7 Capacity building for digital education

This chapter explores efforts to build capacity for digital education among actors at all levels of the education system: educators, institution leaders, parents, students and administrators. In addition to common capacity challenges that impede the effective use of digital education technologies, the chapter presents some promising approaches to building digital capacity. This includes continuing professional learning for educators, strengthening institution leaders' ability to build a culture of digital education, and strengthening local capacity to support education institutions.

Introduction

Reaping the potential of digital education technologies to enhance teaching and learning calls for people who are empowered to put digital technologies to effective use. Empowerment requires two elements to be in place – *capacity* and *motivation*. Educators, institution leaders, parents, students and administrators – each in different ways – need opportunities to develop their capacity to effectively engage with digital technologies for teaching and learning. This chapter explores recent developments and challenges associated with countries' efforts to strengthen capacity for digital education at all levels of the education system. It also presents a range of promising initiatives aimed at supporting educators (individually and collectively), institution leaders, students, parents and administrators in the digital transformation of education. Chapter 8 will address in more detail how – in addition to strengthening the capacity of educators – policy makers can adapt human resource policies to encourage and enable educators to engage with digital education. This includes educators' career structures, job descriptions, working time arrangements and appraisal systems, all of which are important to ensure that educators have the incentives, time and resources to put their digital skills into practice.

To enhance teaching and learning using digital education technologies, educators need the capacity to integrate, optimise and transform digital resources in different pedagogical processes and activities (European Commission, 2020[1]; Redecker, 2017[2]). This requires educators to have sufficient Technological Pedagogical and Content Knowledge as well to be supported in using this knowledge to develop suitable context-specific teaching strategies (Ulferts, 2021[3]; Willermark, 2018[4]). To address this challenge, the chapter considers a range of policy levers to strengthen educators' capacity, ranging from their initial education and continuing professional learning (including the support of peer learning and communities of practice) to the structural supports that could encourage a more widespread take-up of digital education technologies in schools.

At the institutional level, the capacity to effectively incorporate digital technologies hinges on schools' access to digital technologies, effective leadership, and the extent to which their culture and policies support the effective integration of technology in teaching and learning practices (Costa, Castaño-Muñoz and Kampylis, 2021, p. 2[5]; Castaño Muñoz, Pokropek and Weikert García, 2022, p. 5[6]). This chapter therefore considers how governments can provide education institutions with guidance, support their leadership and strengthen their ability to engage in institutional improvement strategies in the area of digitalisation. In addition to educators' and institutions' capacity, the chapter considers how policies can strengthen digital capacity across the wider learning environment. This includes administrative capacity at the central and sub-central levels of government, but also – in the case of younger learners – parents and other stakeholders who can facilitate and shape students' engagement with digital technologies for learning at home.

Building capacity for the effective use of digital education technology raises several challenges, which this chapters seeks to address by taking stock of the available evidence and presenting promising approaches observed in OECD countries. Some of the key questions on this issue that policy makers need to consider include:

- How can teachers' skills for the effective use of digital technologies be strengthened during their initial education and continuing professional learning?
- How to support school leaders in self-evaluation and school improvement efforts focused on advancing the digital transformation of their schools?
- How to guide students in their use of digital technologies and strengthen the capacity of parents and caregivers to act as digital education facilitators?
- How can central and local administrations leverage the potential of digital education technologies and support schools in their use?

Recent developments and current challenges

Educators are increasingly confident in using digital technologies, but many would benefit from further training

School teachers' preparedness for digital education varies greatly across countries

Teachers who are confident in using digital technologies are also better placed to help their students acquire the skills they need to thrive in a digital world. There is a statistically significant positive relationship between teachers' problem-solving skills in technology-rich environments (as measured in the OECD Survey of Adult Skills – PIAAC) and students' performance in computer problem solving and computer mathematics, as measured by the OECD Programme for International Student Achievement (PISA) (OECD, 2019[7]). At the same time, teachers are currently less likely than other tertiary-educated adults to possess these skills (OECD, 2019, p. 180[7]; Boeskens, Nusche and Yurita, 2020[8]) and many report a need for further training in the use of digital technologies for teaching.

