4

Relationships between Digital Reading Performance and Student Background, Engagement and Reading Strategies

This chapter examines the extent to which proficiency in both print and digital reading is associated with certain variables, including students' socio-economic background, immigrant status, the degree of students' engagement in reading, and students' awareness of effective learning strategies.

This chapter examines how a number of variables relate to print and digital reading proficiency. The first part of the chapter investigates student background variables, such as economic, social and cultural status; and immigrant background. The second part examines engagement in reading activities and awareness of effective reading strategies. The chapter focuses on how these aspects are related to print and digital reading proficiency.

An explanatory model, based on students' background characteristics, engagement and reading strategies, is presented at the end of the chapter. This model shows the strength of the relationship between each of the variables and digital reading performance.

Unless otherwise noted, the countries described in this chapter are the 19 countries that conducted the digital reading assessment. OECD averages mentioned here are for the 16 OECD countries that participated in both the print and digital reading assessments.

FAMILY BACKGROUND

The aim of education systems around the globe is to encourage students to achieve at the highest possible levels and to provide equitable opportunities for all students. As discussed in Volume II of this report, inequities may arise as a result of gender, socio-economic status, ethnicity or even geographic location. A weak relationship between a student's family background and his or her performance at school is an indication of an equitable distribution of educational opportunities. The variables discussed in this section are described in greater detail in Annex A1a.

Socio-economic background

Most schools are populated by students from a range of socio-economic backgrounds; and teachers and parents appreciate that the interaction of family background and the educational setting can enhance learning. As was true in the case of print reading proficiency, PISA results show that there is a positive association between socio-economic background and digital reading proficiency.

In PISA, a student's socio-economic background is indicated by the *PISA index of economic, social and cultural status* (ESCS). This index captures several aspects of a student's family background, including information on parents' education and occupations, and home possessions.[1] The index is standardised to have an average value of 0 across all the participating OECD countries in the print reading assessment and a standard deviation of 1.

An examination of the average value of the index for each of four student performance categories gives an indication of the impact of socio-economic background (Table VI.4.1). In digital reading, students who are top performers (*i.e.* those who perform at PISA proficiency Level 5 or above) have an average socio-economic index score of 0.65 – well above the overall average of 0.06 (Table VI.4.2) – while students who are the lowest performers (*i.e.* those who perform at PISA proficiency Level 1 or below) have an average socio-economic index score of -0.45 – well below the average. The average difference in the socio-economic index scores between the top performers and the lowest performers across OECD countries was 1.10 index points. For print reading, the results are similar, with the top performers having an average socio-economic index score of 0.66 and the lowest performers -0.43: a difference of 1.09. The largest difference observed in both digital and print reading is in Chile, which has a difference of 1.84 index points between the top performers and the lowest performers in digital reading, and a larger difference between these two groups of 1.96 index points in print reading. The smallest variation between top performers and lowest performers is found in the partner economy Macao-China, with a 0.61 index point difference in digital reading and 0.56 index point in print reading. Both across and within countries, then, differences between the top and the lowest performers tend to be similar in both the digital and print reading assessments.

Another way of looking at the association between socio-economic background and student performance is to see if there are measurable differences in performance scores between students from socio-economically advantaged and disadvantaged backgrounds (the top and bottom quarters of the *PISA index of economic, social and cultural status*). In the digital reading assessment, the difference, on average across the relevant OECD countries, is 85 score points, compared to a difference of 89 score points for print reading (Table VI.4.2). In both cases, this would be regarded as equivalent to over two years of schooling (one school year is estimated to be equivalent to 39 score points in PISA; see Table A1.2 in *PISA 2009 Results: What Students Know and Can Do: Student Performance in Reading, Mathematics and Science* for an explanation of this calculation). The smallest difference in performance between socio-econonimically advantaged and disadvantaged students is seen in the partner economy Macao-China, with a 23 score point difference in digital reading and a 25 score point difference in print reading.

The largest performance difference between socio-economically advantaged and disadvantaged students occurs in Hungary, with 135 and 118 score points difference, respectively, in digital and print reading. While 12 of the 19 countries have smaller differences between advantaged and disadvantaged students in print reading, in Poland and Chile the differences are larger by 19 and 18 score points, respectively, suggesting that in these two countries the impact of socio-economic background is greater on digital reading than on print reading.

The method for comparing the scores of students from different socio-economic backgrounds used above can be extended to look at a range of student backgrounds. The change in student performance associated with each single unit change of the *PISA index of economic, social and cultural status* is known as the socio-economic gradient (a unit is defined as one standard deviation). The slope of the socio-economic gradient line is an indication of the extent of inequity. Steeper gradients indicate a greater impact of socio-economic background on student performance; gentler gradients indicate less of an impact.

On average across the 16 OECD countries that participated in the digital reading assessment, the slope of the gradient line is 38 score points, which is similar to what is observed for print reading (Table VI.4.3). The OECD countries with the steepest slopes for digital reading are Hungary, Austria, New Zealand, Poland, Belgium and Australia. In these countries, a one-unit change of the index is associated with a performance difference of between 54 (Hungary) and 43 score points (Australia) on the digital reading scale. Countries and economies with slopes of less than 30 score points are Japan, Korea, Norway, Iceland, and the partner economies Macao-China and Hong Kong-China.

For print reading in PISA 2009, the average slope across the 16 OECD countries that participated in the digital reading assessment is 40 score points. The countries with steep slopes in digital reading also tend to have the steepest slopes in print reading. For example, Hungary has a slope of 54 score points for digital reading and 48 score points for print reading, and Austria has slopes of 49 and 48 score points, respectively – all significantly above the OECD averages. At the same time, the countries with gentle slopes in digital reading also tend to have the gentlest slopes in print reading. For example, the partner economy Macao-China has a slope of 11 score points for digital reading and 12 score points for print reading, and the partner economy Hong Kong-China has slopes of 19 and 17 score points, respectively – all significantly below the OECD averages. The largest discrepancy between the gradients for digital and print reading occurs in Japan, with a 14 score point difference: the slope of 26 score points for digital reading is much less than the 40 score points for print reading. Thus, in Japan, there appears to be greater equity in the digital reading results than in the print reading results.

While the steepness of the gradient is an indicator of how many score points are associated with a one-unit change in the *PISA index of economic, social and cultural status,* it does not necessarily show the strength of the relationship. As explained in Volume II, this is better revealed by examining the amount of variance in student performance that is explained by a variable. If this number is low, relatively little of the variance in student performance is explained by students' socio-economic background; if it is high, a large part of the performance variation is explained by socio-economic background. On average across OECD countries, 14.1% of the variation in student performance in digital reading within each country is associated with the *PISA index of economic, social and cultural status* (Table VI.4.3). For print reading, across the 16 OECD countries that participated in the digital reading assessment, the average variance explained by socio-economic background was 14.4%. In Poland, both the slope and the variance explained were noticeably greater for digital reading than for print reading, indicating that socio-economic background in that country has a greater impact on digital reading proficiency than it does on print reading.

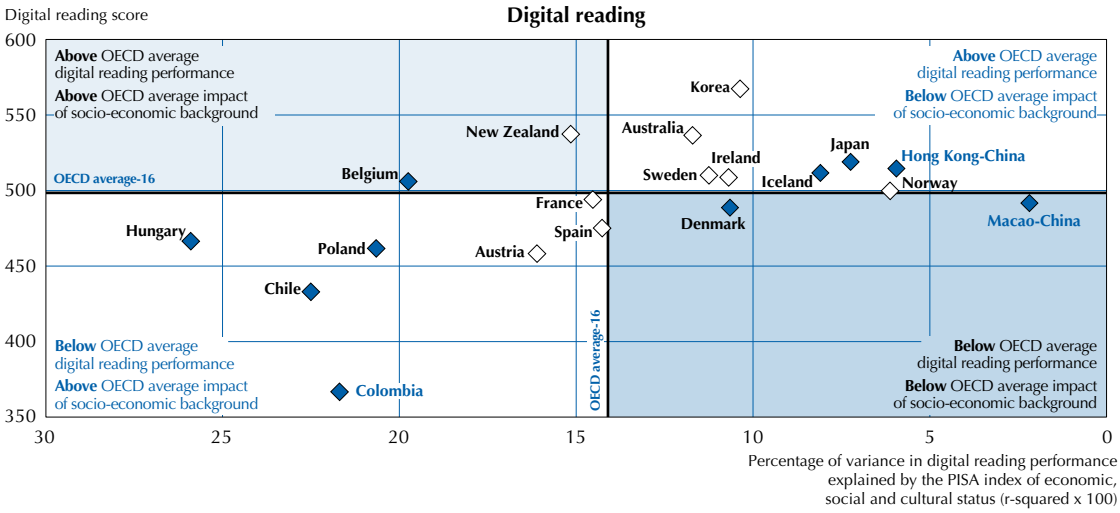
Countries with a lower-than-average impact of socio-economic background are regarded as high-equity countries. Using the information in Table VI.4.3 countries are categorised into four groups: *i)* high performance/low socio-economic impact; *ii)* high performance/high socio-economic impact; *iii)* low performance/high socio-economic impact; and *iv)* low performance/low socio-economic impact (see Figure VI.4.1). Among the countries and economies that participated in the digital reading assessment, Japan, Iceland and the partner economy Hong Kong-China constitute the group of high performance/low socio-economic impact countries; Belgium is the high performance/high socio-economic impact country; and Hungary, Poland, Chile and the partner country Colombia are the low performance/high socio-economic impact countries. Other countries and economies show around average performance and/or around average impact of socio-economic background.

