4

The Importance of Navigation in Online Reading: Think, then Click

Not only are certain text-processing skills particularly important when reading on line, readers must also be able to navigate through and among different texts. This chapter describes students' digital navigation abilities and examines the relationship between navigation skills and performance in digital reading.

While some similar skills are required to read both online and printed documents, online texts often pose greater challenges to readers than printed texts. In both types of documents, readers need to locate key pieces of information, interpret nuances of language, integrate different elements of the text, draw upon prior knowledge of textual and linguistic structures and features, and reflect on the arguments used or the appropriateness of the style, based on their own experience and knowledge of the world. Among these skills, *evaluative skills* can be particularly important for the typical text forms encountered on line. Students who read on line use their prior experience (e.g. about the authority of a certain source) and hints, such as layout, poor grammar and spelling, to assess the trustworthiness and relevance of the information and draw correct inferences from their reading.

In contrast to typical print documents, however, typical online documents are characterised by multi-modality (the combination of text, static images, animations, embedded videos including sound, etc.) and by the presence of hyper-links that create non-sequential page structures. Thus, not only are certain *text-processing* skills particularly important when reading on line, readers must also *navigate* through and among different texts.

What the data tell us

- One in ten students in OECD countries demonstrated limited or no web-browsing activity during the digital reading assessment, signalling a lack of basic computer skills, a lack of familiarity with web browsing or a lack of motivation. By contrast, most students in Korea, Macao-China, Shanghai-China and Chinese Taipei navigated through a high number of pages to arrive at their answer.
- Students in Singapore, Australia, Korea, Canada, the United States and Ireland rank the highest for the average quality of their web browsing (task-oriented browsing). More often than in other countries, these students carefully select links to follow before clicking on them, and follow relevant links for as long as is needed to answer the question.
- There is a strong association between countries' digital reading performance and the quality of students' navigation (task-oriented browsing), even after accounting for performance in print reading.

The skills required to master navigation include good evaluation: assessing the credibility of sources and predicting the likely content of a series of unseen screens, based on hints such as the explicit name assigned to a link, the surrounding text, and the URL that appears by hovering over the link with a mouse. They also include organisational and spatial skills, such as the ability to construct a mental representation of the structure of a website in order to move confidently across the different pages of which it is composed. While related skills are required in print reading as well, the greater uniformity of document types (such as books) and the physical existence of printed documents help readers to meet these demands (Noyes and Garland, 2003; Mangen et al., 2013).

Moreover, students' navigation behaviour and skills cannot be assessed in print reading, but can be measured, in online text, by tracking students' clicking and scrolling behaviour.

PISA digital reading tasks, which were originally developed for use in the PISA 2009 assessment, were constructed to vary in the level of text-processing skills required as well as in the complexity of the required navigation. Box 4.1 describes the main factors that determine the difficulty of navigation.

Box 4.1. **What accounts for the difficulty of navigation?**

The main source of navigation complexity is the number of pages that need to be viewed in order to complete the task. A simple digital reading task may focus on information that is immediately visible on the starting page of the task. It may require scrolling on that page, or it may require the reader to visit several pages or sites. A task becomes more difficult when the information needed to complete it is not immediately visible.

Complexity of navigation also depends on the quantity, prominence, consistency and familiarity of navigation tools and structures on the available pages. When moving between pages is required, if there are many hyperlinks or menu items to choose from, the reader is likely to find the task more difficult than if there are only one or two hyperlinks to choose from. A task is easier if there are prominently placed links in a conventional location on the screen; a task is more difficult if links are embedded in the text or are in an otherwise unconventional or inconspicuous part of the screen. Cluttered web pages and the presence of advertisements or visuals that deflect the readers' attention from the relevant links contribute to the difficulty of navigation.

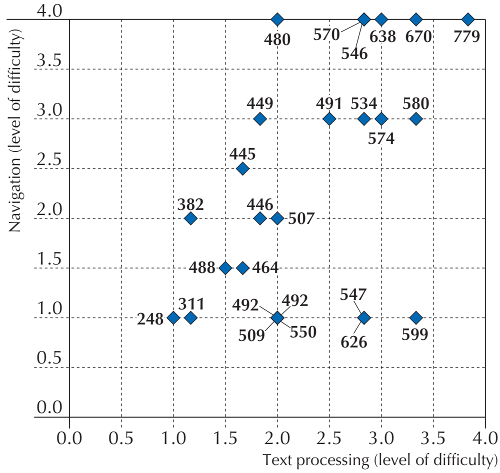
Explicit instructions about the navigation required also reduce task difficulty. Even when the reader needs to consult several pages, explicit directions about the pages that must be visited and the navigation structures to use can make the task relatively easy. A familiar organisation of a website, such as a hierarchical structure, may function as an implicit hint and can facilitate navigation.

Figure 4.1 shows how demands for navigation and text processing contribute to the difficulty of tasks used in the PISA 2012 assessment of digital reading competence. These tasks are a subset of those used in 2009.

As the figure shows, navigation demands and requirements for text-processing skills both contribute to the overall difficulty of each task. The most difficult tasks combine high demands for navigation and advanced text-processing skills. Sometimes, tasks with similar demands for these two sets of skills may still vary in difficulty. Other factors also contribute to task difficulty, such as whether students are asked to construct a response or simply to select a response from a list of suggested answers.

■ Figure 4.1 ■

Relationship between text processing and navigation in digital reading tasks



Notes: The horizontal axis shows the average of experts' ratings of text-processing demands; the vertical axis shows the average of experts' ratings of navigation demands (both ratings are expressed on a 1-4 scale, with 4 corresponding to the most difficult). Each task is represented by a diamond labelled with its overall difficulty, expressed in PISA score points. Several tasks may have the same level of text processing / navigation difficulty.
Source: OECD (2011), *PISA 2009 Results: Students on Line: Digital Technologies and Performance (Volume VI)*, p.43, http://dx.doi.org/10.1787/9789264112995-en.
StatLink http://dx.doi.org/10.1787/888933253022

SUCCESSFUL AND UNSUCCESSFUL NAVIGATION

How do students master navigation demands? What constitutes good navigation?

Clearly, good navigation behaviour cannot be defined in the abstract; the purpose of each task must be taken into account. Reading, including online reading, is always performed with particular goals in mind. Good navigation can be characterised as navigation behaviour that is consistent with these goals. This alignment of behaviour and goals requires both cognitive resources, e.g. understanding the goal of each task, and meta-cognitive regulation, e.g. ensuring that navigation is guided by task demands and not by personal interests.

