. First, I compare the roles that home literacy environments play for intergenerational transmission of educational inequality in 25 countries. It remains to be seen to what extent the positive effects of home literacy environments found in the USA and other Western countries are generalized to other countries that have different social contexts of education. Moreover, I examine the extent to which home literacy environments mediate the effects of socioeconomic background on children's education. To what extent do high socioeconomic status (SES) parents maintain favorable literacy environments, which explain the positive effects of SES on children's education? How do countries differ in the strength of the relationship between SES and home literacy environments?

Second, I simultaneously examine three different aspects of home literacy environments: parental reading attitudes, parental engagement with the child in various literacy activities, and the number of books at home. Although related to each other, they may represent different ways in which parents foster their children's literacy skills. For instance, parents' own reading behavior may not necessarily reflect the degree to which they actually engage with their child in various literacy activities to foster children's literacy skills.

It would be interesting to examine relative effects on children's reading performance of the mere reading habit of parents themselves and the degree of actual involvement in interaction with their child. Examining the effect on occupational attainment, a recent comparative study exclusively focused on the number of books at home during childhood (Evans, Kelly, Sikora, & Treiman, 2005). Evans et al. conceptualized the number of books at home as a reflection of parents' scholarly culture but did not consider other aspects of home literacy environments. Therefore, as far as I know, the current study is the first to consider simultaneously the three different aspects of home literacy environments in cross-national comparative perspective.

Economic development and cross-national variation in the effects of home literacy environments

Beyond descriptions on the effects of home literacy environments in each country separately, I assess whether there is a systematic association between the effects of home literacy environments and the country's economic development level. Of course, other country-level factors, beside economic development, may also affect the relationship between home literacy environments and children's education. According to recent studies (Park, 2005), institutional characteristics of educational systems such as stratification of school systems and curriculum standardization mediate the influence of family's SES on student reading achievement. It would be interesting to see how such institutional arrangements affect the relationship between children's education and home literacy environments as well as family's SES. Another interesting factor to be considered is the impact of the political regime. Are strong welfare countries or socialistic countries, which have placed emphasis on social equality, more successful in reducing differences in home literacy environments among students from varying socioeconomic origins (cf. Ganzeboom, De Graaf, & Robert, 1990)? Therefore, the exclusive focus on the economic development level is a major limitation of this study.

But, on the other hand, the economic level of a country is a major factor that comparative education literature has long focused on. Exploring how the economic development of a country modifies the relationships among family, school, and educational achievement, for instance, Heyneman and Loxley (1982, 1983) found that family socioeconomic background was more important than school factors in determining children's academic performance in economically developed countries, while the opposite pattern was found in developing countries. Baker, Goesling, and LeTendre (2002) also concentrated on the role of economic development when they compared the effects of family and school factors across countries using more recent data.

In this aspect, I follow the long-standing focus of comparative education literature on economic development. However, I extend previous literature in that I look at the linkage between economic levels and cross-national differences in the strength of effects of *home literacy environments*. The aspect of family background that previous studies examined was mainly family SES, usually measured by parental education and/or parental occupation. The effect of economic development on home literacy environments as an independent dimension of family background separated from SES has not been systematically examined yet.

The lack of cross-national research on home literacy environments makes it difficult to develop specific hypotheses on how economic development shapes the effect of home literacy environments on children's education. However, research on the relative effects of family income and parenting style (including parent's engagement with the child in various

literacy activities and parent-child communication) in economically developed countries is useful to formulate possible predictions on the effect of economic development. Examining the effects on children's outcomes in the USA, Mayer (1997) argues that, once the basic material needs of children are met through governmental welfare support, additional improvement in family income would do little to affect children's outcomes. Instead, cross-family variation in parenting style, which is only weakly correlated with family income, would explain a significant portion of differences in children's outcomes.

If Mayer's (1997) finding in the USA can be generalized to other economically developed countries where governments' welfare interventions have removed extreme economic deprivation of their children, home literacy environments are expected to matter more for children's education in economically developed countries than in developing countries. In developing countries, rather than home literacy environments, material resources necessary for meeting the basic needs of children should have greater effects on children's education. In terms of the specific form of the relationship between levels of economic development and the strength of home literacy environment effects, however, it remains to be seen whether the relationship is linear or nonlinear.

