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Implications of Digital Technology for Education Policy and Practice

For the first time, today's parents and teachers have little, if any, experience with the tools that children are going to use every day in their adult lives. This chapter discusses the implications for education policy of the need to equip students with the fundamental skills required to participate fully in hyper-connected, digitised societies.



Using complex tools to solve everyday problems is a defining attribute of our species. Generation after generation, parents raised their children to use the tools with which they were familiar. Later on, some of the more ingenious children tweaked their ancestors' tools and invented new ones. But never before the advent of electronic computers and, more recently, of Internet-based services, did such a large fraction of humanity change their everyday habits and tools in such a short time. Within a couple of decades, the tools used in most trades and for such basic acts as communicating, gathering information, keeping records of the past or drawing plans about the future were replaced by digital ones. For the first time, today's parents and teachers have little, if any, experience with the tools that children are going to use every day in their adult lives.

It is easy to feel overwhelmed by the changes that occurred over the past few generations. Surely such a deep and rapid evolution, affecting our daily lives, must have consequences on the processes and content of education as well; the abundance of irrational fears or enthusiasms about the impacts of technology on our lives would have anyone believe so. But is there evidence to confirm it? This report aims to document the changes that occurred – and did not occur – in the education and lives of young people following the rise of digital technology using data from the OECD Programme for International Student Assessment (PISA).

In the past 25 years, schools and families around the world spent a substantial amount of money on computers, Internet connections, and software for educational use (Chapters 1 and 2). By 2012, in most OECD countries less than 2% of 15-year-old students lived in households without computers (Figure 1.1). And in half of the 34 OECD countries, 15-year-old students went to schools that had at least one computer connected to the Internet available for every three students. In Australia, an early leader in investments in educational technology (OECD, 1999), there was one such computer for every student (Table 2.11).

Empowering young people to become full participants in today's digital public space, equipping them with the codes and tools of their technology-rich world, and encouraging them to use online learning resources – all while exploring the use of digital technologies to enhance existing education processes, such as student assessment (Chapter 7) or school administration – are goals that justify the introduction of computer technology into classrooms.

DIGITAL TOOLS ARE OFTEN COMPLEMENTARY TO SKILLS, BOTH BASIC AND ADVANCED

Technological changes in society raise fundamental questions about the role of education and schools. What should students know and be able to do? What is the value of knowledge that has been traditionally acquired in school, when so much information is available on line?

Most schools and teachers did not directly influence the pace at which computers were introduced into workplaces; nor did they decide that personal communications should happen over the Internet, rather than in face-to-face meetings or using the telephone. Yet the skills that are typically learned at school play a crucial role in determining whether a student adopts digital technology and can benefit from it.



Today, even simple interactions and transactions often require writing and reading, rather than speaking and listening – e.g. asking information from a help-desk, making a professional appointment, sharing information with team members, etc. As a consequence, students who leave school without sufficient reading and writing skills may be even less able to participate fully in economic, social and civic life than they were in the past.

The increasing importance of reading and writing in daily life is one of the reasons why the benefits of digital technologies are unevenly shared across high-skilled and low-skilled individuals. In addition, the fact that computers and digitally enhanced machines, or robots, can perform many tasks at a lower cost than human workers means that the skills that complement new technologies are in increasing demand. The greatest benefits accrue to those who have the ability to design digital solutions, adapting or creating machine algorithms to fit one's needs. These capacities build on advanced reasoning and problem-solving skills and require good mastery of symbolic and formal language. They often build on related skills acquired in mathematics courses.

TEACH THE FOUNDATION SKILLS THAT ARE NEEDED IN A DIGITAL ENVIRONMENT

In a world that is rapidly embracing digital technology as the main medium of communication, students need to be able to gather and use online information (Chapter 3). They must be familiar with the text formats encountered on line in order to learn to navigate through the web critically and successfully. As a matter of fact, the typical texts encountered on line require certain reading processes, such as evaluating the trustworthiness of sources, drawing inferences from multiple texts, and navigating within and across pages, more than do traditional printed texts. All of these processes can be learned and practiced in school settings (Chapter 4).