In order to describe students' navigation behaviour, the sequence of pages visited by students in the process of solving each task was extracted from the log files recorded by the test administration platform. A first measure of students' navigation activity is the length of navigation sequences, which corresponds to the number of movements between different pages (steps) recorded in log files. The number of movements can be expected to be positively related to performance in digital reading for three reasons. First, because by being active on the task, students generate information that they can use to solve the task. Second, longer sequences are often required to solve the more complex tasks. Finally, because short navigation sequences may indicate a lack of motivation and persistence or lack of basic computer skills and familiarity with the typical text formats encountered on line.

To further identify task-adaptive navigation, pages were classified as relevant and non-relevant to the task, and each step (movement between pages) in the full sequence was classified as a task-relevant step (from and to a relevant page), a misstep (movement from a relevant to a non-relevant page), a correction (from a non-relevant to a relevant page), or a task-irrelevant step (from and to non-relevant pages). Relevant pages meet at least one of the following criteria (OECD, 2011; Naumann, forthcoming):

- the page contains information that is necessary in order to complete the task;
- the page contains information that could be assumed to be helpful in completing the task;
- it is necessary to transit through the page in order to reach a page that meets one of the two previous criteria (the starting page of each item, for instance, is always coded as relevant).[1]

While it is possible to follow different paths in order to collect the information required to solve a task, the most effective and efficient paths typically remain on relevant pages only. It is therefore expected that performance in digital reading is positively related to the number of task-relevant steps, and negatively related to movements that stray from the expected path, particularly if students do not revert to the expected path at a later stage. Task-irrelevant movements between non-relevant pages are also expected to signal lower performance.

How navigation is related to success in digital reading tasks

To identify effective navigation behaviours, success on each digital reading task was related, in regression models, to variables describing students' navigation sequence. In a first model, the navigation sequence was described only in terms of its length (the number of movements between pages, or steps, that made up the sequence). In a second, more detailed model, the quality of these steps was inspected, with the sequence decomposed into the four types of steps described above: task-relevant steps, task-irrelevant steps, and missteps, which were separated into those for which a further navigation step later on provided a correction, and those that remained uncorrected (see Annex A.3 for details about the estimation).

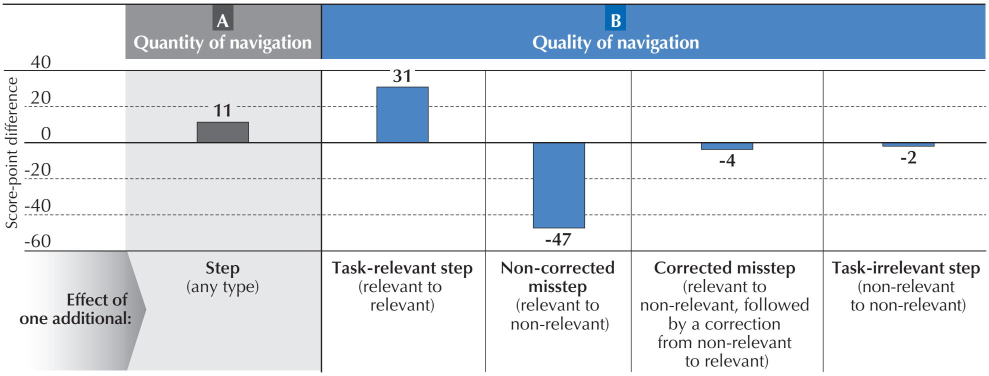
In general, longer navigation sequences were associated with greater success. It can be estimated that students who visited one additional page per task scored 11 points higher on the PISA scale, on average across countries (Figure 4.2). However, as expected, not all navigation steps signal better performance. Only task-relevant steps – from relevant to relevant pages – are positively associated with performance. Movements from relevant to non-relevant pages are associated with lower performance, in general, and particularly if they are not corrected later on by returning to a relevant page.

The relation between navigation behaviour and success in digital reading tasks varies, too, depending on the difficulty of navigation required. Actively generating information by visiting a high number of pages is important only where this is required to solve the problem. In simple tasks, a high level of browsing activity may signal unfocused behaviour, and is therefore negatively associated with performance (Figure 4.3). This negative association is particularly evident in high-income countries where students are familiar with computers and with online texts (see Table 4.5b for estimates about individual countries/economies).

■ Figure 4.2 ■

Relationship between success in digital reading tasks and the quantity and quality of navigation steps

Score-point difference associated with a one-unit increase in the average number of navigation steps across tasks (OECD average)

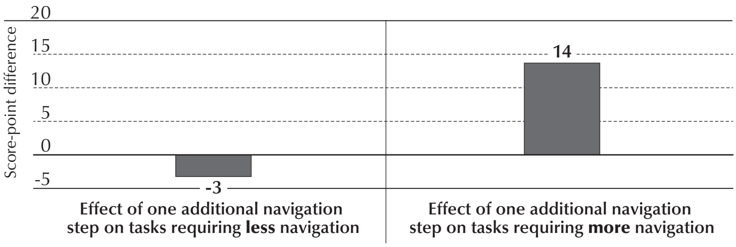


Notes: The figure reports estimates from two separate logit models (A and B). Logit coefficients are converted into PISA score-point equivalents (see Annex A.3).
All estimates are statistically significant.
The figure shows that, across the OECD on average, one additional step in each task's navigation sequence is associated with a gain of 11 score points on the digital reading scale. One additional task-relevant step is associated with a gain of 31 score points on the digital reading scale.
Source: OECD, PISA 2012 Database, Tables 4.5a and b.
StatLink http://dx.doi.org/10.1787/888933253039

■ Figure 4.3 ■

Relationship between success in digital reading tasks and the quantity of navigation steps, by difficulty of tasks

Score-point difference associated with a one-unit increase in the average number of navigation steps across tasks (OECD average)