According to principals surveyed for PISA 2018, only 65% of 15-year-olds were enrolled in schools whose teachers had the necessary technical and pedagogical skills to integrate digital devices in instruction on average across OECD countries. This proportion ranged from 27% in Japan to 84% in Lithuania (OECD, 2020[9]).[1] This is concerning at a time when teachers are increasingly expected to work with data in the classroom and integrate technology in their pedagogical practices. Evidence from the International Computer and Information Literacy Study (ICILS) shows that teachers who were confident about their own ICT capability were more likely than their less confident colleagues to emphasise developing their students' ICT skills (Fraillon et al., 2014[10]).

Teachers in some countries have received limited preparation in the area of ICT skills, according to the 2018 OECD Teaching and Learning International Study (TALIS). Across the OECD, only 56% of lower secondary teachers had received training in the use of ICT for teaching as part of their formal education or training (ranging from less than 40% in Sweden and Spain to 70% or more in Türkiye, England (UK), Colombia, Chile and Mexico). This proportion was significantly higher among recent cohorts of teachers, which reflects the modernisation of initial teacher education (ITE) programmes. Nevertheless, in some countries, more than 25% of teachers who completed their ITE within five years of the survey reported not to have received training in the use of ICT for teaching (including the Czech Republic, Denmark, Portugal, Austria, Korea, Norway and Iceland) (OECD, 2019, p. 207[11]). Likewise, only 43% of OECD lower secondary teachers felt well or very well prepared to use ICT for teaching when they completed their initial education or training (ranging from less than 25% in Austria and Finland to 60% and more in Hungary, Slovenia, Chile, Türkiye and Mexico) (OECD, 2019, p. 207[11]).[2]

Many school teachers report a need for further training on digital technologies

Continuing professional learning can help teachers to hone their practice and acquire skills that have not been covered by their initial teacher training. TALIS 2018 as well as the 2011/12 European Commission Survey of Schools in 27 European countries suggest that teachers use ICT in their classes more frequently and feel more confident in supporting students with digital technologies if they have received relevant training or regularly collaborated with their peers (OECD, 2020[12]; Minea-Pic, 2020[13]; European Commission, 2013[14]). Training is thus a critical factor in moving from the mere availability of digital technologies in schools to its actual use (Gil-Flores, Rodríguez-Santero and Torres-Gordillo, 2017[15]).

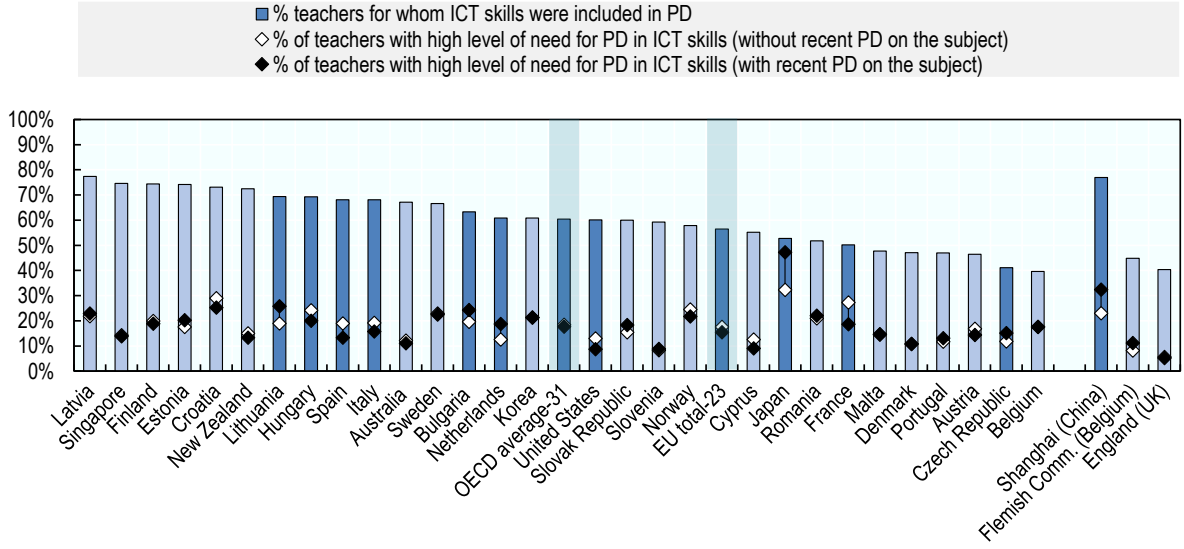
Although the proportion of teachers who participated in ICT-related professional development has increased in many countries since 2013, data from TALIS 2018 show that many teachers expressed a need for further training. In TALIS 2018, 60% of lower secondary teachers reported to have taken part in professional development activities on ICT skills for teaching during the past 12 months, on average across the OECD (57% across the EU). Among those who did, 17.6% reported a high need for further training on