Data

For this study, I use data on student achievement in reading from 25 countries that participated in the Progress in International Reading Literacy Study (PIRLS) 2001 (Mullis, Martin, Gonzales, & Kennedy, 2003). PIRLS assessed reading achievement of the fourth graders in primary schools and collected extensive information on students' family and school experiences (student questionnaire), family socioeconomic conditions, and parental engagement with the child in various literacy activities (parent questionnaire), and various school characteristics and instructional practices (school questionnaire answered by school administrators). Based on a two-stage stratified cluster design, schools were selected with probability proportional to size. Then, one intact classroom for the fourth grade was chosen randomly within each selected school. All students in the chosen class were selected for a reading test.[1]

Originally, 35 countries participated in PIRLS 2001. But I had to exclude 11 countries where home literacy environment measures and parental education, which are key variables for the present analysis, were not available at all or were missing for significant proportions of respondents (more than 30% of total respondents). After deleting cases with missing information on major variables, I ended up with a total of 98,190 respondents across 25 countries.

The major advantage of PIRLS over other international surveys of student achievement (such as the Third International Mathematics and Science Study) is that it collected information on various aspects of home literacy environments. The number of books at home, which is one of the three measures of home literacy environments used in the present analysis, was often gathered in previous international surveys of student achievement. However, PIRLS is unique in providing the other two measures of home literacy environments (early home literacy activities and parental reading attitudes).

Despite the significance of PIRLS for research on cultural resources and children's education, some limitations should be addressed as well. PIRLS did not collect information on parental participation in and/or knowledge on high-brow culture. Therefore, it is impossible to compare the relative importance of high-brow cultural activities and home literacy activities within countries and to examine cross-national variation in this aspect.

Measures

Home literacy environments

A parent or guardian of the child was asked to indicate how often he/she or someone else in the home engaged in the following activities with the child before the child entered primary school: read books, tell stories, sing songs, play with alphabet toys, play word games, or read aloud signs and labels. Each item was based on a 3-point scale: *never or almost never* (1), *sometimes* (2), and *often* (3). I constructed the index of *Early Home Literacy Activities* by averaging the responses on the six items (or non-missing items). Ranged from 1 to 3, higher values of the index indicate higher levels of parental engagement with the child in literacy activities.

Parents were also asked whether they would agree with the following statements about their own reading attitudes: I read only if I have to, I like talking about books with other people, I like to spend my spare time reading, I read only if I need information, and reading is an important activity in my home. Each item is based on a 4-point scale: *disagree a lot* (1), *disagree a little* (2), *agree a little* (3), and *agree a lot* (4). After reversing the scale for negative statements (i.e., I read only if I have to and I read only if I need information), I computed the average score on the five items to create the index of *Parent's Attitude Toward Reading*. Ranged from 1 to 4, higher values of the index indicate more positive attitudes toward reading.

The student was asked the *number of books at home*. The same question was also asked to the parent in a home questionnaire. Because students' reports are more comprehensive than parents' reports, I use the number of books at home as reported by students. But if the student's report is missing, I substitute the parent's report for it. For both students' and parents' reports, the response was based on a 5-point scale: 0 ~ 10 books (1), 11 ~ 25 (2), 26 ~ 100 (3), 101 ~ 200 (4), and more than 200 (5). For the analysis, the linear form (from 1 to 5) of the variable is used.

Reading achievement

A major outcome of analysis in this study is the student's reading test score. The score was scaled to have a mean of 500 points and a standard deviation of 100 points for all students across countries that participated in PIRLS 2001. Instead of a fixed value of reading achievement for each student, PIRLS provides five plausible values for each student estimated on the basis of the Item Response Theory (IRT) method.[2] Following the recommendation by the user guide for PIRLS 2001 (Gonzales & Kennedy, 2003), I analyze the five plausible values simultaneously to obtain estimates of population parameters.

Socioeconomic background and other individual characteristics

To measure students' socioeconomic background, I use parental education and the location of the school the student attends. Parental education indicates the higher level of educational attainment between father's and mother's education. Originally, five levels of educational attainment were distinguished: less than lower secondary, completed lower secondary, completed upper secondary, completed post-secondary but not university, and completed university or higher. Because in several countries the number of students whose parents had less than lower secondary education was so small, I combined it with the category of completed lower secondary. For the same reason, I combined the category of completed post-secondary but not university with completed university or higher. In the

end, three different levels of education are compared: completed lower secondary or less, completed upper secondary, and completed tertiary. School location is identified through school principles' reports on whether their school was located at the urban, suburban, or rural area.

I include gender, the number of children, family structure, and language minority status in the models. Comparative studies of student achievement have documented significant advantage of female students in reading achievement almost in every country (Organisation for Economic Co-operation and Development, 2001). The negative relationship between the number of siblings and a child's education is well established across a variety of societies (Powell, Werum, & Steelman, 2004). PIRLS did not ask directly the number of siblings but only the number of children in the home. Considering literature on the effects of family structure on children's education (McLanahan & Sandefur, 1994), in this study I distinguish one-adult families and two- or more-adult families. PIRLS did not collect information on whom the student lived with but only on the number of adults living together with the student. It is not possible to identify whether two adults living together with the child are the two parents. Language minority status has also received attention from researchers as an important factor for educational differences (Schmid, 2001). I distinguish between those who speak the language of the test at home always or almost always and those who do not. Descriptive statistics for these individual-level variables are presented in Appendix 1.