Notes: The figure reports estimates from a logit model where the dependent variable has been interacted with a binary indicator of demands for navigation. Logit coefficients are converted into PISA score-point equivalents (see Annex A.3).
All estimates are statistically significant.
The figure shows that, in tasks requiring less navigation, sequences that become longer by one step, on average, are associated with a decline of 3 points on the digital reading scale. In contrast, in tasks requiring more navigation (where the number of required steps is higher), a one-unit increase in the average number of steps observed is associated with a gain of 14 points on the digital reading scale.
Tasks requiring less navigation are defined as those tasks where the average of experts' ratings of navigation demands (see Figure 4.1) is not greater than 1.5 on a scale of 1 to 4.
Source: OECD, PISA 2012 Database, Table 4.5a.
StatLink http://dx.doi.org/10.1787/888933253040

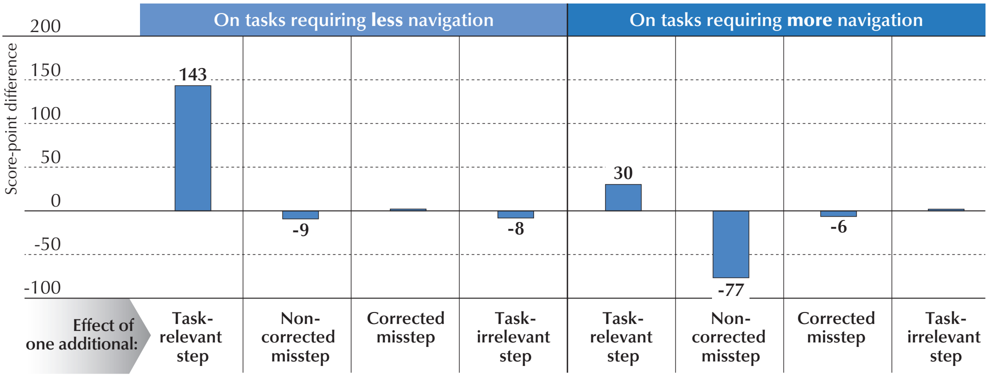
Furthermore, in tasks where demands for navigation are minimal (as in *SERAING*, Task 1[2]), e.g. because the relevant information is on the starting page or can be clearly accessed from it, the most important predictor of success is whether the student performed the few relevant steps that were required.[3] Indeed, when the relevant information is only one or two steps away, any task-relevant sequence is a big step towards the solution. Deviations from the task-relevant path may signal curiosity, more than difficulties with navigation, and are rare; they are associated with relatively small penalties in terms of performance.[4]

In contrast, in tasks demanding complex navigation, many steps are required to locate the relevant information, which itself is often dispersed, so that students need to integrate information from several pages to reach a solution. This is the case in the second and third tasks within the unit *SERAING*. In these and similar tasks, each step along the task-relevant path is a small step towards the solution. Steps away from the task-relevant path that are not followed by a correction can reduce the likelihood that all relevant information to solve the task will be collected. Thus they are associated with a significant penalty. On average, students whose navigation sequences end on non-relevant pages in tasks demanding complex navigation score an estimated 77 points lower on the PISA digital reading scale than students whose navigation ends on a relevant page. Figure 4.4 shows how the relationship between performance in digital reading, on the one hand, and task-relevant and task-irrelevant steps, on the other, varies across tasks requiring simple or complex navigation.

■ Figure 4.4 ■

Relationship between success in digital reading tasks and the quality of navigation, by difficulty of tasks

Score-point difference associated with a one-unit increase in the average number of navigation steps across tasks (OECD average)



Notes: The figure reports estimates from a logit model where dependent variables have been interacted with a binary indicator of demands for navigation. Logit coefficients are converted into PISA score-point equivalents (see Annex A.3).
Statistically significant estimates are reported above/below the columns.
The figure shows that, in tasks requiring less navigation, one additional task-relevant step is associated with a gain of 143 points on the digital reading scale. In tasks requiring more navigation (where the number of required steps is higher), one additional task-relevant step is associated with a gain of 30 points on the digital reading scale.
Tasks requiring less navigation are defined as those tasks where the average of experts' ratings of navigation demands (see Figure 4.1) is not greater than 1.5 on a scale of 1 to 4.
Source: OECD, PISA 2012 Database, Table 4.5b.
StatLink http://dx.doi.org/10.1787/888933253054

In sum, navigation behaviour predicts success in digital reading tasks. More precisely, effective navigation is characterised by a task-oriented selection of what to read, and can thus be measured by observing whether readers access the relevant nodes within a hypertext, e.g. by counting the number of steps in the navigation sequence that involve only relevant pages. Effective navigation is further characterised by sequences that always end on relevant pages. Movements away from the expected navigation path must be corrected to succeed in complex digital reading tasks.

THE NAVIGATION BEHAVIOUR OF STUDENTS IN THE PISA ASSESSMENT OF DIGITAL READING

Based on the analysis of what constitutes effective and ineffective navigation, two indices were computed to describe how students navigate websites when performing typical online reading tasks. The first index captures the quantity of navigation; the second index, the quality of navigation.

Student-level indices used to describe navigation behaviour

First, as a rough measure of the amount of students' overall activity, the total number of tabs and links visited, beyond the starting page, is examined. The *index of overall browsing activity* varies between 0 and 100, with 0 indicating no activity and 100 indicating maximum activity.[5] Very low scores on this index may indicate either lack of motivation, great difficulties in basic text-processing skills (e.g. understanding the purpose of a task) or lack of familiarity with the typical forms of hypertext encountered on line or with basic computer skills, such as using a mouse to navigate a webpage or scroll down a list.

Second, an *index of task-oriented browsing* is formed by examining the sequence of page views and distinguishing between task-relevant steps, missteps, and task-irrelevant steps within the navigation sequence.[6] This index captures whether students carefully select the links they follow, according to the demands of each task. Students who navigate websites by staying on the task-relevant track, and who persist in doing so until they reach the solution, score the highest on this index. Those who navigate in an unstructured way, and are easily distracted by task-irrelevant content, score the lowest on this index, followed by students with insufficient navigation activity.

The typical navigation behaviour of students across countries/economies

There is considerable variation in the navigation behaviour of students across the countries and economies that participated in the PISA assessment of digital reading.