the subject – a proportion that was slightly larger (18.4%) among those who had not received ICT training over the past 12 months (Figure 7.1). At the lower secondary level, ICT skills for teaching were the second-most frequently cited area in which teachers had a high need for professional development (18% across the OECD, ranging from less than 8% in England [UK] and Türkiye to over 30% in Colombia and Japan) (OECD, 2019, p. 209[11]).[3]

As can be seen in Figure 7.1 teachers' participation in and need for ICT training varies significantly across OECD countries and other advanced economies participating in TALIS. While the association between teachers' participation in ICT-related professional development and their reported need for further training is negative in many countries, it is positive in other regions (including, for example, Japan and Shanghai). This may be because training raises teachers' awareness of their knowledge gaps or because teachers with high levels of need are more likely to seek out training (OECD, 2019[11]).

Figure 7.1. Teachers' participation in and need for professional development in ICT skills (2018)

Based on the reports of lower secondary teachers



Notes: Countries and economies are ranked in descending order of the proportion of teachers that engaged in professional development activities on ICT skills for teaching in the 12 months prior to the survey; Statistically significant differences between teachers for whom ICT skills for teaching was included in their professional development activities and teachers for whom it was not included are displayed in a darker tone.
Source: OECD (2019[11]), *TALIS 2018 Results (Volume I): Teachers and School Leaders as Lifelong Learners*, https://doi.org/10.1787/1d0bc92a-en, Table I.5.24.

Educators in VET and higher education also need further training to build their capacities for digital education

Building capacity for digital education is also an important concern for the VET sector. In light of rapidly digitalising work environments, VET teachers need to equip their students not just with vocational but also with digital skills in order to facilitate their transition into the labour force and enhance their adaptability. The use of robots, virtual reality (VR), augmented reality (AR), simulators and other innovative technologies are likely to become more common in VET in the years to come. Teachers' effective use of these technologies promises to foster students' vocational and digital skills at the same time and may increase flexibility, safety and efficiency in VET (OECD, 2021, p. 120[16]).

The use of digital technologies in VET education is already widespread. In the six OECD countries and regions with available data from the 2018 TALIS survey[4], 74% of upper secondary VET teachers reported using digital technology with their students, compared to 66% of general education teachers (OECD, 2021, p. 131[16]). Data from the European Commission's SELFIE further suggest that VET teachers are slightly more likely than general education teachers to report using digital tools for teaching (OECD, 2021, p. 132[16]; Hippe, Pokropek and Costa, 2021[17]). However, a large proportion of VET teachers lack sufficient skills to teach in digital environments. In 2018, 46% of upper secondary VET teachers in the countries and regions with available data reported that ICT skills were the area in which they were most in need of training (OECD, 2021[16]).

At a higher education level, very limited comparative data are available on the training needs of educators regarding their use of digital technologies. Many HEIs were ill prepared for the sudden switch to emergency online delivery in 2020. At the outset of the COVID-19 pandemic, a relatively small share of higher education programmes were delivered substantially or fully on line, and even in digitally intensive systems, such as the United States, less than half of educators (46%) reported that they had previously taught a course on line (Jaschik and Lederman, 2019[18]). Many educators thus considered the rapid shift to online education to be challenging (OECD, 2021[19]).

However, available evidence suggests that the pandemic also led to an acceleration and deepening of digitalisation in teaching and learning (OECD, 2021[19]). For example, research conducted in a Polish university (Ejdys and Kozlowska, 2021[20]) just before the pandemic and then repeated a year later showed that the use of e-learning by both students and teachers had increased, as expected. Both students and teachers reported that their ability to solve problems in the online environment had improved. However, with an increased share of their teaching being undertaken on line, teachers rated both the ease of use and their understanding of procedures and instructions lower, once they were forced to use e-learning for all or most of their teaching (Ejdys and Kozlowska, 2021[20]).