Methods

I use two different methods for multivariate analyses. I first conduct Ordinary Least Squares (OLS) regression analyses for each country, separately, to predict students' reading scores by the three measures of home literacy environments, socioeconomic background, and other control variables. Given that the dependent variable, the reading score, is continuous and its distribution is close to be normal, the OLS regression is appropriate. Of course, to produce appropriate standard errors of estimates, the complicated survey design employed in PIRLS should be taken into account. Statistical software, AM, provided by the American Institute of Research, has a capacity to deal with complicated samples from large-scale surveys, as well as to analyze five plausible values simultaneously.[3]

After assessing the effects separately across countries, I apply a multilevel model technique to the pooled data across all 25 countries (Bryk & Raudenbush 1992). Two-level models, which treat the student as the first-level unit and country as the second-level unit, are particularly useful to assess the extent to which the effects of home literacy environments vary across countries and statistically test whether the cross-national variation depends on the economic level of countries. I estimate the two-level model for each indicator of home literacy environment, separately.

For the model of the index of early home literacy activities, the student-level equation predicting the reading score for student i in country j is specified as:

$$(\text{Reading literacy})_{ij} = \beta_{0j} + \beta_{1j}(\text{Index of Early Home Literacy Activities})_{ij} + \sum_{2}^{k} \beta_{kj} X_{kij} + r_{ij}$$

where, the intercept, β_{0j}, represents the mean reading score in country j adjusted for differences among countries in student characteristics included in the model (all the

student-level variables are centered around grand means). β_{1j} is the slope of the index of early home literacy activities in country j and r_{ij} is the student-specific error. The effects of parental education and other student-level variables are represented through β_{2j} to β_{kj}.

In two-level models, the coefficients in the first-level equation serve as dependent variables in the second-level equation. Thus, the country-level equations are:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{GDP per capita})_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{GDP per capita})_j + u_{1j}$$

$$\beta_{kj} = \gamma_{k0} + u_{kj}$$

I model the slope of early home literacy activities (β_{1j}) to be predicted by the country's economic level (gross domestic product [GDP] per capita) and random errors (u_{1j}).[4] γ_{11} indicates the impact of GDP per capita on the slope of the index of early home literacy activities, while γ_{10} indicates the average slope of early home literacy activities for countries with GDP per capita corresponding to the average among the 25 countries (i.e., GDP per capita is centered around the grand mean). Each country's mean score of reading (β_{0j}) is also modeled to vary across countries as a function of GDP per capita. γ_{k0} represents the overall effect of the kth control variable at the student level, and u_{kj} indicates a random error. The same specifications described for the index of early home literacy activities are applied to the separate models for the index of parental attitudes toward reading and the model for the number of books.[5]

Results

Levels of home literacy environments

Table 1 presents national averages of the three measures of home literacy environments along with mean scores of reading achievement and GDP per capita. Countries are arranged in descending order of the national average of number of books at home. Remember that the number of books was measured on a 5-point scale: 0 ~ 11 books (1), 11 ~ 25 (2), 26 ~ 100 (3), 101 ~ 200 (4), and more than 200 books (5). Sweden (3.717) shows the highest average of number of books, followed by Norway and Iceland. Iran, Columbia, Argentina, and Turkey show the lowest averages.

The next column in the table presents the national averages of the index of parental attitudes toward reading. Higher values of the index indicate more positive attitudes toward reading. Top-three countries showing the most positive attitude are Hungary, Norway, and Sweden, whereas Turkey, Moldova, and Romania show the lowest averages. Note, however, that the averages for those lowest countries are 2.8. In other words, even in those lowest countries, parents of fourth graders, on average, agree a little (3 points) on a statement such as, ''reading is an important activity in my home'' (*disagree a lot* (1), *disagree a little* (2), *agree a little* (3), *agree a lot* (4)).

The fourth column shows the national averages of the index of early home literacy activities. The index indicates the average extent of parental engagement with the child in six literacy activities before primary school (*never or almost never* (1), *sometimes* (2), *often* (3)). Parents in New Zealand, Russia, and Canada are more likely to be engaged in literacy activities for the child than their counterparts in other countries. Parents in Iran, Turkey, and Singapore show the lowest level of parental engagement. Similar to the index of parental attitudes toward reading, it is interesting to see that even in those countries with

Table 1. National averages of home literacy environment measures.