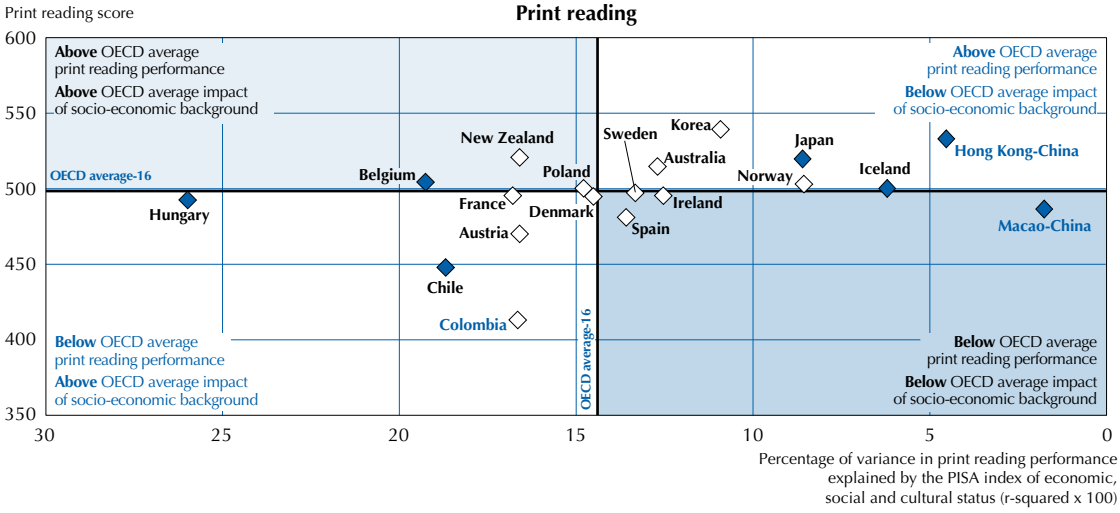
■ Figure VI.4.1 ■

Strength of socio-economic gradient and reading performance

◆ Both, the digital reading performance **and** the strength of the relationship between performance and socio-economic background are **significantly different** from the OECD average.

◇ The digital reading performance **and/or** the strength of the relationship between performance and socio-economic background are **not significantly different** from the OECD average.





Source: OECD, *PISA 2009 Database,* Table VI.4.3.
StatLink http://dx.doi.org/10.1787/888932435416

A comparison of the two graphs shows that there is a greater diversity in the equity of results for digital reading than for print reading. The average socio-economic background of the countries considered varies widely. Table VI.4.3 shows the mean score obtained by each country in the digital reading assessment and also a score that is adjusted for each country's average socio-economic background. In this hypothetical analysis, the South American countries, Chile and Colombia, have adjustments of 22 and 37 score points, taking their scores from 435 to 456 and from 368 to 405 score points, respectively. Countries with higher socio-economic status, such as Iceland and Norway, have their scores adjusted downwards from 512 to 493 and from 500 to 487 score points, respectively. These differences are similar to those observed in print reading, where Chile and Colombia have adjustments of 19 and 32 score points upwards, respectively, while Iceland and Norway have adjustments of 18 and 16 score points downwards, respectively.

Immigrant status

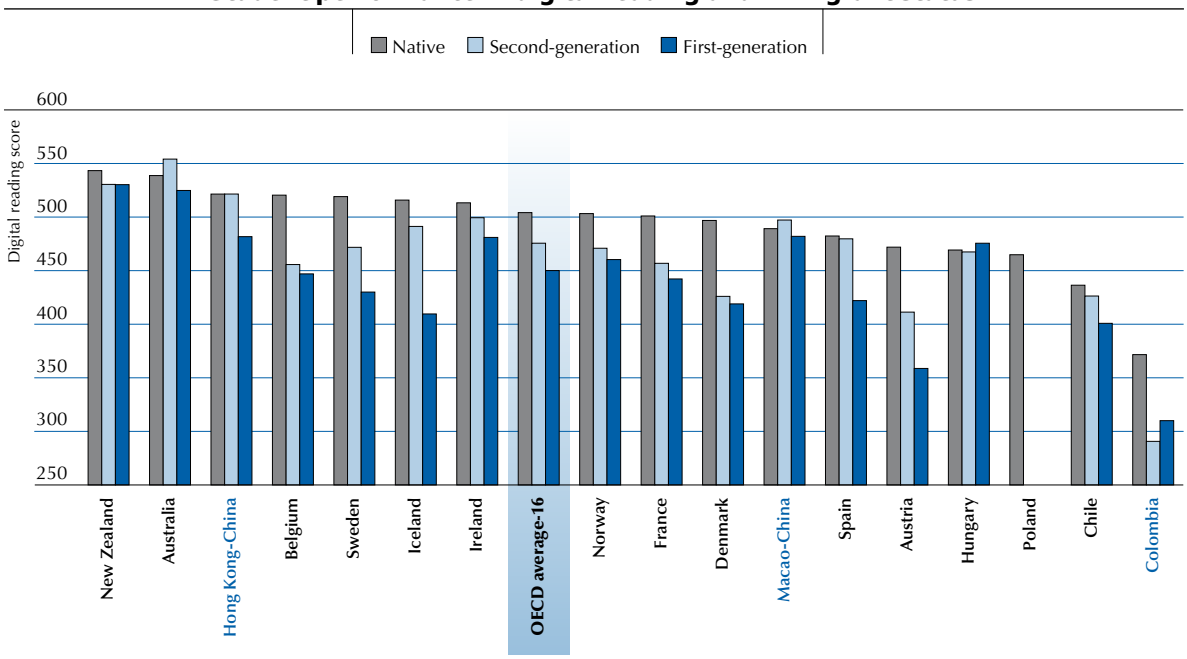
As a result of increased global migration and population mobility, governments are often called upon to provide integration programmes at schools and in the community at large. PISA uses three categories to define the immigrant status of students: *i)* native students, *ii)* second-generation students, and *iii)* first-generation students (see Annex A1a for a detailed description). Generally, students with an immigrant background are defined as first- or second-generation immigrants.[2]

Across OECD countries, the pattern of results indicates that native students perform at a higher level than their immigrant counterparts. Table VI.4.4 shows that, on average, native students score 504 points, compared to 475 for second-generation students and 450 for first-generation students. In print reading, the averages for the same groups are 504, 474 and 449, respectively.

As can be seen in Figure VI.4.2, this pattern is not repeated in all countries. In Australia, for example, second-generation students score at the highest level in digital reading, with 554 score points, followed by native students (539 score points) and then first-generation students (525 score points).

■ Figure VI.4.2 ■

Student performance in digital reading and immigrant status



Countries are ranked in descending order of the mean score of native students.
Source: OECD, *PISA 2009 Database,* Table VI.4.4.
StatLink http://dx.doi.org/10.1787/888932435416

Languages spoken at home

In print reading, students who speak a language at home that is different from the language of the assessment generally perform at a lower level than those whose language is the same. In PISA 2009, the average score in print reading among students whose language is different from the assessment language was 455 points compared to 506 points for those students whose language is the same as the assessment language (see Table VI.4.5). In digital reading, the pattern is similar: the average score for students whose language at home is different from the assessment language was 452 points compared to 504 points for students whose language is the same as the assessment language.

The two largest gaps between print and digital reading are in Norway, where the difference between the language groups is 63 score points for print reading and 40 score points for digital reading, and in the partner economy Hong Kong-China, where these differences are 70 and 35 score points, respectively.