Overall browsing activity

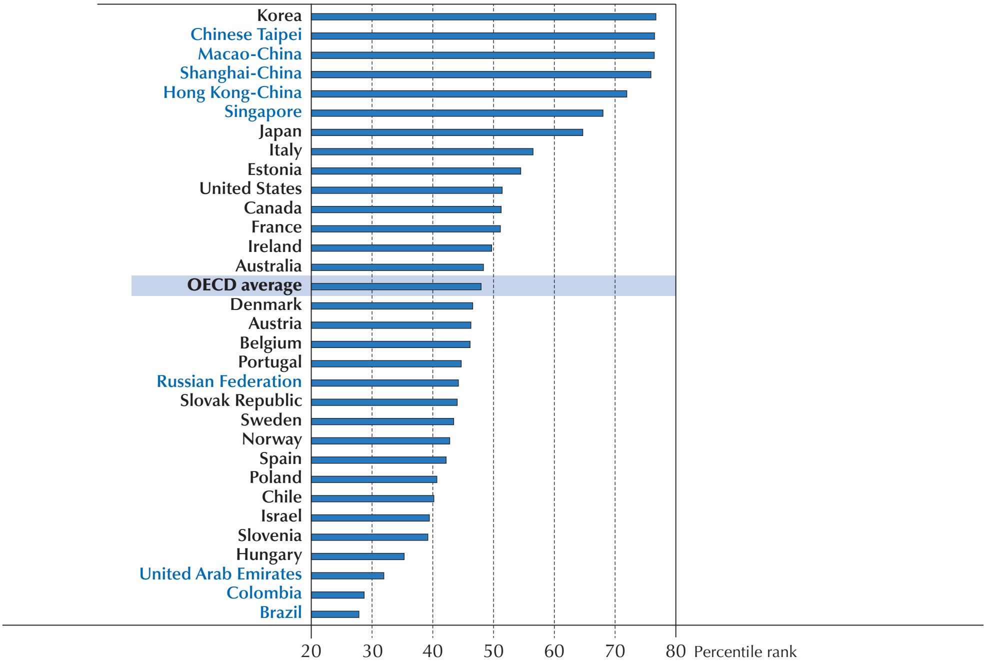
Figure 4.5 shows students' average rank among all students who sat the PISA test, based on their amount of browsing activity. Students with the highest number of page visits score a value of 100 on this index, while students with the lowest number of page visits score a value of 0. This measure is related to the willingness of students to engage in reading, their familiarity with basic computer skills, their ability to read fast, and their persistence in solving difficult tasks.

By this simple measure, East Asian countries and economies (Korea, Chinese Taipei, Macao-China, Shanghai-China, Hong Kong-China, Singapore and Japan, in decreasing order of their mean value on this index) stand out for having the highest average values.

■ Figure 4.5 ■

Overall browsing activity

Average rank of students in the international comparison of students taking the same test form



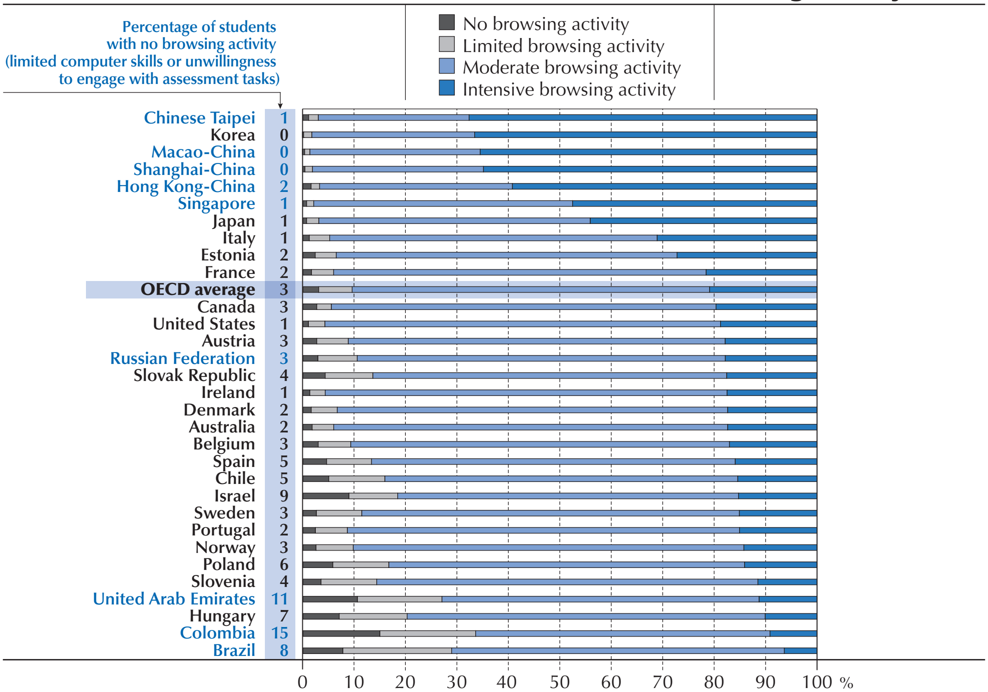
Note: The *index of overall browsing activity* varies from 0 to 100, with 0 indicating no browsing activity (no page visits beyond the starting page) and 100 indicating the highest recorded level of browsing activity (page visits) for each test form.
Countries and economies are ranked in descending order of the index of overall browsing activity.
Source: OECD, PISA 2012 Database, Table 4.1.
StatLink http://dx.doi.org/10.1787/888933253068

Within each country/economy, however, students' navigation behaviour varies. To characterise this variation in students' browsing activity, four categories of students were constructed (Figure 4.6): students with no browsing activity, students with some but limited browsing activity, and students with intensive browsing activity. The fourth middle category groups students with moderate browsing activity.

At the bottom are students for whom no browsing activity at all was recorded in log files. Most likely, these students lack basic computer skills, such as operating a mouse, or lack basic familiarity with web browsing, such as knowledge of links and tabs. In a few cases, a technical failure in the hardware or software used to administer the test may have resulted in no activity being recorded. On average across OECD countries, 3% of students are in this category. In Israel (9%) and Hungary (7%), as well as in partner countries Colombia (15%), the United Arab Emirates (11%) and Brazil (8%), the share is much larger (Figure 4.6).