	Number of Books at Home	Parental Attitudes toward Reading	Early Home Literacy Activities	Mean Score of Reading	GDP per capita (PPP $)	Number of Students
Sweden (SWE)	3.717 (1.098)	3.346 (0.688)	2.174 (0.373)	561 (96)	25400	5483
Norway (NOR)	3.598 (1.117)	3.371 (0.673)	2.217 (0.363)	499 (83)	31800	3104
Iceland (ISL)	3.536 (1.092)	3.267 (0.620)	2.275 (0.355)	512 (72)	27100	3065
Latvia (LVA)	3.500 (1.137)	3.073 (0.571)	2.347 (0.375)	545 (81)	8300	2886
Hungary (HUN)	3.447 (1.252)	3.377 (0.623)	2.352 (0.364)	543 (65)	13300	4445
Czech Republic (CZE)	3.386 (1.067)	3.214 (0.649)	2.281 (0.342)	537 (70)	15300	2666
Canada (CAN)	3.378 (1.154)	3.261 (0.655)	2.409 (0.387)	544 (67)	29400	6863
New Zealand (NZL)	3.372 (1.210)	3.271 (0.707)	2.440 (0.399)	529 (73)	19500	2086
France (FRA)	3.220 (1.180)	3.077 (0.630)	2.286 (0.392)	525 (66)	25700	3173
Slovak Republic (SVK)	3.207 (1.105)	3.274 (0.640)	2.329 (0.355)	518 (75)	12200	3687
Bulgaria (BGR)	3.139 (1.473)	3.098 (0.788)	2.343 (0.471)	550 (92)	6600	3301
Singapore (SGP)	3.113 (1.175)	2.927 (0.656)	2.161 (0.433)	528 (71)	24700	6860
Slovenia (SVN)	3.099 (1.147)	3.209 (0.618)	2.364 (0.352)	502 (62)	18000	2859
Russia (RUS)	3.084 (1.218)	3.054 (0.678)	2.412 (0.406)	528 (64)	8800	4040
Germany (DEU)	3.069 (1.182)	3.041 (0.780)	2.183 (0.381)	539 (103)	26600	6656
Greece (GRC)	2.996 (1.174)	3.252 (0.722)	2.345 (0.419)	524 (75)	19000	2175
Lithuania (LTU)	2.902 (1.097)	2.940 (0.693)	2.228 (0.386)	543 (93)	8400	2471
Italy (ITA)	2.827 (1.225)	3.089 (0.742)	2.381 (0.392)	541 (81)	25000	3394
Macedonia (MKD)	2.380 (1.151)	3.084 (0.662)	2.394 (0.413)	442 (90)	5000	2877
Romania (ROM)	2.369 (1.262)	2.821 (0.750)	2.278 (0.472)	512 (66)	6800	3534
Moldova (MDA)	2.183 (1.196)	2.782 (0.662)	2.176 (0.430)	492 (92)	3000	3466
Turkey (TUR)	2.060 (1.115)	2.782 (0.698)	1.994 (0.477)	449 (70)	7000	4988
Argentina (ARG)	2.027 (1.157)	2.868 (0.686)	2.245 (0.468)	420 (72)	10200	2332
Colombia (COL)	1.983 (1.152)	2.975 (0.737)	2.185 (0.470)	442 (66)	6300	4637
Iran (IRN)	1.788 (1.106)	3.000 (0.663)	1.843 (0.493)	414 (86)	7000	7142

Note: Countries are arranged in descending order of the national average of number of books at home. Values in parantheses are standard deviations.

the lowest averages, parents show a fairly high level of engagement with the child in literacy activities. The averages of 1.84 in Iran and 1.99 in Turkey indicate that even in the two countries with the lowest level, the average level of parental engagement is close to "sometimes."

Comparing top and bottom countries in each home literacy environment measure reveals some relationship between the average level of home literacy environment and the national economic level. For instance, the top-three countries in the number of books are highly developed countries, while the bottom-seven countries (except Argentina) are economically poor countries. Correlations among variables at the national level reveal the relationship clearly. Although the correlation between GDP per capita and the index of early home literacy activities among 25 countries is relatively weak ($r = 0.17$), correlations of GDP per capita with the number of books ($r = 0.65$) and with the index of parental attitudes toward reading ($r = 0.58$) are fairly strong. In short, home literacy environments tend to be more favorable in more developed countries. The index of early home literacy activities ($r = 0.52$), the index of parental attitudes toward reading ($r = 0.46$), and the number of books at home ($r = 0.83$) also show considerably positive relationships with the

national average score of reading, indicating that countries with more favorable literacy environments tend to show better average performance in reading.