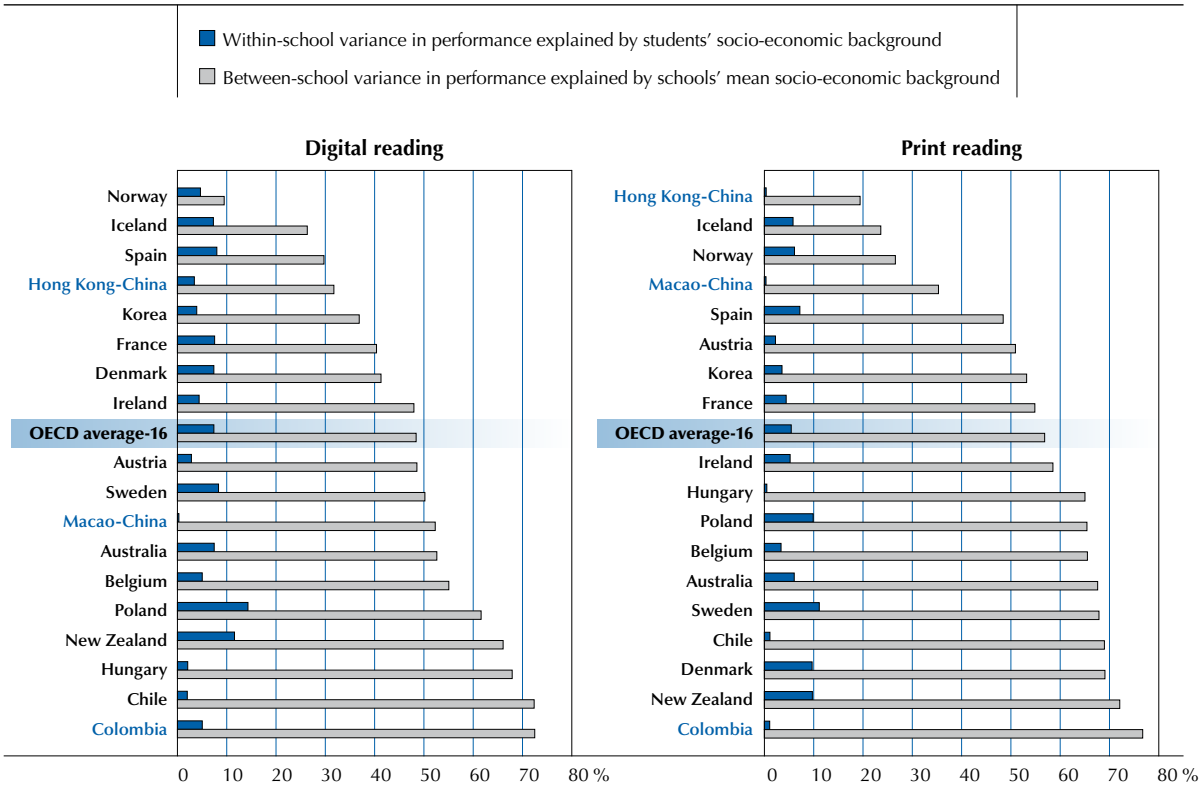
Performance differences within and between schools

Figure VI.4.3 shows the proportion of the between- and within-school variance in performance in digital and print reading that can be attributed to differences in socio-economic background within and between schools. Digital reading is shown on the left, while print reading is shown on the right. The grey part of the bar represents the between-school variation that is explained by schools' socio-economic background; the blue part of the bar represents the within-school variation that is explained by the socio-economic background of students within schools (see Table VI.4.6).

On average, between schools, the percentage of the variance in student performance explained by a school's socio-economic background is smaller in digital reading (48.4%) than in print reading (56.8%). In contrast, within schools, the percentage of the variance in student performance explained by students' socio-economic background is larger in digital reading (7.4%) than in print reading (5.5%).

■ Figure VI.4.3 ■

Variation in performance in digital and print reading explained by students' and schools' socio-economic backgrounds



Countries are ranked in ascending order of the between-school variance in performance explained by schools' socio-economic background.
Source: OECD, *PISA 2009 Database,* Table VI.4.6.
StatLink http://dx.doi.org/10.1787/888932435416

STUDENT ENGAGEMENT AND ATTITUDES

Do engagement in reading and awareness of reading strategies have the same kind of relationship with digital reading proficiency as they do with print reading proficiency? As shown in Chapters 2 and 3, the skills required to succeed in the digital reading tasks are both general, that is, applicable to print reading as well, and specific, usually associated with navigating through online texts. As it could be expected that engagement in online reading is likely to have a closer link with proficiency in digital reading than with print reading, online reading practices are closely examined below.

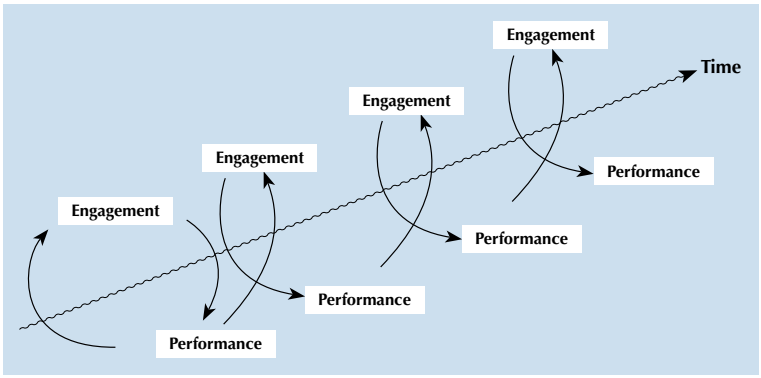
Box VI.4.1 A cycle of engagement in reading activities, reading strategies and reading performance

Students who are highly engaged in diverse reading activities and who are aware of what strategies work best for reading and understanding texts perform better in the PISA reading assessment. However, this finding cannot be interpreted as direct evidence of a causal relationship between being engaged in reading, adopting effective reading strategies and achieving high levels of reading proficiency. Evidence presented in *PISA 2009 Results: Learning to Learn (Volume III)* for print reading, and in this chapter for digital reading, reflects the cumulative observed association between how engaged students are, the reading strategies they adopt and how well they do.

What does cumulative association mean? Studies in education and applied psychology suggest that reading proficiency is the result of multiple developmental cumulative cycles (see Aunola, *et al.,* 2002 for a review). Attitudes towards reading and learning, motivation, engagement in reading activities and reading proficiency are mutually reinforcing. Positive reinforcement operates at two levels. The first reflects the fact that the future depends on the past. Past engagement matters for current and future engagement, and past reading performance is also a very good predictor of future reading performance (Fredericks, Blumenfeld and Paris, 2004; Stanovich, 2004). This suggests that a student's past reading activities will influence his or her future reading activities. Similarly, how effectively the student applied learning strategies in the past is one of the aspects that determine how well he or she will apply reading strategies in the future.

The second level indicates that associations among engagement, reading strategies and performance are circular. Engaging in reading activities, adopting effective reading strategies and being a proficient reader are mutually dependent: as students read more they become better readers; and when they read well and expect good performance in reading, they tend to read more and enjoy reading (Nurmi, *et al.,* 2003).

The graph below illustrates how results of associations between how engaged in reading activities students are, the reading strategies they adopt, and how well they read should be interpreted in the context of the two levels of reinforcement.



The evidence that emerges from PISA on the positive interplay between engagement in reading activities, the adoption of particular reading strategies and reading performance suggests that preparing students to read well and promoting a passion for reading and effective reading is very important. Students who are highly engaged and are effective learners are most likely to be proficient readers; proficient readers are also the students most engaged and interested in reading.

Engagement in reading and digital reading proficiency

This section focuses on three different aspects of how students engage in reading activities:

- how much students enjoy reading (positive or negative attitudes towards reading);
- which kinds of print material they read and how often; and
- which kinds of online reading activities they engage in and how often.

Box VI.4.2 The association between reading engagement, awareness of reading strategies and reading performance

Results presented in this chapter can be used to answer two main policy questions:

1. How strong is the association between digital reading performance, reading engagement and reading strategies?

- One indicator used to answer this question is the inter-quartile range, which represents the difference between the top and bottom quarters of different indicators, such as reading enjoyment, diversity of print reading material, online reading practices, and awareness of reading strategies. This indicator can reveal the extent of the differences in reading performance between, for example, enthusiastic and unenthusiastic readers.