■ Figure 4.6 ■

Classification of students based on their overall browsing activity



Note: The four categories in this figure are defined as follows. No browsing activity: students with no navigation steps recorded in log files; Limited browsing activity: some navigation steps recorded, but *index of overall browsing activity* equal to 10 or lower; Moderate browsing activity: *index of overall browsing activity* between 10 and 75; Intensive browsing activity: *index of overall browsing activity* higher than 75.
Countries and economies are ranked in descending order of the share of students who browse intensively.
Source: OECD, PISA 2012 Database, Table 4.2.
StatLink http://dx.doi.org/10.1787/888933253075

The next group shows some, but only limited activity. Their level of activity places these students in the bottom decile among all students who were given the same digital reading questions. Combined with the no-activity group described above, these groups represent 10% of students, on average across OECD countries. In East Asian countries and economies participating in PISA, however, fewer than 4% of all students show no, or only limited, activity. One reason for these countries'/economies' good performance on the test, therefore, may be their students' willingness to try to answer questions.

At the other extreme are students with high levels of activity (those with the longest navigation sequences). For better or worse, these students are persistent in their navigation behaviour. They rank in the top quarter of all students who sat the PISA test internationally, based on the amount of navigation recorded. About two in three students in Hong Kong-China, Korea, Macao-China, Shanghai-China and Chinese Taipei belong to this category – significantly more than in any other country/economy participating in PISA. Students in Estonia, Italy, Japan and Singapore are also more frequently found in this group than students across OECD countries, on average (Figure 4.6).

Task-oriented browsing

Reading a lot and fast is not always desired or efficient. It can be the sign of reading that is unfocused, oblivious to the specific purposes of the task. What's more, online readers who access non-relevant links may expose themselves or their hardware to significant threats, such as illegal or fraudulent content, spyware, viruses or worms. To avoid such threats, students need to exert self-control while reading on line.

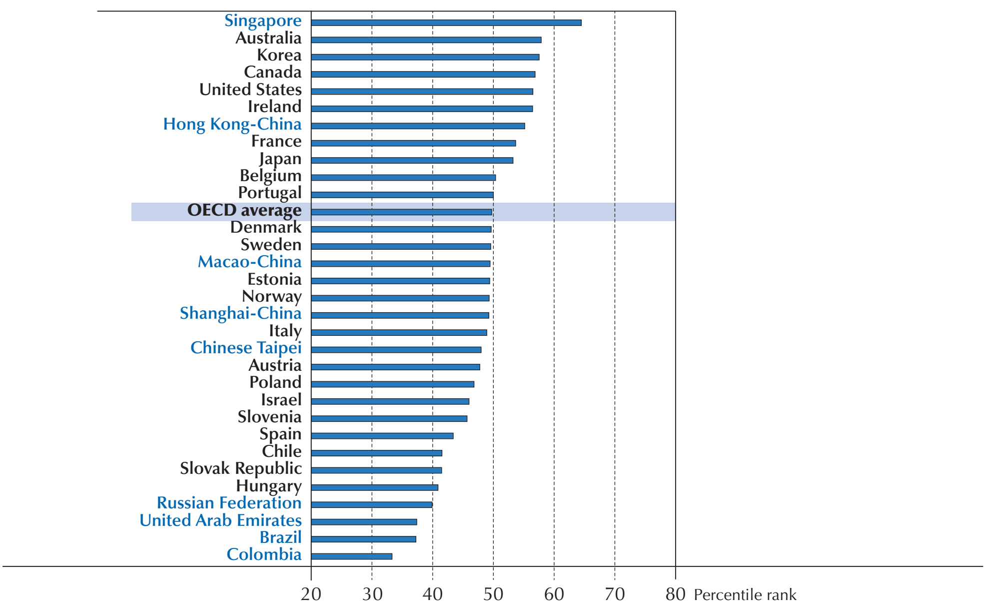
The second measure used to characterise students' navigation proficiency thus assesses whether or not students' navigation conforms to expectations, given the demands of the task. Students score high on this index if they select the links that they follow based on the purpose of each task ("think, then click"). Students who are less selective, and only think whether the link is relevant after having clicked on it (if at all), score low on this index, as do students who do not persist in their navigation for as long as the task demands.

Figure 4.7 shows that, on average, students in Singapore, followed by students in Australia, Korea, Canada, the United States and Ireland, rank the highest for the average quality of their browsing.

■ Figure 4.7 ■

Task-oriented browsing

Average rank of students in the international comparison of students taking the same test form



Note: The *index of task-oriented browsing* varies from 0 to 100. High values on this index reflect long navigation sequences that contain a high number of task-relevant steps and few or no missteps or task-irrelevant steps.
Countries and economies are ranked in descending order of the index of task-oriented browsing activity.
Source: OECD, PISA 2012 Database, Table 4.1.
StatLink http://dx.doi.org/10.1787/888933253082

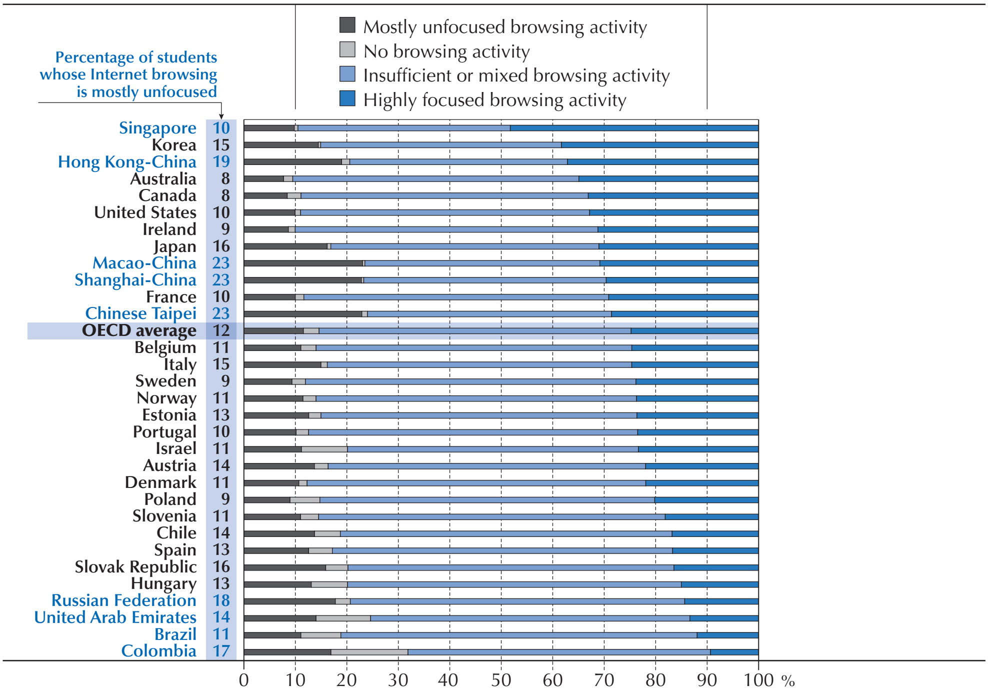
Students in these countries tend to be the most selective in their online navigation behaviour, carefully selecting links to follow before clicking on them, and following relevant links for as long as is needed to solve the task.