Mediating the effects of parental ducation

In order to assess the extent to which home literacy environments mediate the effects of socioeconomic background on children's education, I examine how the reading gap between students whose parents had tertiary education and those whose parents did not complete upper secondary education changes after controlling for each measure of home literacy environments. For this purpose, I estimate five different models for each country separately. The first model (Model 1) includes parental education and other individual characteristics but not any home literacy environment measures. The reading gap between students having parents with tertiary education and those having parents with less than upper secondary education estimated from Model 1 serves as the baseline difference. In Model 2, the index of early home literacy activities is added to Model 1. Thus, comparing Model 1 and Model 2 shows the extent to which the effect of parental education is accounted for by the difference in parental engagement in literacy activities with the child between parents with high and low levels of educational attainment. Models 3 and 4 add the index of parental attitudes toward reading and the number of books, respectively, to Model 1. The final model (Model 5) adds all the three measures of home literacy environments to Model 1.

Table 2 presents the reading gaps by parental education across the five models in each country. Among the 25 countries, Hungary shows the largest reading gap (77 points) between students whose parents had tertiary education and their counterparts whose parents did not complete upper secondary education, after controlling for demographic and other individual characteristics. The gap is reduced to 75 points, 66 points, and 63 points when the index of early home literacy activities, the index of parental reading attitudes, and the number of books at home, respectively, are added to the model. When all the three measures are included, the reading gap is reduced by 25% from 77 points in Model 1 to 57 points in Model 5.

Although not universal across all the countries, the mediating role of the index of early home literacy activities is rather weak compared to the index of parental reading attitudes and the number of books in many countries. Except for a few countries, controlling for the index of early home literacy activities reduces the effect of tertiary education only by less than 10%. Moreover, in many countries, the reduction in the reading gap by parental education seems rather modest even after controlling for all the three measures of home literacy environment (less than 30% from Model 1), although the reduction is fairly substantial in Moldova (55%), Romania (51%), Russia (51%), and Bulgaria (43%). Except for Russia, the reading gap by parental education remains significant in all countries, even after controlling for all three measures of home literacy environments. The results indicate that, although differences in home literacy environments between high- and low-educated parents account for, to some extent, the reading gap by parental education, a significant proportion of low-educated parents in many countries show a fair level of home literacy environments as indicated by the three measures used in this study.

Effects of home literacy environments

Now I move to examine the independent effects of the home literacy environment on children's reading performance in each country. Table 3 displays changes in the reading

Table 2. Reading gaps between students whose parents completed tertiary and did not complete upper secondary education.

	Model 1 *control variables*	Model 2 *Model 1 + EHLA*	Model 3 *Model 1 + PATR*	Model 4 *Model 1 + BOOK*	Model 5 *Model 1 + EHLA + PATR + BOOK*	% reduction between M1 and M5
Hungary	76.5	75.1	66.5	63.2	57.4	25
Iran	74.5	68.1	70.3	64.5	57.8	22
Slovak Republic	74.4	73.5	66.4	56.7	52.7	29
Slovenia	74.0	70.6	63.0	63.5	54.7	26
Singapore	73.5	66.8	70.5	60.7	55.8	24
Norway	70.5	63.7	64.3	59.9	52.7	25
Argentina	69.6	65.3	65.4	55.8	51.4	26
New Zealand	69.5	69.7	52.7	58.3	42.4	39
Greece	62.4	57.0	56.9	55.0	48.6	22
Romania	60.7	54.2	50.7	36.2	29.8	51
Czech Republic	59.9	59.0	52.0	44.0	40.0	33
Bulgaria	57.7	50.8	46.8	41.7	33.1	43
Iceland	54.9	51.1	51.6	49.1	44.9	18
France	54.8	52.8	48.4	43.8	39.9	27
Macedonia	49.1	48.5	45.1	45.5	42.5	13
Canada	46.5	42.4	39.4	39.4	34.0	27
Sweden	46.1	43.3	37.0	36.5	30.1	35
Italy	45.0	43.6	35.6	37.6	30.3	33
Germany	44.9	44.6	34.6	33.1	27.3	39
Moldova	43.1	32.8	34.2	27.9	19.5	55
Latvia	42.9	42.2	40.3	38.6	37.0	14
Lithuania	41.6	41.0	37.4	34.6	31.8	23
Columbia	41.2	40.9	39.2	30.0	28.8	30
Turkey	36.6	34.6	33.0	27.9	23.8	32
Russia	20.8	13.5	17.0	17.4	10.3	51

EHLA: Index of Early Home Literacy Activities; PATR: Parental Attitudes toward Reading; BOOK: Number of Books at Home.

