Are students ready for a technology-rich world?

OECD Briefing Notes for Japan

1. Access of ICT at Home and School

Almost all 15-year-old students in OECD countries have experience of accessing/using to computers, but the length of time for which students have been accessing computers differs greatly across countries. Figure 2.3 shows that despite its high level of economic development, Japan (15%) ranks in the bottom 10 countries (together with Turkey, Mexico, Tunisia, Latvia, etc.) with only 15% of students with access of 'more than five years' of ICT access in PISA 2003. Majority of 15 year old students have 'at least five years' experience of accessing to computers in eight OECD countries: Australia (69%), Canada (66%), United States (62%), Sweden (57%), New Zealand (55%), Denmark (52%), Finland (51%), Iceland (50%), and Korea (45%).

Referring to figure 2.5, which shows the changes in home and school access to computer between PISA 2000 and 2003, Japan data was not available due to their absence in the PISA 2000 questionnaire. With respect to other countries, both school and home access rose significantly in almost every country which administered the questionnaire in both years giving an OECD average of 7% and 5% increase, respectively. The rise of computer availability at school was particularly rapid in countries where it had previously been relatively low: Germany it increased from 69 to 93%, Mexico from 61 to 83% and in the partner country the Russian Federation from 60 to 76%. Similarly, the rise of computer availability at home was particularly rapid in countries where it had previously been relatively low, particularly, Hungary, Czech Republic, and Mexico with 20%, 24% and 22% increase, respectively.

Another comparison that can be made between the PISA 2000 and 2003 surveys is the change in the number computers per student (figure 2.8) to the extent to which school principals reported that learning of 15-year-old students was hindered by the school not having enough computers for instruction (figure 2.9). Referring to figure 2.8, Japan shows an increase in ICT per student from 0.11 to 0.19. Now, referring to figure 2.9, Japan shows a slight and insignificant increase of 8%. These figures provide some empirical comparison of quantitative and qualitative figures of ICT usage for educational purposes. Referring of figure 2.8, all countries except the partner countries Brazil, Indonesia and Tunisia, 99% or more of students are in schools with more than one computer. In Australia, Austria, Canada (not available), Hungary, Korea (0.21 to 0.27), New Zealand, the United Kingdom (0.14 to 0.23) and the United States(0.22 to 0.30), the number of computers per student has increased to a level of more than 0.2, implying five or fewer students per computer. In Turkey and the partner countries Brazil, Indonesia, the Russian Federation, Serbia, Thailand, Tunisia and Uruguay, the number of computers per student is 0.05 or less, implying 20 or more students per computer.

Referring to figure 2.9 shortages of computers reported by the principal shows a varying picture. The reported effects of shortages have lessened in Germany (–16%), Greece, Iceland and Korea (–12%), and the partner countries Liechtenstein and the Russian Federation. The hindering of instruction was reported more frequently in 2003 than 2000 in Belgium, Canada (15%), Denmark, Hungary, Luxembourg, Norway, Poland, Portugal and Spain.

2. Frequency of ICT Usage

Even though access to computers is more universal at school than at home, 15-year-old students use their computers at home most frequently. Figure 3.2 shows how often students used a computer at school, at home or at other places. In Japan, 26%, 37%, 2% of students used computer 'most frequently' (almost every day or a few times each week) at school, home, and other places, respectively. In all countries except Hungary, Mexico and the partner countries Serbia and Thailand, students report that they use computers most frequently at home. Over three-quarters report doing so in 17 of the 32 surveyed countries, although in some it is much fewer. In most countries, it appears that most students who have access to computers at home use their home computers frequently. However, this is not true in Japan, where 79% of students have access to computers at home, but where only 37% report using them frequently (Tables 2.2a and 3.1). Typically, much fewer students use computers frequently in school than do at home, and in only ten countries do the majority of students use them frequently at home. However, over two-thirds of students do so in Denmark (68%), Hungary (80%) and the United Kingdom (71%) (Figure 3.2).

Students use computers for a wide range of functions, not just to play games. Various common uses, such as Internet research, have educational potential, but students use specific educational software less frequently.