2. Are reading engagement and reading strategies good predictors of performance?

- The proportion of the variation in digital reading performance that is accounted for by engaging in reading and reading strategies, or explained variance, helps to answer this question by identifying the proportion of the observed variation in student performance that can be attributed to reading engagement and reading strategies.
- If this number is low, knowing the students' reading engagement and level of awareness of reading strategies says very little about their digital reading performance. If this number is high, one can associate students' performance in digital reading reasonably well with their engagement in reading and awareness of reading strategies.

Box VI.4.3 Interpreting PISA indices

- Indices allow for comparisons of countries that are above or below the OECD[a] average in certain variables: indices used to characterise students' engagement in reading activities (either print or online) and awareness of reading strategies were constructed so that the average OECD student would have an index value of zero and about two-thirds of the OECD student population would be between the values of -1 and 1 (*i.e.* the index has a standard deviation of 1). Negative values on the index do not imply that students responded negatively to the underlying question. Rather, students with negative scores are those who responded less positively than the average response across OECD countries. Likewise, students with positive scores are those who responded more positively than the average student in the OECD area (see Annex A1a for a detailed description of how indices were constructed).
- Most of the indicators of engagement-in-reading activities are based on students' self-reports. They can thus suffer from a degree of measurement error because students are asked to assess their level of engagement in reading activities retrospectively. Apart from potential measurement error, cultural differences in attitudes towards self-enhancement can influence country-level results in engagement-in-reading activities and the use of learning strategies (Bempechat, *et al*., 2002). The literature consistently shows that response biases, such as social desirability, acquiescence and extreme response choice, are more common in countries with low GDP than in more affluent countries, as they are, within countries, among individuals from more disadvantaged socio-economic backgrounds and with less education.
- As in the first PISA cycle and as for print reading performance (Volume III, *Learning to Learn*), many of the self-reported indicators of engagement in reading are strongly and positively associated with digital reading performance within countries, but show a weak or negative association with performance at the country level. This may be due to different response biases across countries or the fact that country-level differences in reading performance are due to many factors that go beyond levels of engagement in reading activities and that are negatively associated with reading performance and positively associated with engagement in reading.

....

- PISA 2009 used two indicators aimed at assessing the extent to which students are aware of effective strategies to understand, memorise and summarise information. These measures are less subject to self-reported biases because they gauge whether students agree with education experts on what strategies work best to achieve certain goals (see Annex A1a for a detailed description of how these indices were constructed). Analyses presented in Volume III, *Learning to Learn,* and this volume confirm that these indicators are strongly associated with print and digital reading performance both within and across countries.
- The *PISA 2009 Technical Report* (OECD, forthcoming) contains a detailed description of all the steps that were taken in PISA 2009 to ensure the highest possible level of cross-country comparability and to assess the validity of cross-country comparisons based on the indices featured in the report.[b]

a. As indices are derived from the core student questionnaire, the OECD average is computed using all the OECD countries that participated in PISA 2009.

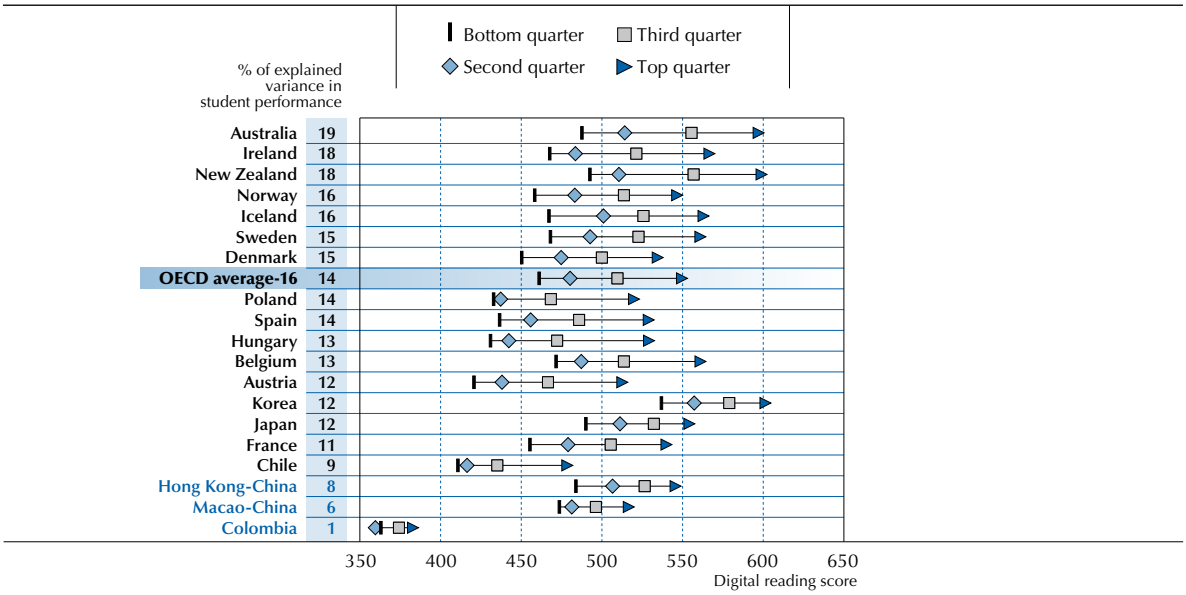
b. In PISA 2009, several tests were conducted to determine whether the use of country-specific item parameters improved cross-country comparability of indices. For example, simulation studies indicated that using country-specific item parameters in regression models did not lead to improvements in the comparability of indices across countries. During the estimation procedure, an index of differential item functioning (DIF) across countries is produced that can be used to gauge the amount of DIF for each item across countries. If necessary, the impact of DIF on items can then be tackled using country-specific item parameters. However, simulation studies have shown that introducing country-specific item parameters for DIF items has a negligible impact on the regression coefficients in a two-level regression (students within countries) of background variables (with and without country-specific items) on cognitive scores in reading, mathematics and science.

Do students who enjoy reading read better on line?

Enjoyment in reading was measured in PISA 2009 as well as in PISA 2000.[3] Volume III, *Learning to Learn,* shows that within countries, enjoyment of reading is closely linked to print reading proficiency in all the 65 participating countries and economies, except in the partner country Kazakhstan.

■ Figure VI.4.4 ■

Relationship between enjoyment of reading and digital reading performance



Note: All differences between the top and bottom quarters of this index are statistically significant.
Countries are ranked in descending order of the percentage of explained variance in student performance.
Source: OECD, *PISA 2009 Database,* Table VI.4.7.
StatLink http://dx.doi.org/10.1787/888932435416

Is enjoyment of reading as strongly linked to digital reading proficiency as it is to print reading proficiency? Again, in all countries that participated in the digital reading option, enjoyment of reading is significantly and positively related to performance in digital reading (Figure VI.4.4). On average,[4] 14% of variation in performance in digital reading can be explained by differences in the extent to which students enjoy reading. The explained variation in digital reading performance is higher than 15% in Australia (19%), Ireland (18%), New Zealand (17%) and Iceland (16%). In four other countries and economies, it is below 10%: Chile (9%), the partner economies Hong Kong-China (8%) and Macao-China (6%), and the partner country Colombia (1%) (Table VI.4.7).

The difference between the students least and most enthusiastic about reading (the bottom and top quarters of the index) is striking in most countries: 88 score points, on average, on the digital reading scale. On average, the least enthusiastic students are twice as likely to perform poorly in digital reading (in the bottom quarter of the national reading performance distribution) as the most enthusiastic readers.

As some variation could be expected by gender, analyses were performed to estimate whether the relationship between enjoyment of reading and digital reading performance varies according to gender. In most countries, there is no significant variation related to gender.[5] In four countries the relationship between enjoyment and performance is significantly greater for boys than for girls: Poland and Australia, where the gender difference is 9 score points; and Sweden and Japan, where the gender difference is 8 and 7 score points (Table VI.4.8).

Enjoyment of reading explains less variation in digital performance (14%) than in print reading performance (20%).[6] This is not surprising, as the enjoyment of reading scale involves 6 out of 11 items that specifically mention books and explicitly or implicitly refer to print material. Although no causal relationship can be established, enjoyment of reading is closely linked with reading performance in both media. But, as illustrated in Box VI.4.1, there is a virtuous circle linking enjoyment of reading and reading proficiency: students who enjoy reading engage more in reading activities and provide themselves with more opportunities to become better readers. At the same time, the better they read, the more they feel confident about their own reading abilities, the more they read and choose to engage with challenging reading tasks or texts that will allow them to grow as readers.