Note: Countries are arranged in descending order of the size of reading gap by parental education as in Model 1.

score per unit change in each measure of home literacy environments. The second column presents the effect of the index of early home literacy activities, which has three values to indicate the level of parental engagement in literacy activities: 1 for *never or almost never*, 2 for *sometimes*, and 3 for *often*. Therefore, one unit increase in the index corresponds to a change from the response of *never or almost never* to the response of *sometimes*, or the response of *sometimes* to the response of *often*. For example, in New Zealand, children whose parents were engaged *often* with them in literacy activities have a 39-point higher average score on reading than those whose parents were engaged *sometimes*. In turn, children whose parents were engaged *sometimes* have a 39-point higher average than those whose parents were *never or almost never* engaged.

In Table 3, countries are sorted in order of the effect of early home literacy activities. Top-five countries in the magnitude of the effect are New Zealand, Norway, Greece, Canada, and Iceland. Columbia, Slovak Republic, Germany, Macedonia, and Lithuania show the weakest effect of early home literacy activities. Early home literacy activities do not significantly contribute to increasing children's reading performance in Columbia and

Table 3. The effects of home literacy environments on reading performance (OLS regression).

	Early Home Literacy Activities	Parental Attitudes toward Reading	Number of Books at Home
New Zealand	39.3	28.1	16.8
Norway	34.6	13.6	11.7
Greece	32.7	13.1	9.5
Canada	28.2	16.5	12.6
Iceland	28.0	9.0	9.2
Slovenia	24.1	19.1	9.4
Iran	23.5	13.5	9.1
Singapore	23.5	11.6	17.7
Moldova	21.5	14.7	16.1
Argentina	19.1	10.3	11.9
Latvia	18.6	9.9	5.8
Sweden	17.1	14.4	11.4
Russia	16.9	6.2	4.9
Czech Republic	16.7	16.3	11.9
Romania	16.3	12.6	17.1
Hungary	15.7	14.7	9.8
Bulgaria	15.6	11.8	9.4
Turkey	14.3	14.8	13.7
France	13.7	16.9	12.0
Italy	13.6	17.5	8.8
Lithuania	12.8	9.1	10.0
Macedonia	12.6	14.9	6.3
Germany	12.3	16.9	15.4
Slovak Republic	6.2	11.6	10.5
Columbia	1.9	5.7	11.2

Note: Countries are arranged in descending order of the effect of early home literacy activities.

the Slovak Republic, once parental education and other individual characteristics are taken into account.

The third column in Table 3 presents the effect of the index of parental attitudes toward reading, measured by changes in the reading score per unit change in the index. Indicating the degree to which parents agree to positive statements on reading behaviors, the index has values from 1 to 4 (*disagree a lot, disagree a little, agree a little*, and *agree a lot*). Therefore, one unit increase in the index indicates the difference between two consecutive categories. In Slovenia, which shows the second largest effect, the reading gap associated with one-level increase in parental reading attitudes is 19 points. In Columbia, which has the weakest effect, the gap is 6 points. The index of parental attitudes toward reading is significantly associated with children's reading performance in all 25 countries.

The final column in the table shows the effect of the number of books at home on children's reading performance. Note that the number of books was originally measured on a 5-point scale: 0 ~ 11 books (1), 11 ~ 25 (2), 26 ~ 100 (3), 101 ~ 200 (4), and more than 200 books (5). Because I use it as a continuous variable with values from 1 to 5, the meaning of one unit increase in the number of books is not so straightforward. Singapore shows the strongest effect (18 points by one unit increase in the number of books), while Russia has the weakest effect (5 points). The effect is significant in all 25 countries.

Because of different units of measurement, it is difficult to assess the relative effects among the three measures of home literacy environments. To facilitate the comparisons, I rescaled each variable so that the mean and the standard deviation of it becomes 0 and 1, respectively, for all students in the 25 countries. Thus, one unit increase in each variable of home literacy environments corresponds to one standard deviation increase. Now, the effect of each measure is presented by change in the reading score per one standard deviation increase in each measure of home literacy environments. Furthermore, because the variables were rescaled to have a mean of 0 and a standard deviation of 1 across all students in the 25 countries, the effects are directly comparable across countries.

Figure 1 depicts the effects of the three home literacy environment measures in each country as changes in the reading score per standard deviation change. Note that the effects were derived from models that included all three measures at the same time in addition to parental education and other individual variables. Although not universal, the overall pattern is the relatively stronger effect of number of books than those of early home literacy activities and parental attitudes toward reading. It is the case for 20 out of 25 countries.