For ICT use in Internet and entertainment, Japan reports a mean index of – 0.91 below the OECD average index standardized at 0. Students' use of ICT is highest in Australia, Canada, Iceland, Korea, New Zealand, Sweden and the United States, and the partner country Liechtenstein (Figure 3.3). The lowest usage of computers for the Internet and entertainment is in Ireland, Japan and the Slovak Republic, and the partner countries Latvia, the Russian Federation, Serbia, Thailand, Tunisia and Uruguay.

For ICT use in programs and software, Japan reports a mean index of – 1.03 below the OECD average index standardized at 0. Australia, Italy, Poland, Portugal, the United Kingdom and the United States, and the partner country Uruguay, students report comparatively high use of programs and software. Students in Finland, Ireland, Japan and Korea, and the partner countries Latvia and the Russian Federation, report comparatively low use.

- Gender Gap for the Two Indices

For ICT for Internet and entertainment, males significantly use more ICT than females. The most pronounced gender differences are in reported use of computer games. In Japan the gender gap in the mean index (male – female) is 0.11. On average in the OECD, males are twice as likely as females to play such games frequently (70 and 35%, respectively). On the other hand, Denmark and Sweden, the gap is even wider, with more than 80% of males frequently playing computer games. In the United States, where the gender gap is narrower, over one-half of females aged 15 frequently use computers for games. On average across the OECD, males are also twice as likely to download games and other software frequently (51% of males and 25% of females) (Table 3.3). However, males and females make similar use of computers for electronic communication, with an average of 56% of males and 55% of females reporting frequent use of computers for this purpose.

For ICT for programs and software, in majority of the cases, males use more ICT than females. In Japan, the gender gap in the mean index (male – female) is – 0.13. However, the gender gap here is on average less than half as wide as for Internet and entertainment uses, and in Ireland, Japan and Korea a statistically significantly higher percentage of females report more frequent use (Table 3.4). Almost twice as many males report frequent use of computers for programming (30% of males and 16% of females on average in the OECD). This gender difference is particularly large in the Czech Republic, Denmark and Sweden, and the partner country Liechtenstein, where males are three to four times more likely to frequently use computers for programming than are females, and in Finland males are nearly six times as likely to do so. However, gender differences for other program and software uses are not very pronounced.

4. Attitudes Toward ICT

The vast majority of students are able to tackle basic ICT tasks and students are generally confident about their Internet abilities. While fewer can perform high-level tasks unaided, most think they could do so with some help. In Japan students report a mean index of attitudes of – 0.41 below the OECD average index standardized at 0. Comparatively, students in Austria, Canada, Germany, Iceland, Korea, Poland and Portugal, and the partner countries Liechtenstein, Serbia and Tunisia, express more positive attitudes towards computers, whereas students in Denmark, Finland, Ireland, Hungary and Japan, and the partner country Latvia report slightly less positive attitudes (Table 3.6). In all countries except Japan and the partner countries Thailand and Tunisia males report statistically significantly more positive attitudes towards computers.

5. Confidence Toward ICT

Generally, students in all participating countries report high confidence in using ICT, with the majority saying they are able to perform 17 of the 23 tasks specified very well by themselves. Students are relatively more confident performing routine tasks than Internet tasks or high-level tasks on a computer, although even in the case of the latter, most students thought that they could do each task at least if they had some help. In Japan the index of confidences are – 0.80, – 0.71, – 0.71 for the routine, Internet, and high level ICT tasks, respectively. For all three indices of confidence in ICT tasks, students in Australia, Canada and the United States, and the partner country Liechtenstein are among the most confident on average, although students in Korea have greatest confidence when using the Internet. Conversely, students in Japan and the partner countries the Russian Federation, Serbia, Thailand and Tunisia have among the lowest mean levels of reported confidence on all three indices (Figure 3.6). In Japan, access to computers is higher, but as noted in earlier chapters, fewer than half of students in Japan say that they can use home computers for school work as only just over one-third used their home computers frequently.