Reading in the digital medium builds on reading skills acquired in a non-digital environment, but also relies on good navigation skills. Navigation, in turn, requires metacognitive regulation, the ability to organise complex hypertext structures into a coherent mental map, experience in evaluating the relevance of pages, and a repertoire of effective strategies for reading on line. Without these, students find themselves digitally adrift.

The most successful countries and economies in the PISA digital reading assessment have similar visions of the importance of digital skills for today's students. But they differ in the level of use of information and communication technologies (ICT) in schools.

Singapore and Korea, the two highest-performing countries in digital reading (Chapter 3) and among those countries where the quality of students' web-navigation behaviour is highest (Chapter 4), have excellent broadband infrastructure (ITU, 2014) and high levels of familiarity with computers among 15-year-olds students (Chapter 1). Yet students are not more exposed to the Internet in school than are students on average across OECD countries. Despite this, most students have a good mastery of the strategies that assist them in online navigation – in addition to performing strongly in all domains assessed in PISA. This suggests that many evaluation and navigation skills may be acquired more easily if students are already proficient in higher-order thinking and reasoning processes in other domains.



In Australia, another high-performing country where students demonstrate strong ability in browsing the web, the Internet is used during school hours to a greater extent than in any other country that participated in the optional ICT familiarity questionnaire in PISA 2012 (Chapter 2). ICT is represented in two ways in the Australian Curriculum – within the “Technologies learning area curriculum”; and through the “ICT general capability”, which is embedded across all learning areas of the curriculum. The learning continuum for the ICT general capability describes the knowledge, skills, behaviours and dispositions that students can reasonably be expected to develop at particular stages of schooling.¹ This framework guides teachers and industry in creating the educational resources that promote proficiency in the use of electronic sources of information, and helps to ensure that students develop useful skills in their time on line, such as planning a search, locating information on a website, evaluating the usefulness of information, and assessing the credibility of sources.

Studying online resources at school can not only help to develop digital reading skills, but also expand the diversity of topics, genres, and sources that are used in class. Greater diversity of reading materials, in turn, can lead to greater enjoyment of reading. PISA data collected in 2009 show that the share of students who do not read anything for enjoyment increased since 2000 (OECD, 2010a). Yet there’s no question that reading anything for enjoyment is better for student performance than reading nothing. By including, among learning resources, those reading materials that are favourites among the students who read for enjoyment, teachers can promote the habit of reading to the largest number of students (OECD, 2015a).

INVEST IN SKILLS TO PROMOTE EQUAL OPPORTUNITIES IN A DIGITAL WORLD

Differences in access to digital resources across students of different socio-economic status have narrowed considerably over recent years, to the point where, in all but five OECD countries with available data, disadvantaged students spend at least as much time on line as advantaged students do (Table 5.12).² Yet, even with equal access, not all students have the knowledge and skills to be able to benefit from the resources that are available to them.

In the past, the convergence of goods and services, including those related to education, onto online platforms was sometimes described as a great opportunity to bridge existing inequalities in access to offline equivalents (think of online encyclopaedias and massive open online courses). And indeed, affordable and widespread ICT devices, particularly mobile phones, have created many opportunities to bring education, health and financial services to poor or marginalised populations (OECD, 2015b). But the ability to benefit from new technologies seems to increase with individuals’ and societies’ skill levels. Therefore, the move to online services may mitigate purely economic disadvantage, but amplify the disadvantage that stems from a lack of access to a quality education in the early and primary school years.

The results presented in Chapter 5 imply that in developed countries, differences in the uptake and use of Internet resources are related to the unequal distribution of skills, more than to unequal access to such resources. In our increasingly digital world, deep and pre-existing social and cultural divides also cut into civic engagement in online fora, participation in online learning, and the ability to search on line for a better job (e.g. Van Deursen and Van Dijk, 2014).



What can schools do to help all students make the most of their access to digital tools? Results show that if current gaps in reading, writing and mathematics skills are not narrowed, inequalities in digital skills will persist, even if all Internet services were available free of charge. The cost of Internet services is often only of secondary importance when it comes to participating in status-enhancing activities.