There are large differences in the rankings of countries, depending on whether the quality of students' browsing (Figure 4.7) or the quantity of students' browsing (Figure 4.5) is considered. While students in Macao-China, Shanghai-China and Chinese Taipei have among the highest levels of activity, they rank much lower in terms of the quality of their browsing activity.

Indeed, some students know how to browse and are willing to engage with a task, but are "digitally adrift", in that they do not navigate as if they were guided by a clear direction. Figure 4.8 shows that more than one in five students in Macao-China, Shanghai-China and Chinese Taipei belong to the group of students with mostly unfocused browsing activity. In contrast, in Australia, Canada, France, Ireland, Poland, Singapore, Sweden and the United States, less than 10% of all students belong to this group.

■ Figure 4.8 ■

Classification of students based on the quality of their browsing activity



Note: The four categories in this figure are defined as follows. Mostly unfocused browsing activity: students for whom the sum of navigation missteps and task-irrelevant steps is higher than the number of task-relevant steps; No browsing activity: no navigation steps recorded in log files; Insufficient or mixed browsing activity: the sum of navigation missteps and task-irrelevant steps is equal to the number of task-relevant steps or lower, and the *index of task-oriented browsing* is equal to 75 or lower. Highly focused browsing activity: *index of task-oriented browsing* higher than 75.
Countries and economies are ranked in descending order of the share of students with highly focused browsing activity.
Source: OECD, PISA 2012 Database, Table 4.3.
StatLink http://dx.doi.org/10.1787/888933253097

At the same time, the group of students whose navigation behaviour best conforms to task demands – those who rank in the top quarter for the quality of their browsing among all students who sat the PISA digital reading test – is largest in Singapore (48%), Korea (38%), Hong Kong-China (37%), Australia (35%), Canada (33%) and the United States (33%) (Figure 4.8 and Table 4.3).

The difference between rankings based on quantity and rankings based on quality may be related to the behaviour of students who make missteps when navigating a website. Box 4.2 explores cross-country differences in how students react to such missteps.

In sum, students in Australia, Canada, Korea, Singapore and the United States have, on average, the most task-driven, and thus better, navigation sequences. Students in East Asian countries and economies tend to have long navigation sequences. More often than in other countries, however, these sequences occasionally deviate from the expected path. A possible reason for this is that in these countries and economies, even the students who are most likely to make mistakes are willing to try. In the confined space of a simulated web environment, this behaviour occasionally leads them to the right cues to solve PISA tasks. It may have more negative consequences if applied to the unconfined World Wide Web.

Box 4.2. **How students react when they deviate from the expected navigation path**

A third measure used to describe students' typical browsing activity focuses on students' missteps. Leaving students with no or only limited browsing activity aside, it groups students into three classes: those who never deviate from the task-relevant path (no missteps); those who occasionally deviate and visit task-irrelevant pages, but always correct such mistakes by returning to the expected path (in which case, the number of corrections is equal to the number of missteps); and those who make missteps and do not always correct them (e.g. because they do not realise their misstep or do not know how to return on the task-relevant path). Figure 4.a presents the share of students in each category across countries and economies participating in the digital reading assessment.

It is relatively common for students to have missteps in their navigation sequences. On average across OECD countries, only 7% of students never deviate from the task-relevant navigation path (this excludes students with no or limited navigation). In those countries and economies where students have the longest navigation sequences, on average, less than 5% of students do not make any mistakes when navigating on line. This includes all East Asian countries and economies (Hong Kong-China, Japan, Korea, Macao-China, Shanghai-China, Singapore and Chinese Taipei) as well as Estonia and Italy. What students do after committing a misstep, however, differs widely across countries.

In Italy, Korea, Macao-China, Shanghai-China and Chinese Taipei, more than three out of five students visit task-irrelevant pages, and do not correct such missteps by returning to the task-relevant path. Furthermore, because students in these countries/economies who

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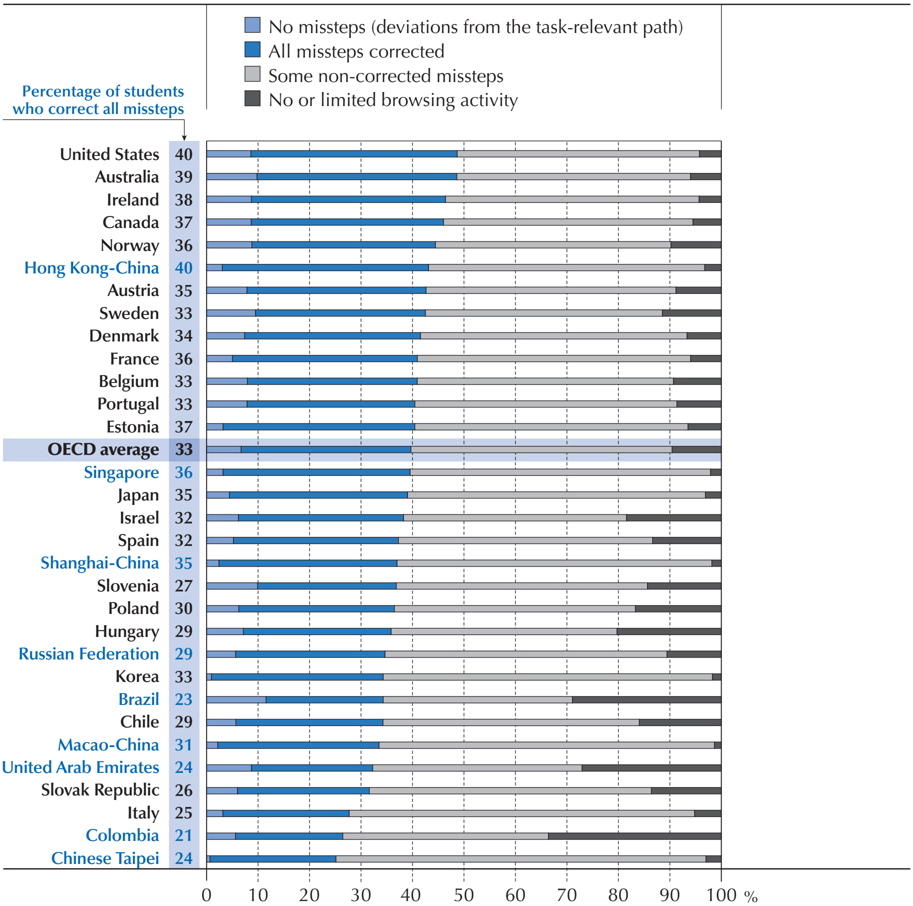
commit a misstep often do not give up on solving the task, they tend to have long navigation sequences (see Figure 4.5 in this chapter). In contrast, in Australia, Canada, Ireland and the United States (all countries with a high average quality of navigation; see Figure 4.7 in this chapter), there are both more students with clean navigation sequences than on average across OECD countries, and more students who return to the navigation path that is relevant to solve the task after making a misstep.