In most OECD and European higher education systems, training in teaching or participation in professional development is not mandatory for academic staff (OECD, 2019[21]), (Eurydice, 2017[22]). Where teaching qualifications do exist, the associated curriculum or training activities are often developed by individual higher education institutions, making it difficult to ascertain the extent to which digitally enhanced teaching is emphasised. At the same time, many studies highlight the need for more capacity building for digital education within higher education systems. For instance, a survey of the digital experiences of students in post-secondary education in the United Kingdom showed that many educators struggle with technology and lack confidence in their ability to manage technology well; students reported that the most important thing institutions could do to help learning would be to help teaching staff to become more skilled in technology use (Ghurbhurun, 2020[23]).

Higher education educators themselves are also aware of the need to improve their competence in the use of digital technologies. A recent systematic literature review of the digital competence of teaching staff in higher education concluded that educators self-identify as having low to medium digital competence, with particular weaknesses in areas such as evaluation of educational practice, solving problems using digital technologies and working collaboratively on digital education within a network of contacts (Basilotta-Gómez-Pablos et al., 2022[24]). Interviews with higher education educators also indicate that many of those who have integrated digital approaches into their teaching have done so with little awareness of how technology can support teaching and made limited use of evidence from the research literature on teaching practices (Martin et al., 2020[25]; Price and Kirkwood, 2014[26]).

A lack of capacity among educators limits the benefits of education technology for students with special education needs

As discussed in Chapter 1, the effective use of digital technologies can enable teachers to provide more differentiated forms of instruction and to cater to students with special education needs (SEN) with the help

of digital assistive technologies. In TALIS 2018, 22% of teachers across the OECD reported a high level of need for further training on teaching students with SEN – the most widely reported training need. Teachers' limited capacity to use digital technologies in the classroom may contribute to or exacerbate their difficulty in teaching students with SEN, which raises concerns for equity and inclusion (OECD, 2019, p. 209[11]). Analyses from the United States also point to a lack of exposure to digital assistive technologies in teachers' pre-service training and suggest that a significant proportion of special education teacher education programmes do not include mandatory modules on the use of digital technologies to support students with SEN (Atanga et al., 2020[27]).

Although no international comparative data on the use of digital assistive technologies is available, TALIS 2018 data show that – in some education systems – teachers in schools with a high share of students with SEN make greater use of digital technology for instruction. In Alberta (Canada), New Zealand, Singapore and the United Arab Emirates, for example, the share of teachers who use ICT for teaching on a regular basis is 3 to 12 percentage points higher in schools where more than 10% of students have SEN. By contrast, in Croatia and Hungary, the share of teachers who reported "frequently" or "always" letting students use ICT for projects or class work is 6 percentage points lower in schools where the concentration of students with SEN is above 10% (OECD, 2022, p. 103[28]).[5] Digital technologies can also be used to widen access to higher education for students with SEN. To do so effectively, HEI staff need training and support in the use of assistive technologies (Asselin, 2014[29]).

Widening access to higher education for students with physical impairments and learning disabilities requires not only a focus on physical access and technological support, but also different approaches to pedagogical practices, assessment and evaluation (Hanafin et al., 2007[30]). In addition, technologies can create barriers and challenges for students with disabilities due to the inaccessibility of digital tools and learning materials and because staff need support to use those tools in ways that provide effective support to students with physical impairments and learning disabilities (Bong and Chen, 2021[31]). In the **United States**, a survey of university support workers during the pandemic suggested that students with physical impairments and learning disabilities found the move to wholly remote delivery of higher education more difficult than other students (Scott and Aquino, 2020[32]). Research into this topic suggests that instructional staff need to receive training on assistive technologies and pedagogical approaches such as universal design for learning to implement them effectively (Bong and Chen, 2021[31]).

Education institutions demonstrate varying capacities to effectively engage with the digital transformation

Variation among schools' and school leaders' capacity to engage with the digital transformation of education poses equity challenges

The successful digital transformation of schools requires strong institutional capacity and a strategic approach to school improvement and whole-school development. School leaders play a critical role in managing this transition successfully and bringing their teachers on board to embrace the effective use of digital education technologies. This requires not only a motivation to embrace change, but also the skills and resources necessary for principals to engage in instructional leadership, i.e. taking purposeful actions to promote students' learning.