The association between the diversity of print material students read and digital reading proficiency

PISA 2000 and 2009 asked students to indicate how often they read magazines, newspapers, comic books, fiction and non-fiction books because they want to (that is, not because they are required to for school).[7] Kirsch, *et al*. (2003) and Volume III, *Learning to Learn,* have shown extensively that students who read a wide variety of materials perform better in reading print texts.

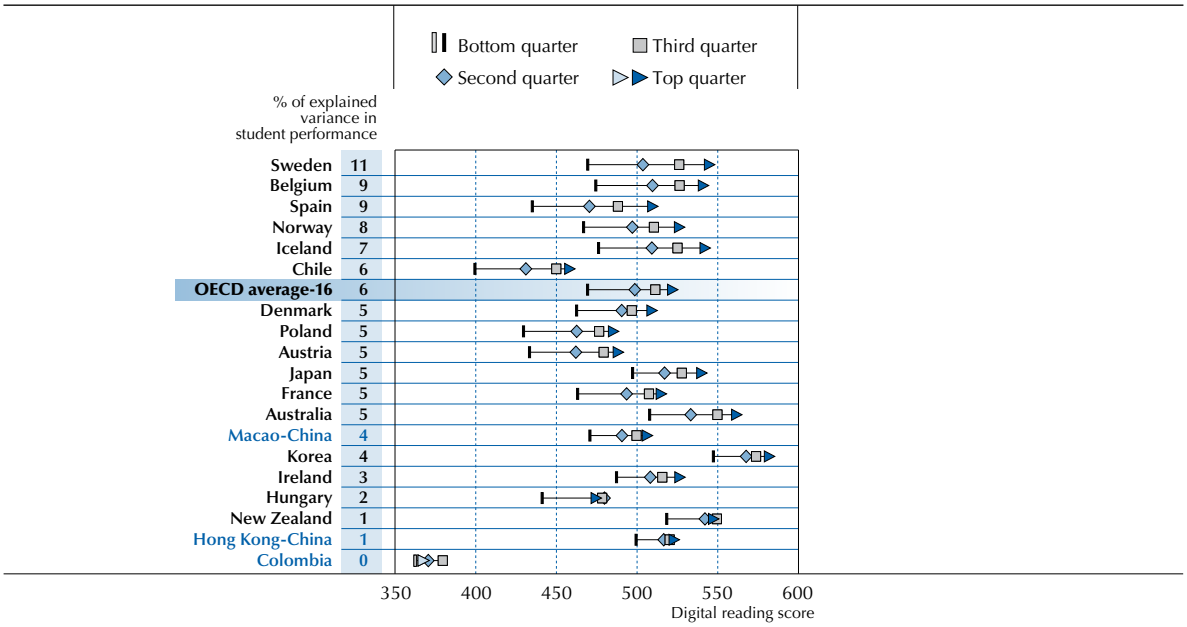
Does this relationship between "diversity of (print) reading" and reading proficiency also apply to digital reading proficiency? And, if so, how strong is the relationship?

In most countries that took part in the digital reading option, proficient online readers are also those students who regularly read a diversity of print material (Figure VI.4.5). As stated in Volume III, *Learning to Learn*, results appear "to contradict commonly held beliefs about how what one reads influences reading proficiency. While it is true that regularly reading some materials, such as fiction, is associated with better reading proficiency, reading other materials, such as newspapers and magazines, does so too if it complements other types of texts" (OECD, 2010a). What was true for print reading is also true for digital reading proficiency. However, for both print and digital proficiency, the percentage of variation in student performance explained by diversity of reading is low. On average, 7% of variation in print reading performance[8] can be explained by differences in the extent to which students regularly read diverse print material. Some 6% of variation in digital reading performance can be explained by differences in diversity of reading. Higher percentages of explained variation are observed in Sweden (11%), Belgium (9%) and Spain (9%). In contrast, explained variance is close to zero in New Zealand, the partner economy Hong Kong-China (1%), and the partner country Colombia (0%).

The relationship between print and digital reading proficiency and diversity of reading is noticeably weaker than that for enjoyment of reading.

■ Figure VI.4.5 ■

Relationship between diversity of reading and digital reading performance



Note: Countries in which differences between the top and bottom quarters of this index are statistically significant are marked in a darker tone.
Countries are ranked in descending order of the percentage of explained variance in student performance.
Source: OECD, *PISA 2009 Database,* Table VI.4.9.
StatLink http://dx.doi.org/10.1787/888932435416

The difference between students who reported that they regularly read diverse material and those who reported that they infrequently did so is, on average, 53 score points on the digital reading scale. On average, the least diverse readers (students in the bottom quarter) are 1.8 times more likely to perform poorly in digital reading (in the bottom quarter of the national reading performance distribution) than the most diverse readers (students in the top quarter).

In most countries, the relationship between diversity of reading material and digital reading performance does not vary according to gender. Indeed, gender explains variation in only three countries. The largest difference is seen in Spain, where the score point difference associated with a change of one unit in the index of diversity of reading is equal to 23 score points for boys and 37 for girls (Table VI.4.10).

Online reading practices

Students' engagement in reading also encompasses students' online reading practices, including the amount of time they spend accessing online reading material. Digital reading activities are becoming increasingly popular, especially among teenagers (Mills, 2010) and many literacy practices that previously involved print material, such as reading books, documents and newspapers, increasingly involve the use of electronic devices.

Volume III, *Learning to Learn,* examines how frequently students in each country report reading on line. On average across OECD countries, the most common type of online reading activity reported by students is chatting on line, with almost three-quarters of the students reporting that they engaged in this activity at least several times a week. This is followed by reading e-mails (64%) and searching online information (51%). Results suggest that in most countries, boys and girls do not differ, or differ only marginally, in how much they use the Internet for reading for enjoyment.

Analyses investigating the extent to which online reading practices are related to print reading proficiency show that reading on line is associated with better performance in all PISA participating countries and economies, excluding Liechtenstein. However, the amount of variation in the print reading score explained by the online index is small.

Not surprisingly, the amount of variance in the digital reading score explained by online practices is somewhat higher (6%)[9] than it is for print reading (3% on average among the 16 OECD countries that took part to the digital reading option).

More in-depth analyses[10] applied to the set of online reading activities reveal that there are two distinct kinds of online reading activities: searching for information and social activities. By analysing the two separately, it is possible to obtain a more nuanced view of which online reading activities are related to proficiency in digital reading.

Searching for information on line involves such activities as reading news, using a dictionary, searching online information to learn about a particular topic and searching for practical information on line. Social activities on line involve, among other activities, reading e-mails and chatting.[11]

The amount of time students spend in activities aimed at searching for information varies from country to country. Students in Poland, Korea, Hungary and the partner economy Hong Kong-China reported frequent online activities aimed at searching for information. In Ireland, Belgium, Japan and the partner economy Macao-China, students reported below-average frequency of online searching-information activities (index below - 0.20) (Table VI.4.11).

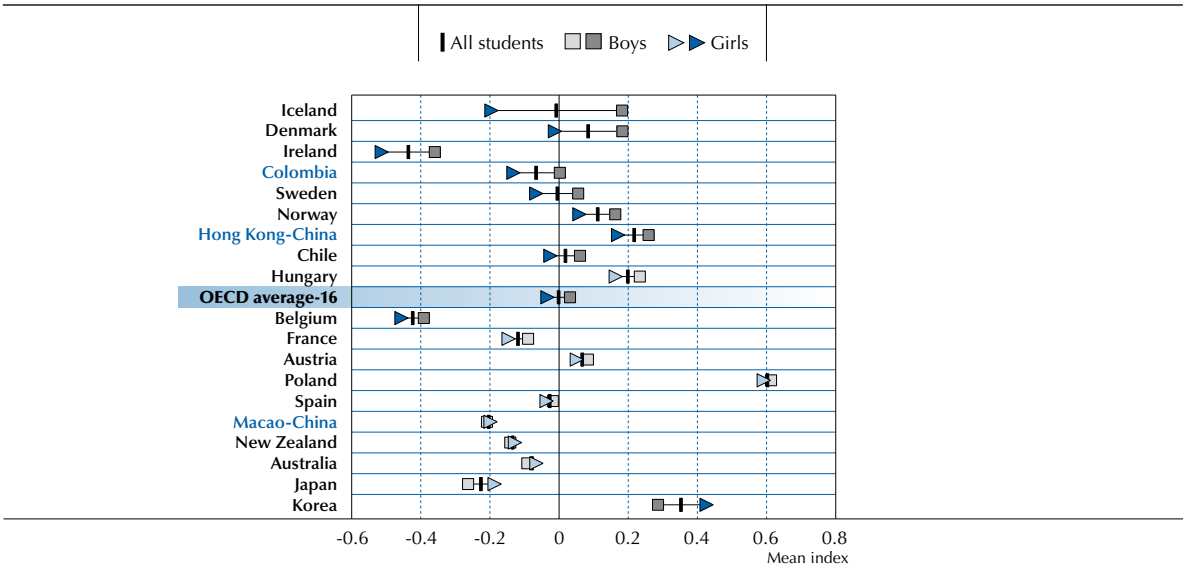
The pattern for online social activities is very different. Students in Iceland, Hungary, Denmark, Belgium, Norway and Austria reported frequent and above-average online social activities, while those in Korea, Colombia, Ireland, Chile, Japan and New Zealand reported below-average frequency of online social activities (Table VI.4.12).