This means that to reduce inequalities in the ability to benefit from digital tools, countries need to improve equity in education first. Ensuring that every child reaches a baseline level of proficiency in reading and mathematics will do more to create equal opportunities in a digital world than can be achieved by expanding or subsidising access to high-tech devices and services.

RAISE AWARENESS OF THE POSSIBLE HARMFUL ASPECTS OF INTERNET USE

When every child has access to the Internet, parents and teachers can use the educational resources that are available on line to foster children's learning. Yet unlimited access to the Internet can also have negative consequences for children's development. Those in charge of educating today's "connected" learners are confronted with a number of new (or newly relevant) issues, from "information overload" to plagiarism, from protecting children from online risks (fraud, violations of privacy, online bullying) to setting an adequate and appropriate media diet (OECD, 2012a; OECD, 2014).

Previous studies had found negative impacts of extended screen time on adolescents' sleep (Cain and Gradisar, 2010; Hysing et al., 2015), physical activity (Melkevik et al., 2010) and social well-being (Richards et al., 2010). Based on the available research evidence, several national public health authorities have warned about the possible negative consequences of increased screen time (e.g. House of Commons Health Committee, 2014, p. 85) and issued guidelines that recommend limiting children's recreational screen time, typically to less than two hours per day (e.g. Council on Communications and Media, 2013; Population Health Division, 2015).

PISA data confirm and extend these findings (Chapter 1). They show that 15-year-olds who spend more than six hours on line every day are particularly at risk of suffering from lower emotional well-being and of behaving in problematic ways at school, such as arriving late for class or skipping days of school. While these findings cannot demonstrate the direction of causality, they suggest that well-being at school is strongly related to the electronic media diet outside of school. Parents, schools and health professionals can work together to monitor and plan children's use of new media.

Schools should educate students as critical consumers of Internet services and electronic media, helping them to make informed choices and avoid harmful behaviours. They can also raise awareness in families about the risks that children face on line and how to avoid them (OECD, 2012b). In addition to protecting children from online threats, parents must help children to balance leisure uses of ICT with time for other recreational activities that do not involve screens, such as sports and, equally important, sleep.

DEVELOP COHERENT PLANS, INCLUDING TEACHER TRAINING, FOR USING ICT IN THE CLASSROOM

Plans for technology in education sometimes promised to improve the efficiency of education processes, delivering better results at lower cost (OECD, 1999; OECD, 2010b). Yet the link from



more technology to better results is far from direct, with many actors involved in making the required changes happen. And the costs are not limited to devices that need to be bought; they include teachers to train, resources to develop and buildings to adapt, as well as the foregone benefits of alternative uses of that money (opportunity costs).

Evidence from PISA shows only a weak or sometimes negative association between the use of ICT in education and performance in mathematics and reading, even after accounting for differences in national income and in the socio-economic status of students and schools (Chapter 6). In most countries, students who make some use of the Internet at school, for instance, tend to be better at reading, particularly when it comes to understanding and navigating online texts, than students who never browse the Internet for schoolwork at school. But other activities, such as using drilling and practice software for mathematics or languages, show a clear negative relationship with performance. And more frequent, daily browsing of the Internet at school is also generally associated with lower performance (Australia is a rare exception to this pattern).

The most rigorous impact studies also show no effects of investments in computers on students' non-digital performance. While there is too little credible evidence on this issue, positive findings are limited to certain contexts and certain uses of ICT. These include when computer software and Internet connections help to increase study time and practice, or allow teachers to provide optimal learning opportunities to students, in which students assume control over their own learning and/or learn collaboratively (see Chapter 6 for a full discussion and references).

The conclusion that emerges is that schools and education systems are, on average, not ready to leverage the potential of technology. Gaps in the digital skills of both teachers and students, difficulties in locating high-quality digital learning resources from among a plethora of poor-quality ones, a lack of clarity on the learning goals, and insufficient pedagogical preparation for blending technology meaningfully into lessons and curricula, create a wedge between expectations and reality. If these challenges are not addressed as part of the technology plans of schools and education ministries, technology may do more harm than good to the teacher-student interactions that underpin deep conceptual understanding and higher-order thinking.