- Gender Differences

There are quite clear gender differences on the indices of confidence in routine tasks, Internet tasks and high-level tasks. In the majority of countries, males report far higher confidence in all three categories of ICT tasks (Figure 3.6). IN Japan, the gender gaps in confidence index for the three tasks are 0.14, 0.08, 0.09, respectively. The largest differences in favour of males are found with regard to confidence in performing high-level tasks, and these are statistically significant in all countries except Thailand. In particular, far fewer females in the Czech Republic, Denmark, Finland, Germany, Iceland, Poland, Sweden and Switzerland, as well as in the partner countries Latvia and Liechtenstein, report being confident in performing high-level tasks on a computer, with a difference of at least 0.60 index points in favour of male students (Table 3.12).

6. ICT Access and PISA Math Scores

The minority of students who still have only limited access to computers performed below the OECD average in PISA 2003. In particular, those without access to computers at home are, on average, one proficiency level below the OECD average. In most countries this effect remains even after controlling for social background.

- Home Access and PISA Math Scores

In Japan, the mean performance in math for students with ICT access at home is 550 and for students without access at home is 496. On average in OECD countries, students with computers available to use at home have a mean score in mathematics of 514 score points, whereas those without computers available score only 453 points. The exceptions are that students with access to computers reach, on average, Level 4 in Belgium, Finland and Japan, but only Level 2 in Greece, Italy, Mexico and Portugal; those without access to computers reach Level 3 in Canada, Finland and Japan, but only Level 1 in Mexico, Turkey and the United States. In Finland and Iceland where access is also near universal, the performance disadvantage of students without a computer available to use at home is, while still statistically significant, only about half the OECD average (Table 4.2).

Once accounting for socio-economic background the performance advantage associated with home computer access remains statistically significant in 23 of the 31 countries with data available. These performance differences, which are typically between one-third and one-half as great as before controlling for ESCS, remain above 30 score points (around one-half a proficiency level) in Australia, Belgium, Germany, Korea, Switzerland and the United States, and the partner country Thailand (Figure 4.3).

- School Access and PISA Math Scores

In Japan, the mean performance in math for students with ICT access at school is 537 and for students without access at school is 544. The performance difference associated with student access to a computer at school is less clear-cut than in the case of access at home. In 15 out of 29 countries with available data students with a computer available to use at school perform statistically significantly better than students who lack school computer access (Figure 4.3). In this case the performance advantage is particularly prominent in the United States (98 score points) and is also high in Canada and the Czech Republic (64 and 62 score points respectively – or about one proficiency level).

- Length of Access and Math Scores

Students with the shortest experience of using computers scored poorly on average in PISA 2003. Those with less than a year's experience can typically perform only the simplest mathematics tasks. In Japan, the performance in math for students with 'less than 1 year' of ICT usage is 501 while students with 'more than 5 years' in ICT usage is 565. The OECD average scores are 433 and 532, respectively. This gap in scores between the student with 'less than one year' and 'more than five years' of computer usage is particularly large in Belgium, Korea, New Zealand, Switzerland and the United States. In the United States, for example, those who have used a computer for less than one year are likely to struggle with even the simplest PISA mathematics questions – they are near the bottom of Level 1 – whereas those with at least five years' experience perform above average for the OECD, being on average proficient at Level 3.

- Accounting for Socio Economic Background

Performance differences hold once accounting for socio-economic background and that the biggest differences remain between students who have just started using computers (less than a year before the survey) and those who have used computers for at least one year. In Japan, the observed differences in math scores from to the lowest 'less than one year' level of frequency changes from 34, 60, 64 to 24, 45, 42, once we control for socio-economic factors (Table 4.3). Compared to students who have only been using a computer for less than a year, on average in the OECD countries there is a 34 score points advantage for students who have used computers for one to three years, a 56 score points advantage for students who have used computers for 3 to 5 years and a 64 score points advantage for students who have used computers for more than 5 years. In fact, once accounting for socio-economic background the performance differences between students who have used a computer for more than 5 years and students who have used a computer for less than one year remain the equivalent of one proficiency level or more in Australia, Austria, Belgium, Iceland, Italy, Korea, New Zealand, Portugal, Sweden, Switzerland, the United Kingdom and the United States, and the partner country Uruguay.

7. ICT Frequency and PISA Math Scores

Students who use computers least frequently at home also performed below average in PISA 2003. However, students using computers frequently at school do not in all countries perform better than others; in most countries moderately frequent users do slightly better.