Effective school leaders set normative expectations, support teachers in trying out new teaching practices, help them to collaborate on shared problems and encourage them to implement what they have learned in professional development (Goddard et al., 2015[33]; OECD, 2022, p. 61[28]). Previous evidence from TALIS showed that principals who received training in instructional leadership were more likely, for example, to support co-operation among teachers to develop new teaching practices (OECD, 2014[34]). A number of countries – Finland, Latvia, Portugal, Singapore, the Slovak Republic and Spain – appear to

have made progress in this regard and significantly increased the proportion of principals that were trained in instructional leadership between 2013 and 2018 (OECD, 2020, p. 137[35]).

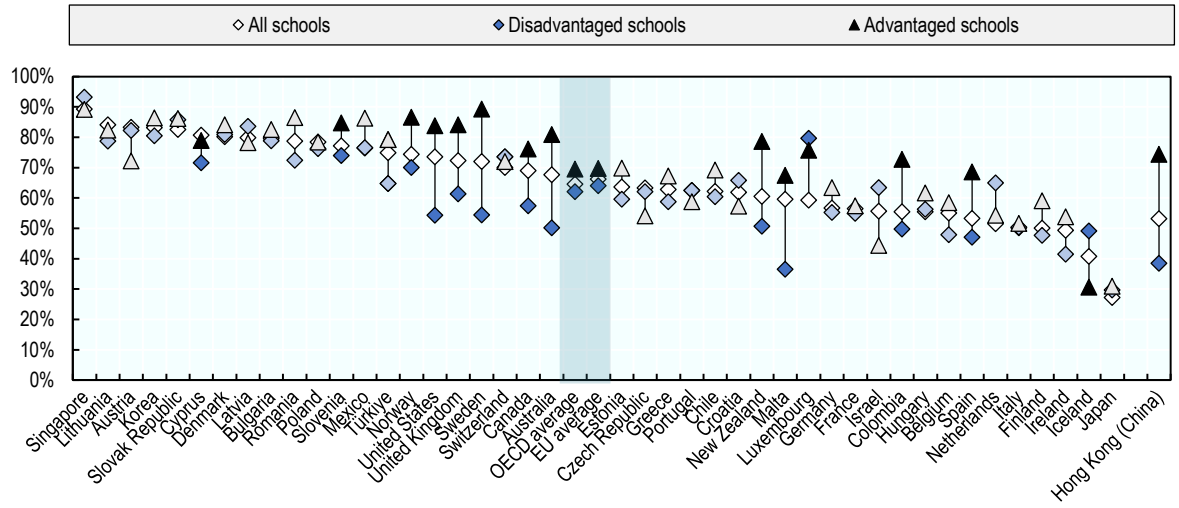
A resistance to innovation can constitute an important barrier to the adoption of new pedagogical approaches and changing a school's culture to embrace digital teaching and learning is a difficult task for school leaders. In TALIS 2018, school leaders have tended to report a greater openness to innovation than their teachers (85% across the OECD and the EU agreed that their school "readily accepts new ideas") (OECD, 2019, p. 205[11]). Likewise, teachers under age 30 were more likely to feel that their colleagues are not sufficiently open to change (OECD, 2019, p. 205[11]). To foster a school environment open to new ideas, leaders can encourage work in school-based professional learning communities to proactively identify needs for change and make assistance available to support teachers in the process of change (OECD, 2019, p. 31[11]). In TALIS 2018, teachers' openness to innovation appeared to be lower in many European countries than in other parts of the world. On average across OECD countries with available data, 74% agreed that most teachers in their school are open to change (compared with 72% across the EU). The proportions were particularly low in Portugal (59%), Belgium (61%) and the Netherlands (67%) (OECD, 2019, p. 205[11]).

Principals seeking to lead their schools towards the effective integration of digital education technology have to contend with widely diverging levels of resources and existing capacity. In TALIS 2018, on average across OECD countries, 27% of school leaders reported that a shortage or inadequacy of digital technology was hindering the provision of quality instruction. This proportion ranged from 5% or less in Iceland and Slovenia to more than 50% in Portugal and Colombia (OECD, 2020, p. 205[35]). Such a shortage of ICT resources in schools can limit teachers in their ability to enhance their teaching with the help of digital technology.