Economic level and cross-national variation in the effects

The results in Table 3 reveal substantial variations across countries in the effects of home literacy environments. To assess the extent to which the effect of each measure of home literacy environments varies according to the country's economic development level, I use the two-level model technique. In Table 4, the effects of other student-level variables, besides home literacy environments, are not presented for simplicity of presentation. In the second column for the index of early home literacy activities, the average within-country effect of early home literacy activities is 19.012 for countries with an average GDP per capita (grand-mean centering). The cross-level interaction term between the effect of early home literacy activities and GDP per capita is significantly positive, indicating that the

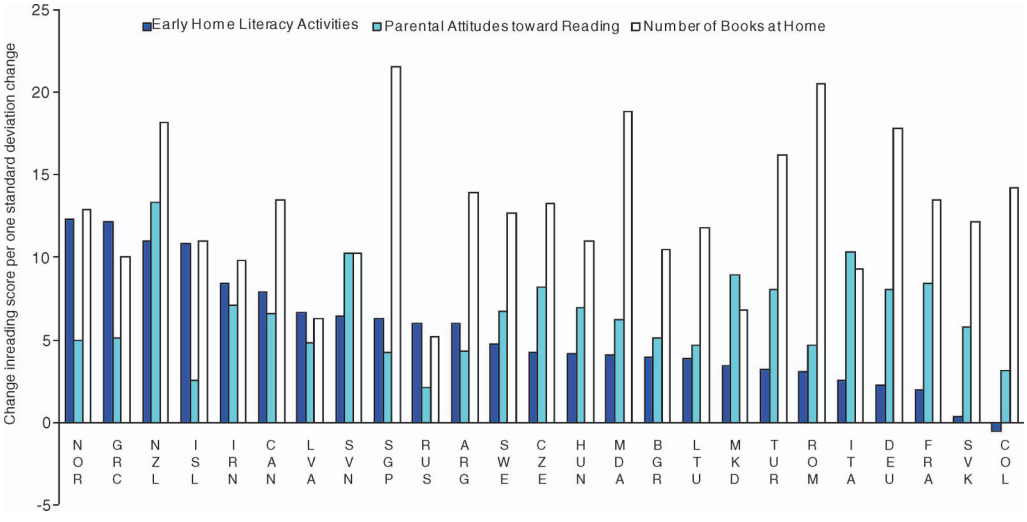

Figure 1. Relative effects of home literacy environments.

Table 4. Cross-national variation in the effect of home literacy environment by GDP per capita (multilevel model).

	Early Home Literacy Activities	Parental Attitudes toward Reading	Number of Books at Home
Index of Early Home Literacy Activities	19.012***		
	(1.388)		
X GDP per capita ($1000 unit)	0.317*		
	(0.139)		
Index of Parental Attitudes toward Reading		14.165***	
		(0.830)	
X GDP per capita ($1000 unit)		0.168*	
		(0.078)	
Number of Books at Home			10.635***
			(1.212)
X GDP per capita ($1000 unit)			−1.275*
			(0.490)
X GDP per capita ($1000 unit)^2			0.038*
			(0.015)
Variance of the slope of each HLE measure without interaction with GDP per capita	49.605***	15.785***	13.411***
Variance of the slope of each HLE measure without interaction with GDP per capita	39.830***	14.053***	12.558***
% of variance explained by GDP per capita	19.7%	11.0%	6.4%

Note: The effects of other student-level variables are not presented for simplicity. The values in parantheses are robust standard errors.
***$p < .001$, **$p < .01$, *$p < .05$.

contribution of early home literacy activities to children's reading performance increases along with the country's economic development level. The table also shows that the total between-country variance of the slope of early home literacy activities is 49.6, and about 20% of it is explained by GDP per capita. The result suggests a role of the economic development level in influencing the relationship between early home literacy activities and children's reading performance. Note, however, that the effect of GDP per capita is not quite substantial in terms of the size: the slope of early home literacy activities would increase only by 0.32 per $1,000 increase in GDP per capita. The additional analysis (not shown) revealed no significant effect of the squared term of GDP per capita, indicating a linear effect of the economic level on the slope of early home literacy activities.

The next column shows evidence of the relationship between the within-country effect of parental attitudes toward reading and GDP per capita. The effect of GDP per capital on the slope of parental reading attitudes is significantly positive, suggesting the greater contribution of parental reading attitudes on children's reading achievement in economically developed countries. GDP per capita accounts for 11% of the total between-country variance of the slope of parental reading attitudes. Similar to the case for early home literacy activities, however, the magnitude of the effect of GDP per capita is quite modest: The effect of parental reading attitudes increases only by 0.17 per $1,000 increase in GDP per capita.

In contrast to the linear effect of GDP per capita on the slopes of early home literacy activities and parental attitudes toward reading, the relationship between GDP per capital and the number of books turned out to be nonlinear. The final column in Table 4 shows

that both GDP per capita and GDP per capita squared are significantly related to the slope of number of books. The coefficient of GDP per capita is negative, while the coefficient of GDP per capita squared is positive. This results in the U-shaped pattern: The effect of the number of books on children's reading performance is weakest among countries with middle levels of economic development. Including both GDP per capita and its squared term explains 6% of the total between-country variation in the effect of number of books.