■ Figure 4.a ■

Classification of students based on their reaction to navigation missteps



Countries and economies are ranked in descending order of the share of students who either make no missteps or correct all missteps.

Source: OECD, PISA 2012 Database, Table 4.4.

StatLink http://dx.doi.org/10.1787/888933253101

THE RELATIONSHIP BETWEEN PERFORMANCE IN DIGITAL READING AND STUDENTS' NAVIGATION BEHAVIOUR

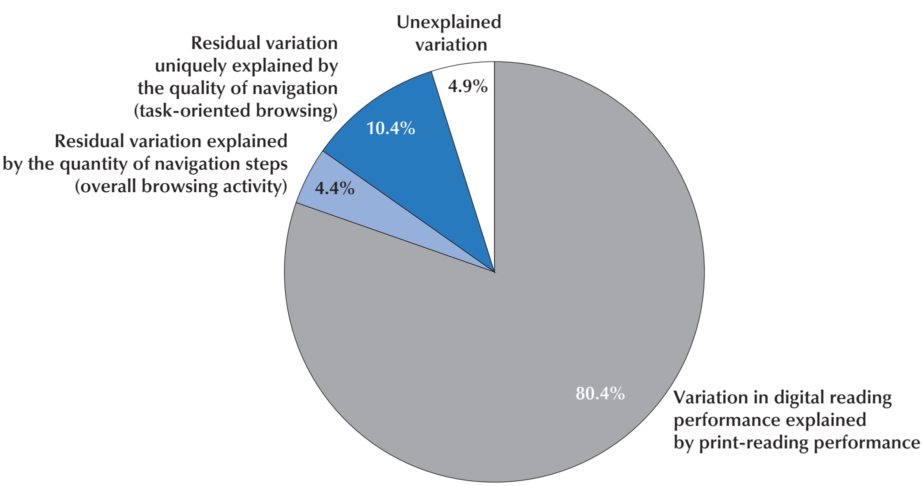
Students' performance in digital reading is not perfectly aligned with their performance in print reading. This is true at aggregate levels too. In some countries/economies, average performance lies above or below the level that could be expected, given their students' performance in print reading. Are such differences related to students' navigation behaviour?

Figure 4.9 shows that students' average navigation behaviour – quantified by the indices of overall navigation activity and task-oriented navigation activity – explains a significant part of the differences in digital reading performance between countries/economies that is not accounted for by differences in print-reading performance. Of the 20% of unexplained variation, only about one-fourth (5%) is not associated with between-country differences in students' average navigation behaviour.

More precisely, after controlling for differences in print reading, the quantity of navigation (as measured through the *index of overall browsing activity*) accounts for about one-fifth of the remaining between-country differences in digital reading performance (or 4.4% of the overall variation in reading performance). The quality of students' navigation (as measured through the *index of task-oriented browsing*) explains more than half of the residual variation (an additional 10.4% of the overall variation).

■ Figure 4.9 ■

Explained variation in the digital reading performance of countries and economies