Gender differences in online reading practices

The amount of time students reported spending in online searching-information activities (Table VI.4.11) is somewhat shorter for girls (average -0.03) than for boys (+0.03). On average, the gender difference is limited (0.07). Nevertheless, in a few countries, the gender difference is close to or above 0.10 – Iceland (0.38), Denmark (0.20), Ireland (0.15), Colombia (0.13), Sweden (0.12) and Norway (0.10). In each of the northern European countries that participated in the digital reading option, boys reported more frequent online searching-information activities. In Korea, Japan, Australia, New Zealand and the partner economy Macao-China, girls reported more frequent online searching-information activities than boys. But, in those countries, the difference is usually close to zero; only in Korea (-0.14) is the difference significant.

■ Figure VI.4.6 ■

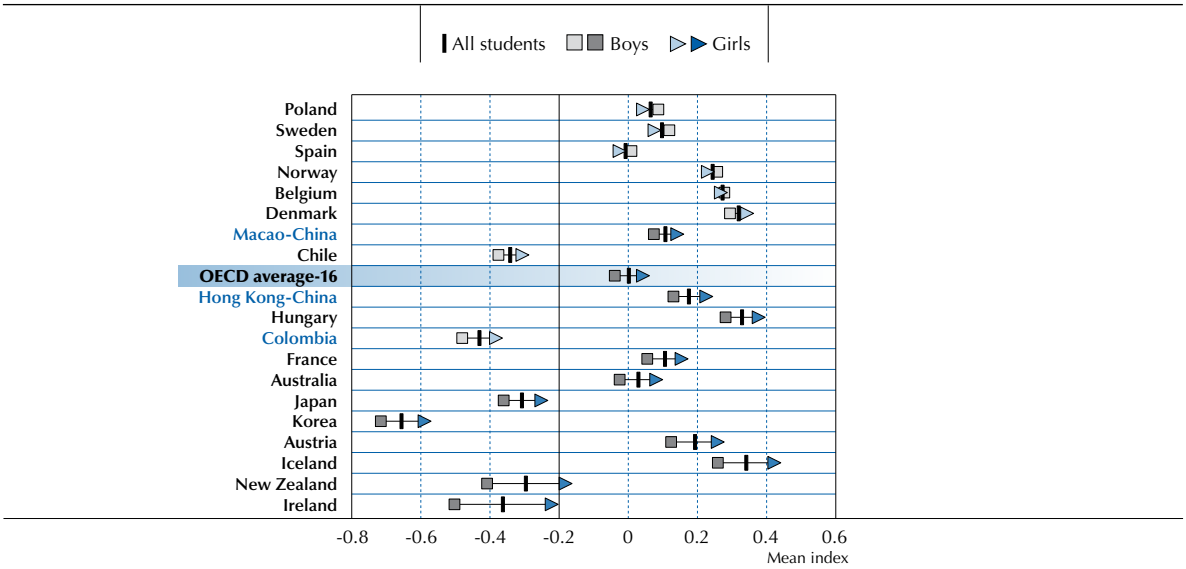
Index of online searching-information activities, by gender



Note: Countries in which gender differences are statistically significant are marked in a darker tone.
Countries are ranked in descending order of the difference between boys and girls in the mean index of online searching-information activities.
Source: OECD, *PISA 2009 Database,* Table VI.4.11.
StatLink http://dx.doi.org/10.1787/888932435416

■ Figure VI.4.7 ■

Index of online social activities, by gender



Note: Countries in which gender differences are statistically significant are marked in a darker tone.
Countries are ranked in descending order of the difference between boys and girls in the mean index of online social activities.
Source: OECD, *PISA 2009 Database,* Table VI.4.12.
StatLink http://dx.doi.org/10.1787/888932435416

The amount of time students reported spending on social activities on line is somewhat shorter for boys (average -0.04) than for girls (+0.04). The gender difference is about the same magnitude (-0.08), on average, as for searching for information; only in Ireland (-0.28) and New Zealand (-0.23) is the gender difference above -0.20, and students in both countries reported infrequent online social activities. In Iceland, Austria, Korea, Japan, Australia, France, Hungary and the partner economy Hong Kong-China, the difference between boys and girls is at or slightly above 0.10 and statistically significant, with girls reporting more frequent social activities on line. In Poland, Sweden, Spain, Norway and Belgium, boys reported more frequent online social activities than girls, but in each case, the difference is small (< 0.04) and not statistically significant.

Online reading practices and digital reading proficiency

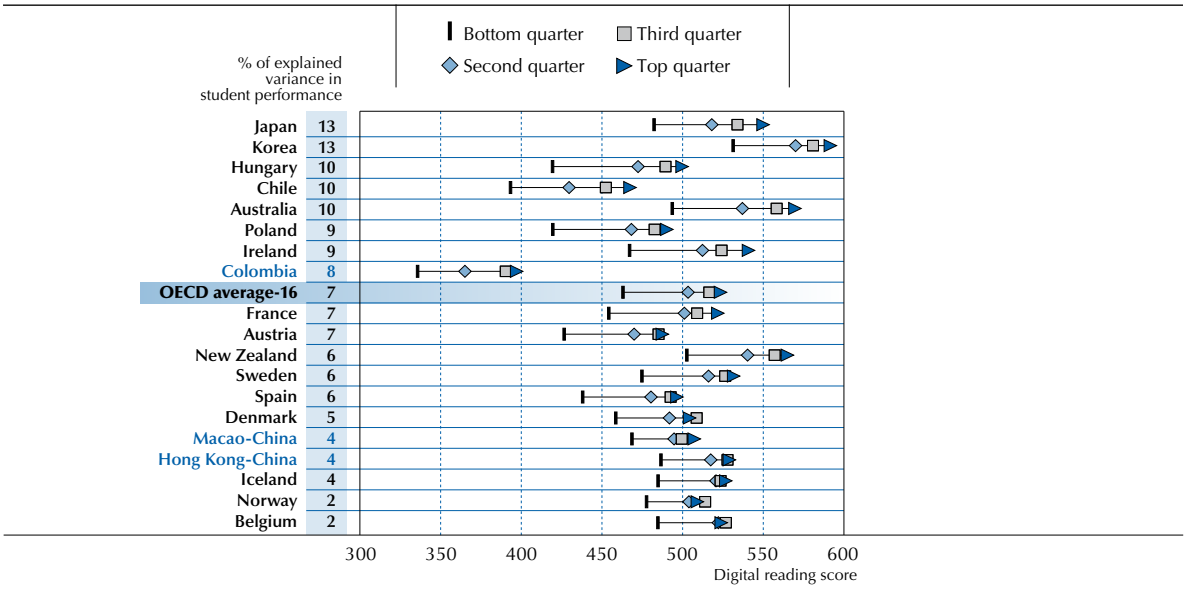
To what extent is the amount of time students reported spending on online searching-information or social activities related to digital reading proficiency?

In each of the 19 countries that took part in the digital reading option, more frequent online searching-information activities are related to better performance in digital reading. On average, the percentage of explained variation in the digital reading score is 7.5% (Table VI.4.11).