LEARN FROM PAST EXPERIENCE TO IMPROVE THE EFFECTIVENESS OF FUTURE INVESTMENTS IN TECHNOLOGY

When it comes to decisions about investments in technology, it is easy to discard evidence from past experience by pointing at the many differences between “there and then”, and “here and now”. The devices themselves are likely to differ, if not in shape (laptops rather than desktops; tablets rather than interactive whiteboards) at least in their capabilities. Yet unless past disappointment with technology in education can convincingly be attributed to the limitations of hardware (and it rarely can), changing the device will not help to avoid the pitfalls encountered in previous large-scale education technology plans. Technology can amplify great teaching, but great technology cannot replace poor teaching. In schools as well as in other organisations, technology often increases the efficiency of already-efficient processes, but it may also make inefficient processes even more so.³



Certainly, some of the intended goals of current and past ICT initiatives are difficult to measure. For instance, it is sometimes argued that digital technologies should be seen as a support for “a more flexible, learner-centred notion of education” that helps to develop curiosity, creativity, collaboration and other “soft skills” vital to 21st-century societies (Livingstone, 2011).

Many other potential benefits fall outside of what PISA can measure through the performance of 15-year-old students. The fact that this report does not document them does not imply that they do not exist. For example, technology provides great platforms for collaboration among teachers and for their participation in continuous professional development, thus empowering them as knowledge professionals and change leaders.

Still, countries and education systems can do more to improve the effectiveness of their investments in ICT by being both gradually accepting and sceptical. They can more clearly identify the goals they want to achieve by introducing technology in education, and strive to measure progress towards these goals, experimenting with alternative options too. This kind of clarity in planning would enable them, and other countries and systems, to learn from past experience, gradually improving on previous iterations and creating the conditions that support the most effective uses of ICT in schools.

Despite the many challenges involved in integrating technology into teaching and learning, digital tools offer a great opportunity for education. Indeed, in many classrooms around the world, technology is used to support quality teaching and student engagement, through collaborative workspaces, remote and virtual labs, or through the many ICT tools that help connect learning to authentic, real-life challenges. Teachers who use inquiry-based, project-based, problem-based or co-operative pedagogies often find a valuable partner in new technologies; and industry is developing several technologies (learning analytics and serious games, for example) that promise to exploit the rapid feedback loops afforded by computers to support real-time, formative assessments, thus contributing to more personalised learning (Johnson et al., 2014).

What this shows is that the successful integration of technology in education is not so much a matter of choosing the right device, the right amount of time to spend with it, the best software or the right digital textbook. The key elements for success are the teachers, school leaders and other decision makers who have the vision, and the ability, to make the connection between students, computers and learning.



Notes

1. The ICT general capability is one of the seven “general capabilities” that inform teaching and learning across all school subjects in Australia. The learning continuum for ICT general capability comprises five dimensions: “Applying social and ethical protocols and practices when using ICT”, “Investigating with ICT”, “Creating with ICT”, “Communicating with ICT”, and “Managing and operating ICT”. In the ICT general capability curriculum documents, learning goals are further articulated across the year levels from Foundation to Year 10, with examples related to subject areas. This recognises that students develop their ICT capability around its use as well as their ability to transfer and apply it in other settings. Furthermore, the Australian National Assessment Program (NAP) includes a triennial sample population assessment to monitor students’ ICT literacy at the system and national level (Australian Curriculum, Assessment and Reporting Authority, 2015; Santiago et al., 2011).
2. Among OECD countries, the exceptions are: Chile, Mexico, Poland, Portugal, the Slovak Republic and Slovenia. Data are not available for Canada, France, Luxembourg, the United Kingdom and the United States.
3. Microsoft founder Bill Gates expressed this in the following way: “The first rule of any technology used in a business is that automation applied to an efficient operation will magnify the efficiency. The second is that automation applied to an inefficient operation will magnify the inefficiency” (Gates, Myhrvold, and Rinearson, 1995, p.136).

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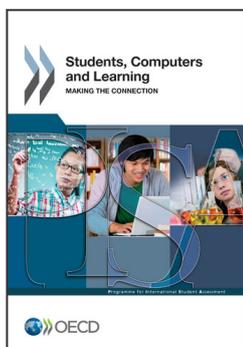
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