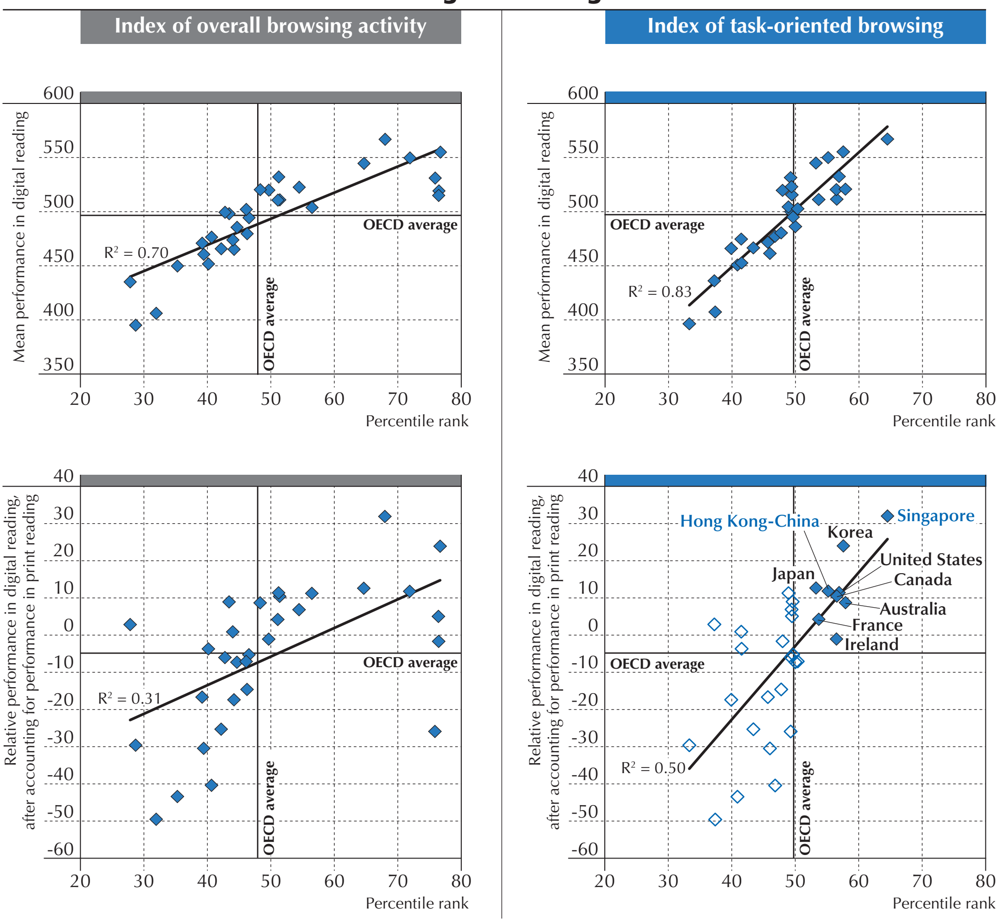


Notes: Percentages may not total 100% due to rounding.
The figure is based on results from regressions of countries' and economies' mean performance in digital reading on mean performance in print reading and average values for the two indices of navigation.
Source: OECD, PISA 2012 Database, Table 4.6b.
StatLink http://dx.doi.org/10.1787/888933253119

Figure 4.10 illustrates how the association between digital reading performance and navigation works in practice. The charts in the top row show that students' average navigation behaviour is strongly related to mean performance in digital reading. However, much of students' navigation behaviour can be predicted by whether they are good readers – i.e. by their performance in print reading. This is because, to a large extent, good navigation relies on the same cognitive skills and motivational aspects that are prerequisites for success in the paper-based assessment of reading as well.

■ Figure 4.10 ■

Relationship between digital reading performance and navigation behaviour in digital reading



Notes: The relative performance of countries/economies in digital reading is the average difference between students' observed and expected performance. Each student's expected performance is estimated, using a regression model, as the predicted performance in digital reading given his or her score in print reading.
Each diamond represents the mean values of a country/economy.
Source: OECD, PISA 2012 Database, Tables 3.6 and 4.1.
StatLink http://dx.doi.org/10.1787/888933253123

Does good navigation require more than good reading? And if so, can good navigation explain differences in performance across countries, after accounting for reading performance?

The bottom row in Figure 4.10 shows that there is a strong association between digital reading and the quality of navigation (task-oriented browsing), even after accounting for performance in print reading. Performance is often better in digital reading than would be expected, based on print-reading performance, in countries/economies where students' navigation is of better-than-average quality, namely in Australia, Canada, France, Hong Kong-China, Ireland, Japan, Korea, Singapore and the United States.

A similar relationship exists within countries, among students (Table 4.6a). Across all countries/economies, the variation in digital reading performance observed among students, within countries, who perform at the same level in print reading can be largely accounted for by differences in their navigation behaviour. An estimated 9% of the total variation in digital reading performance, on average, is uniquely explained by students' navigation behaviour.[7]

If navigation skills are so critically important, how can they be developed? Statistical analyses show that students' reading skills in print documents strongly predict their navigation behaviour in a digital environment (Tables 4.6b and 4.7a). This indicates that the development of print-reading skills is likely to contribute to better navigation skills as well. Indeed, the quantity of navigation may be linked to reading engagement, in general, while the quality of navigation depends on the kinds of skills, such as drawing inferences, that can be practiced just as well in print as in electronic texts.

Problem-solving skills are also important. Among student with similar reading skills, those with higher scores in the PISA assessment of problem solving tend to be more persistent in their navigation (as indicated by higher values on the *index of overall browsing activity*). Often, these students navigate better too (as indicated by higher values on the *index of task-oriented browsing activity*). This suggests that to navigate on line, students use generic problem-solving skills and dispositions, such as the ability to think, autonomously, about unfamiliar problems and how to solve them, and their willingness to engage with such situations in the first place (OECD, 2014).

Good navigation therefore requires good problem-solving skills. But even among students of similar skill in both reading and problem solving, differences in navigation remain strongly associated with differences in digital reading proficiency. In fact, the skills measured in the PISA assessment of problem solving only marginally reduce the strength of the relationship between the navigation indices and performance in digital reading (Table 4.8). For the most part, the problem-solving skills that students demonstrate when navigating complex online texts are specific, and are likely best learned in the context of reading from the Internet.

Notes

1. The coding of pages and navigation steps in sample task *SERAING*, presented in Chapter 7, illustrates how even within the same unit (i.e. the same website), the relevant pages may vary depending on the purpose of each task.

2. Items from unit *SERAING* can be seen, and tested, on the website of the Australian Council for Educational Research (http://cbasq.acer.edu.au/index.php?cmd=toEra2012).

3. Tasks with minimal navigation demands are defined as those where the average of experts' ratings of navigation demands (see Figure 4.1) is not greater than 1.5, on a 1 to 4 scale.

4. In tasks where little navigation is required, many of these "non-corrected missteps" are observed after students have found the information they need (which is sometimes presented on the starting page itself).

5. The number of steps (clicks on tabs or links leading to a different page) that are contained in the navigation sequence for each task is summed across tasks. To convert this number into an *index of overall browsing activity*, a percentile score reflecting the rank of the student among all students who were administered the same digital reading questions is computed. The unweighted, pooled distribution of students from all participating countries is used.

6. To compute this index, the number of steps that start and end on relevant pages is computed first (task-relevant steps), then the number of steps that end on a non-relevant page (missteps and task-irrelevant steps) is subtracted from this sum. The result is then transformed into a percentile score reflecting the rank of the student among all students who were administered the same digital reading questions, in order to make fair comparisons between students who were given different questions.

7. Because navigation indices were not used in the conditioning model for generating plausible values of digital reading performance, the percentage of variation explained by navigation indices may be underestimated.

Chapter 4 tables are available on line at http://dx.doi.org/10.1787/edu-data-en.

Note regarding Israel

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

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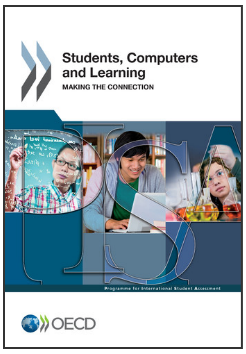

From:

Students, Computers and Learning

Making the Connection

Access the complete publication at:

https://doi.org/10.1787/9789264239555-en

Please cite this chapter as:

OECD (2015), “The Importance of Navigation in Online Reading: Think, then Click”, in *Students, Computers and Learning: Making the Connection*, OECD Publishing, Paris.

DOI: https://doi.org/10.1787/9789264239555-7-en