The difference between the students who reported being the least engaged in online searching-information activities and those who are most engaged is 60 score points, on average. The least engaged students (those in the bottom quarter) are 2.1 times more likely to perform poorly (in the bottom quarter of the national digital reading distribution) than the most engaged (those in the top quarter). In almost all countries, as students' engagement in searching information on line increases, their performance improves. Indeed, the average performance of each subsequent quarter is higher than the average performance of the previous quarter. On average across OECD countries, students in the first quarter attain a score of 463; in the second quarter, they attain a score of 503; in the third, a score of 516; and in the fourth quarter, they attain a score of 523. The average difference between the third and the fourth quarters is small. In many countries, only the difference between the least engaged students and the rest is meaningful. In all participating countries, the relationship between online searching-information activities and digital proficiency is non-linear.[12] This means that students who reported frequent online searching-information activities do not perform better than moderately engaged students; but they perform much better than the least-engaged students.

■ Figure VI.4.8 ■

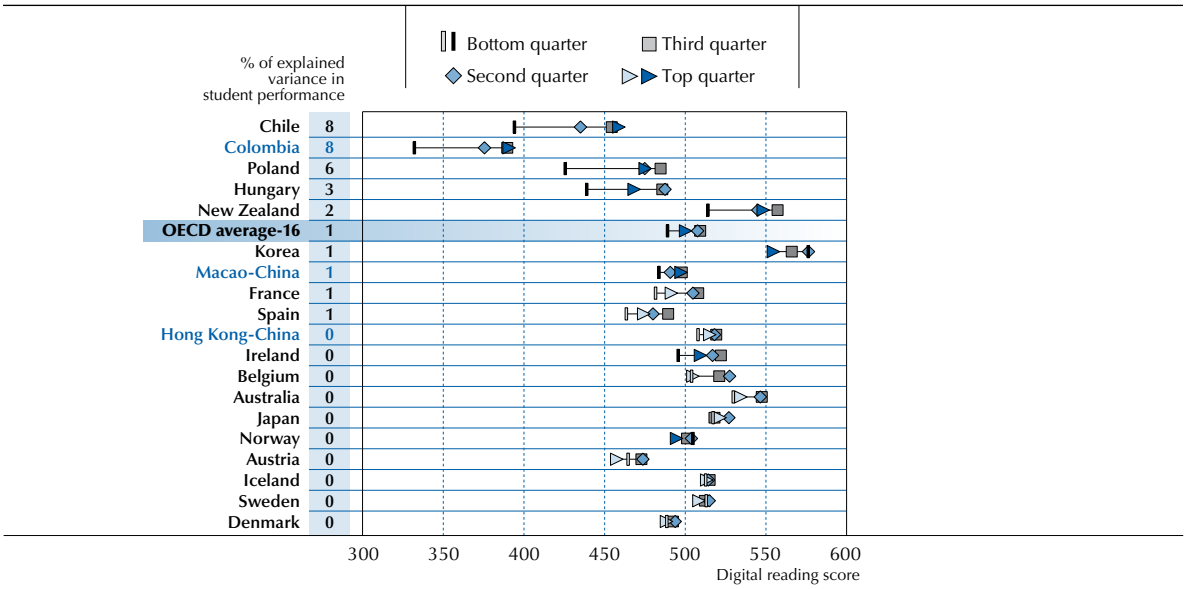
Relationship between online searching-information activities and digital reading performance



Note: All differences between the top and bottom quarters of this index are statistically significant.
Countries are ranked in descending order of the percentage of explained variance in student performance.
Source: OECD, *PISA 2009 Database,* Table VI.4.11.
StatLink http://dx.doi.org/10.1787/888932435416

■ Figure VI.4.9 ■

Relationship between online social activities and digital reading performance



Note: Countries in which differences between the top and bottom quarters of this index are statistically significant are marked in a darker tone.
Countries are ranked in descending order of the percentage of explained variance in student performance.
Source: OECD, *PISA 2009 Database,* Table VI.4.12.
StatLink http://dx.doi.org/10.1787/888932435416

In 14 out of 19 countries, the relationship between online searching-information activities and digital reading proficiency does not vary significantly according to gender. In New Zealand, Poland, Australia, Belgium and Japan, the relationship between those activities and digital reading proficiency is stronger and more positive for boys than for girls. In New Zealand, for instance, the score point difference associated with a change in one unit in the index of online searching-information activities is equal to 30 score points for boys and 19 score points for girls (Table VI.4.13).

Box VI.4.4 Relationship between online reading, print reading and enjoyment of reading

Do students who read more often on line also read a diversity of print material more frequently? Or is the reverse true? Contrary to common expectations, students who read more frequently on line also frequently read a diverse array of printed material. Moderate correlations (0.28 on average) are observed between online reading practices and a diversity of print reading material – ranging from 0.20 (Colombia) to 0.33 (Australia) (Table VI.4.20).

More precisely, the average correlation of print reading diversity with online searching-information activities is 0.33, while it is only 0.05 with online social activities. Correlations are noticeably high in the English-speaking countries Australia (0.39) and New Zealand (0.38); in the Nordic countries of Denmark (0.37), Norway (0.34) and Sweden (0.34); in Belgium (0.35) and in France (0.38). Thus, while students who spend more time searching for information on line also spend more time reading a diversity of print material, there is virtually no relationship between the time spent socialising on line and the time spent reading a diversity of print material.

Do students who spend more time reading on line also report more enjoyment in reading? Correlations between online reading practices and enjoyment of reading (attitudes towards reading) are, on average, weak (0.12) and close to zero in Iceland, Austria, Hungary, Poland, Sweden, the partner country Colombia and the partner economy Hong Kong-China. Correlations are somewhat stronger (equal to or higher than 0.20) in the three English-speaking countries of Ireland (0.23), New Zealand (0.21) and Australia (0.20). In these countries, students who read more on line have slightly more positive attitudes towards reading than students who read less on line.

Again, the relationship between enjoyment of reading and online searching-information activities (0.24) is, on average, stronger than its relationship with online social activities (-0.09). There is, in fact, a negative relationship between enjoyment of reading and online social activities: students who are frequently involved in online social activities have, on average, a less positive attitude towards reading.

In short, it appears that students who reported frequent online searching-information activities also read a diversity of print material more frequently, and more often reported enjoying reading. In contrast, students who reported intensive online social activities read neither more nor fewer kinds of print material than students who reported less frequent online social activities. Moreover, they show slightly less positive attitudes towards reading. Online social activities, then, seem to be independent of print reading and online searching-information practices; they are also weakly related to digital reading performance, especially for girls.

In most of the 19 countries that took part in the digital reading option, online social activities are weakly related to digital reading proficiency. The average amount of variation explained in the digital score is only 1.4%. Only in a few countries is the percentage of variation in the digital reading score somewhat more consistent, namely in Chile and the partner country Colombia (both with 8% of variation explained), and in Poland (6% of variation explained). Online social activities are thus less related to digital reading performance than online searching-information activities. Most of the digital reading tasks call for searching-information strategies and navigation, skills that can be developed or reinforced by repeated contact with online searching-information practices. Some tasks more related to online social practices are also included in the digital reading tasks, but those tasks require basic skills that are now familiar to almost all 15-year-olds.

Students who are among the least engaged in online social activities are only 1.35 times more likely to perform poorly (in the bottom quarter of the national distribution of digital reading performance) than students in the most-engaged quarter. The difference between students who reported being the least engaged in such activities and those who reported being most engaged is only 11 score points, on average. Only in Chile, Poland, Hungary, New Zealand, the partner country Colombia and the partner economy Macao-China are the differences between students in the least-engaged (bottom) quarter and students in the other three (more engaged) quarters somewhat greater. In fact, a unique pattern arises here: the least engaged (first quarter) and the most engaged (fourth quarter) attain, on average, the weakest scores: 489 and 500, respectively (OECD average). Meanwhile, moderately engaged (second and third quarters) students attain, on average, slightly better scores: 508 for those in the second quarter and 509 for those in the third quarter.

Thus, online searching-information activities are linked more linearly to better digital reading performance: the more the students are involved in searching information on line, the better they perform on digital reading tasks, even if the difference between the third and the fourth quarters is small. For online social activities, there is a kind of "optimum threshold" of involvement in those activities.[13] Students who are below this threshold are at risk of performing less well on digital reading tasks than students who reach this threshold. Being unfamiliar with online social practices seems to be associated with low digital reading proficiency; but students who frequently e-mail and chat on line also perform less well than students moderately involved in these activities.