- At Home

In Japan, the mean student performance in math for students for ‘rare of no use’, ‘moderate use’, and ‘frequent use’ of ICT at home are 512, 559, 561, respectively. The OECD averages are 464, 508, 517. In every country, students reporting rare or no use of computers at home (on average 18% of students) score much lower than their counterparts reporting moderate use or frequent use. Students using computers rarely at home perform at Level 2 and, in some cases, at Level 1 on the mathematics proficiency lead by Tunisia, Mexico, Thailand, etc. in the lower end. While the highest ‘rare user’ students were lead by Finland, Japan, Liechtenstein, Korea, Slovak Republic, Czech Republic, Canada, etc.

- At School

However, when it comes to frequency of use at school, there is less consistent association with performance. In Japan, the scores are 553, 544, 512, respectively while the OECD averages are 507, 516, 499. In some countries such as the Czech Republic and the Slovak Republic, rare users perform substantially worse than their peers, but in Germany, Greece, Japan and Korea, and the partner country Tunisia, it is the other way around. In around one-half of the countries with available data, lower performing students make more frequent use of computers at school.

- By Type of ICT

Looking at the frequency with which students use computers for a range of purposes (ICT for Internet and entertainment and ICT for program and software), the highest performances in PISA 2003 were seen among those students with a medium level of computer use rather than among those using computers the most.

In Japan, the mean math performance of students in the bottom, second, third, and top quarters of ICT frequency index for Internet and entertainment are 514, 538, 550, 550, respectively and for program and software frequency index the mean math scores are 517, 540, 551, 544. On average, the quarter of students with the lowest use of ICT for the Internet and entertainment in each country score 12 points less in mathematics and 11 points less in reading than the quarter with the second-lowest use; the equivalent gap on the programs and software index is 14 score points in both mathematics and reading (see Table A3.1 in Annex A3 for significance tests of these differences). However, those who use computers frequently for a wide range of purposes also tend to have relatively low average scores, especially in the case of those making wide use of programs and software. On average in OECD countries, students in the top quarter of users of programs and software are 20 score points below those in the third quarter of users in mathematics and the difference in reading performance is slightly more pronounced (25 score points).

8. ICT Attitude and Confidence and PISA Math Scores

Students with low confidence in their ability to undertake routine tasks on the computer or to use the Internet performed much lower in mathematics in PISA 2003 than did the most confident students.

- Attitude

In Japan, 'the change in the math score per unit of index of attitude'(degree of association) is 10.6. In 15 countries, more positive attitudes towards computers are significantly associated with improved performance in mathematics such as Tunisia, Thailand, Japan, Russia, etc. (Figure 4.7) with average OECD value of 2.6. However, even in these countries the association is not large (Table 4.11).

- Confidence By Tasks

In Japan, 'the change in the math score per unit of index of confidence for routine tasks' is 26.9. Students' confidence in performing routine tasks on a computer is a relatively strong predictor of student performance with an average value of 30.7 OECD countries lead by Belgium, Switzerland, Portugal, Korea, Hungary, etc.

In Japan, 'the change in the math score per unit of index of confidence for Internet tasks' is 22.9. Students' confidence in performing routine tasks on a computer is a relatively strong predictor of student performance with an average value of 22.7 OECD countries lead by Korea, Belgium, Switzerland, Hungary, etc. Students' confidence in performing Internet tasks is associated with students' performance almost as strongly as ability to perform routine tasks. It is strongest, with a difference of over 50 score points between the quarter of students with highest and lowest confidence, in Belgium, Greece, Hungary, Italy, Japan, Mexico, Poland, Portugal, the Slovak Republic, Switzerland and Turkey, and the partner countries Thailand and Uruguay.

In Japan, 'the change in the math score per unit of index of confidence for high level ICT tasks' is 21.4. Students' confidence in performing high level ICT tasks on a computer is a relatively weak predictor of student performance vis-a-vis other tasks an average value of 9.2 across OECD countries lead Japan, Hungary, Mexico, Russia etc. Students' confidence in performing high-level tasks is also positively associated with performance in mathematics (9 score points on average), although this relationship is less than half as strong as for routine and Internet tasks and is not significant in five of the countries with available data (Figure 4.7). However, the relationship in Hungary and Japan is stronger, with a gap of around 50 score points between the least confident and most confident students in these tasks.

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