Discussion and conclusions

Even controlling for parental education and other individual characteristics, the index of early home literacy activities, the index of parental attitudes toward reading, and the number of books at home are significantly associated with children's reading performance in almost all 25 countries. Although home literacy environments mediate to some extent the effect of parental education, in many countries, the effect of parental education on children's reading performance remains substantial even after home literacy environments are taken into account. The results suggest that, despite some correlation between parental education and home literacy environments, still a significant proportion of low-educated parents are engaged often with the child in literacy activities, have positive attitudes toward reading, and have a large number of books at home. In other words, rather than simply reproducing educational differences among children from different socioeconomic origins, home literacy environments are important resources even for children from poor socioeconomic backgrounds to benefit from. On the other hand, the finding of a significant effect of parental education, even after controlling for home literacy environments, invites researchers to explore various mechanisms through which parental education affects student's academic performance.

Although home literacy environments have positive influences on children's reading in most countries, considerable cross-national variations are found in the effect of each home literacy measure. By focusing on the role of a country's economic level, this study finds evidence of a systematic association between the country's economic level and the effect of early home literacy activities: the higher the economic level, the stronger the effect. A similar pattern is found for the effect of parental attitudes toward reading. Note, however, that the association is rather weak in terms of the magnitude of the change in the effect per unit change in GDP per capita. In contrast to the linear relationship that the country's economic level has with the slopes of early home literacy activities and parental attitudes toward reading, the effect of the country's economic level on the slope of the number of books shows the U-shaped pattern: The effect is weakest among middle-level countries in economic development.

As discussed earlier, the number of books has been widely used as a proxy variable for family SES, especially in the absence of traditional measures of SES such as parental occupation and education (Buchmann, 2002). The number of books at home has been found a strong predictor of student achievement (Wößmann 2003). Moreover, in most surveys, the problem of missing values tends to be less serious for the number of books at home than for traditional SES measures such as parental occupation and education (Buchmann, 2002). These features of the variable indicate that the number of books is an important variable to be collected in international surveys of student achievement.

However, the finding that the number of books has a different relationship with the economic level, compared to the other two measures of home literacy environments, raises an interesting question about measurement properties of the variable as an indicator of

home literacy environments. It seems unclear to what extent the number of books at home measures the overall literacy environment at home or the economic power of a family to purchase books and other materials. Moreover, possessing books at home should not be necessarily equivalent to reading those books to the child. Considering the useful features of the variable as emphasized above, future research should pay more attention to uncovering properties of the variable, number of books at home.

Beyond a body of research that focused on cross-national differences in the influences of *socioeconomic* aspects of family background (Breen & Jonsson, 2005; Shavit & Blossfeld, 1993), the current study examined *cultural* aspects of family background as related to children's education. A major contribution of the study is to reveal substantial cross-national variation in the effects of home literacy environments on children's reading and its systematic relationship with the level of economic development. The limitation of this study, which exclusively focused on economic development as a contextual variable, should be overcome by future research that will explore how other contextual factors such as educational systems and political regimes may account for cross-national variation in the relationship between cultural resources of family and children's education. Understanding how national contexts mediate educational stratification can help educational policy-makers and researchers in a society develop programs and policies that can be more effective in reducing educational inequality in their specific context.

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Notes

1. See Martin, Mullis, and Kennedy (2003), for more detailed information on the sampling of PIRLS 2001.
2. Randomly drawn from the posterior distribution for a student's ability, plausible values are appropriate especially to estimate population parameters such as mean and variance, taking into account the uncertainty associated with the estimates (Wu, 2004). In practice, the five plausible values should be used simultaneously to obtain correct estimates of sampling variances of estimated population parameters.
3. More detailed information on features of AM statistical software is available on the AM website: http://am.air.org
4. Information on GDP per capita for the 25 countries was obtained from the *World Fact Book* on the following website: http://www.umsl.edu/services/govdocs/wofact2003/rankorder/2004rank.html. The figures are estimates on a purchasing power parity basis mostly in the year of 2002 or 2001.
5. Multilevel models were estimated with the statistical software HLM 6.

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Appendix 1. Descriptive statistics of individual-level variables

Variables	*M*	*SD*	Minimum	Maximum
Female	0.51	0.50	0	1
2 or more-adult family	0.89	0.31	0	1
Language of test	0.79	0.40	0	1
Number of children at home	2.80	1.66	1	11
Parental education: tertiary	0.34	0.47	0	1
Parental education: upper secondary	0.24	0.43	0	1
School location: suburban	0.15	0.35	0	1
School location: urban	0.48	0.50	0	1

Note: Weighted values.