In 11 out of the 19 countries, the relationship between online social activities and digital performance is not significantly different for boys and girls. In Austria, Ireland, Hungary Iceland, New Zealand, Australia, Denmark and Sweden, the relationship between online social activities and digital reading proficiency is stronger and more positive for boys than for girls. In Hungary, for instance, the score point difference associated with a change in one unit in the index of online social activities is equal to 22 score points for boys and 11 score points for girls. In most of the above-mentioned countries, the score point difference associated with a change in one unit in the index of online social activities is positive for boys and negative for girls (for instance: -9 for girls, +3 for boys in Austria, -6 for girls, +4 for boys in Iceland, and -5 for girls, +3 for boys in Sweden) (Table VI.4.14).

READING STRATEGIES

Students employ different reading techniques and processes to help them to learn. The PISA 2009 student questionnaire included a number of questions to find out which strategies students favour the most and which strategies are effective. Analyses have focused on two strategies: those to understand and remember information, and those to summarise what they have read. This volume asks whether there is an association between these strategies and digital reading proficiency, and whether there is any difference in how they are associated with digital and print reading proficiency.

Awareness of strategies to understand and remember information

Students were asked to rate different strategies for understanding and remembering information that they had read. The extent to which their ratings corresponded to those of experts determined their score on this index (see Annex A1a for a full description of how this index was constructed).

For both print and digital reading, students in Belgium, Austria, France, Denmark and Ireland, among OECD countries, reported to be most knowledgeable about effective strategies to understand and remember information they have read. Students in Norway, Iceland, Sweden, Poland, the partner country Colombia and the partner economy Hong Kong-China reported to be least knowledgeable about these strategies (Table VI.4.15).

This index is associated with proficiency in both digital and print reading. The relationship appears to be stronger for print reading than for digital reading. The change in score associated with a one standard deviation change in the index is 31.9 points for digital reading and 36.5 points for print reading. The variance explained by this index is 13.1% for digital reading and 15.7% for print reading.

Students with lower levels of awareness of these strategies were more likely to attain lower levels of proficiency in the digital reading assessment: 73% of the students at Level 1a or lower have a low awareness of these strategies (see Table VI.4.16).

Awareness of effective strategies to summarise information

Students were asked to rate different strategies for summarising information that they had read (see Annex A1a for a full description of how this index was constructed).

For both print and digital reading, students in France, Denmark, Belgium, Ireland, and Norway, among OECD countries, reported to be most knowledgeable about effective strategies for summarising information. Students in Iceland, Chile, the partner country Colombia and the partner economies Hong Kong-China and Macao-China reported to be least knowledgeable about these stratetgies.

This variable is associated with proficiency in both digital and print reading. The relationship appears to be stronger for print reading than for digital reading. The change in score associated with a one standard deviation change in the index is 38.4 points for digital reading and 43.0 points for print reading. The variance explained by this index is 19.0% for digital reading and 21.9% for print reading (Table VI.4.17).

MODEL FOR THE RELATIONSHIP BETWEEN READING PERFORMANCE AND STUDENT BACKGROUND CHARACTERISTICS

By combining these variables into a single-level regression model it is possible to examine the amount of variance explained by each of the variables after the effects of the other variables have been accounted for. Since this is a single-level model, it only considers student-level background characteristics (see Table VI.4.19).

Chapter 7 of this report presents a multilevel model that considers student and school aspects together.

■ Figure VI.4.10 ■

Single-level model to explain performance in digital and print reading, OECD average-16

	Variance explained by:										
	Highest occupational status of parents (HISEI)	Highest level of parents' education	Index of cultural possessions	Index of home educational resources	Number of books at home	Index of family wealth	Single-parent family	Immigrant background (first- and second-generation)	Non-native	Language spoken at home	Total explained variance
	%	%	%	%	%	%	%	%	%	%	%
Digital reading	0.7	0.9	0.6	0.7	2.9	0.4	0.1	0.2	0.3	0.2	19.0
Print reading	2.0	0.4	0.8	0.6	3.6	0.8	0.1	0.1	0.2	0.3	22.7

Source: OECD, *PISA 2009 Database*, Table VI.4.19.
StatLink http://dx.doi.org/10.1787/888932435416

Parents' occupation

PISA obtains information about parents' occupations from student responses to the questionnaire. These are then coded using the ISCO88 coding of occupations. PISA uses the higher of the two parents' occupations (labelled HISEI). In the 16 relevant OECD countries, parents' occupation, by itself, explained 0.7% of the variance in digital reading performance and 2.0% of the variance in print reading performance as shown in Figure VI.4.10.

Parents' education

PISA obtains information about parents' education from responses in the student questionnaire, then converts the responses to years of schooling. The higher value of the two parents is used in the analysis. Parents' education, by itself, accounted for just 0.9% of the variance in digital reading performance and 0.4% of the variance in print reading performance.

Number of books in the home

Students were asked to estimate the number of books in their homes to determine whether that has any relationship with student performance. Table VI.4.19 shows that, on average across OECD countries, the number of books at home explains 2.9% and 3.6% of the variance in student performance in digital reading and print reading, respectively.

The fact that the number of books (*i.e.* printed reading material) at home is associated with performance in digital reading underscores the importance of reading as the foundation for lifelong learning.

Cultural possessions

The *index of cultural possessions* is based on students' responses to whether they had the following at home: classic literature, books of poetry, and works of art. In the model, cultural possessions accounted for less than 1% of the variance in student performance in both digital and print reading.

Home educational resources

The *index of home educational resources* is based on the items that measure the level of educational resources at home, such as a desk and a quiet place to study, a computer that students can use for schoolwork, educational software, books to help with students' school work, technical reference books, and a dictionary. In the model, home education resources accounted for less than 1% of the variance in student performance in both digital and print reading.

CONCLUSIONS

Results of previous PISA surveys have shown that one of the most important aspects related to student performance in print reading is students' enjoyment of reading. This was also true in PISA 2009, as the *index of enjoyment of reading* explained 20% of the variation in student performance in print reading, with a 103 score point difference between the least enthusiastic and the most enthusiastic students. In digital reading, the relationship is not quite as strong, with the index explaining 14% of the variation and an 89 score point difference between the least enthusiastic and the most enthusiastic students.

Students who read widely also tend to be more proficient in print reading and in digital reading, with a 53 score point difference on the digital reading scale between those who read a narrow range of materials and those who read a more diverse mix of materials. Online reading practices account for more of the variation in digital reading (6%) than in print reading (3%).

The socio-economic background of students, as expressed in the *PISA index of economic, social and cultural status*, influences both print and digital reading. When examining the social gradient, or the extent to which socio-economic background affects performance, it was found that, across participating OECD countries, a one unit difference in the index was associated with a 38 score point difference in digital reading performance and a 40 score point difference in print reading performance. PISA results also show that 14.1% of the variation in student performance in digital reading is explained by socio-economic background – a percentage almost identical to that in print reading (14.4%).

What seems most remarkable about this set of results is the similarity in the relationship between these aspects and student performance in both print and digital reading. Students' attitudes and family backgrounds seem to have much the same effects on reading proficiency in both media.

Notes

1. For full details of the calculation of the *PISA index of economic, social and cultural status*, see the *PISA 2009 Technical Report* (OECD, forthcoming).

2. Japan and Korea are not represented in this figure because they have insufficient numbers of immigrant students.

3. For a detailed description of the index, see Annex A1a and the *PISA 2009 Technical Report* (OECD, forthcoming).

4. When analyses refer to the countries that took part in the digital reading option (19 countries), the average is computed for the 16 OECD countries out of the 19 countries. The partner countries and economies Colombia, Hong Kong-China and Macao-China are not included in the average.

5. The variation of the relationship between reading enjoyment and digital reading proficiency related to gender is not statistically significant in 15 out of 19 countries.

6. In order to allow for the comparison, the percentage of variation explained for print reading has been computed for the same set of 16 OECD countries that participated in the digital reading option. Results from this volume are comparable with those for print reading in Volume III.

7. For a detailed description of the index, see Annex A1a.

8. It is calculated based on the 16 OECD countries that administered the digital reading assessment.

9. The proportion of the variance explained by the index of online reading activities was complutered based on the *PISA 2009 Database* (*www.pisa.oecd.org*).

10. A factor analysis performed on equally weighted countries extracts two factors. The first explains 22% of the total variance and the second explains 14% of the total variance.

11. The proportion of the variance in performance explained by the index of online reading activities was computed based on the *PISA 2009 Database* (*www.pisa.oecd.org*)

12. An analysis aimed at estimating whether the curvilinear relationship between online searching information and digital proficiency is significant shows that curvilinearity is statistically significant in each of the participating countries.

13. An analysis aimed at estimating whether the curvilinear relationship between online social practices and digital proficiency is significant shows that curvilinearity is statistically significant in each of the participating countries.