PISA 2018 data also suggest significant heterogeneity within countries when it comes to schools' capacity to use ICT for teaching and, in some cases, systematic inequities between advantaged and disadvantaged schools. On average across the OECD, the principals of 15-year-olds in socio-economically advantaged schools were 7 percentage points more likely than those in disadvantaged schools to report that their teachers had the necessary technical and pedagogical skills to integrate digital devices in instruction. On average across the EU, this discrepancy was slightly lower, at 6 percentage points, particularly pronounced in Sweden (35%), Malta (31%) and Spain (22%) (see Figure 7.2).

Figure 7.2. School's capacity to enhance teaching and learning using digital devices (2018)

Percentage of students in schools whose principal agreed or strongly agreed that teachers have the necessary technical and pedagogical skills to integrate digital devices in instruction



Notes: The socio-economic profile is measured by the PISA index of economic, social and cultural status (ESCS). A socio-economically disadvantaged (advantaged) school is a school in the bottom (top) quarter of the index of ESCS in the relevant country/economy; Statistically significant differences between advantaged and disadvantaged schools are marked in a darker tone; Countries and economies are ranked in descending order of the percentage of students in schools where teachers have the necessary technical and pedagogical skills to integrate digital devices in instruction.
Source: OECD (2020[9]), *PISA 2018 Results (Volume V): Effective Policies, Successful Schools*, https://doi.org/10.1787/ca768d40-en, Tables V.B1.5.15 and V.B1.5.16.

In many schools, teachers appear to lack the resources to learn how to use digital devices. Across the OECD, only 65% of 15-year-old students attended schools whose principal agreed that there were sufficient professional resources for teachers to learn how to use digital devices. Across the EU, the average stood at 67%, ranging from 29% in Hungary and 41% in Germany to more than 80% in Denmark, Sweden and the Czech Republic. Again, the perceived lack of professional resources was more acute in disadvantaged schools, on average (OECD, 2020, p. 266[9]; OECD, 2020[36]). On average across the OECD, socio-economically advantaged schools also had a higher share of teachers with high self-efficacy and confidence in their ability to support learning using ICT (OECD, 2022, p. 28[28]).

Increased autonomy in the higher education sector can lead to fragmentation of the development of digital capacities, and uneven progress across and within institutions

The COVID-19 pandemic exposed the extent of differences in digital capacity between higher education systems across the world, with some groups of institutions to move relatively seamlessly to fully online provision using digital tools, and others demonstrating very limited capacity to do so (Crawford et al., 2020[37]). In most OECD jurisdictions, HEIs enjoy a high level of autonomy to make decisions on staffing, finances, organisational structure and in academic matters (Kupriyanova, Bennetot Pruvot and Estermann, 2020[38]). The faculties and departments of the institution and to the individual academics employed in them will also have more autonomy to design their education offers than is the case in schools (OECD, 2020[39]).

As a result, governments have recourse to fewer policy tools to boost HEIs' capabilities. For instance, in many cases, they cannot set training requirements for staff, unlike in the school sector. Academic advancement and salary settings are also often outside the power of governments. Therefore, governments must rely on influence and incentives to encourage HEIs to increase digital capacity.

As discussed in Chapter 6, higher education institutions in European countries are increasingly able to access the basic elements of sound digital infrastructure. They also have digital analytical and information tools, such as Learning Management Systems that helps them to manage their teaching, communicate course content to their classes, track students' progress, communicate with individual students and conduct assessment (Ifenthaler, 2012[40]).

The ability of HEIs to make use of that infrastructure in a shift to digitalised delivery is likely to depend on their overall leadership on digital education issues, as well as the digital competence of staff and students. In higher education systems, the concept of digital maturity is often used to-denote a measure of the capacity of an institution to adopt and manage digital approaches across all its activities and functions. (Đurek, Kadoic and Begičević Ređep, 2018[41]). The level of digital maturity of an institution depends on the choices made by the leadership of an institution and by the capabilities of the various faculties and departments to make the HEI commit to the digital maturity programme (Marshall, 2018[42]).

Furthermore, even at HEI level, the abilities of the top-level institution leadership to mandate the measures needed for digital maturity may be limited (Marshall, 2018[42]). In larger institutions, some faculties and departments are likely to be large entities that exercise considerable autonomy in their own right; they control large budgets and an extensive staff and have considerable discretion in their use of digital resources. As a result, in larger HEIs, digital maturity may differ widely between the constituent parts of an institution. Finally, some evidence indicates that the extent of digital capacity among teaching staff in higher education may vary within an institution depending on the teachers' field of study (for example (Cabero-Almenara et al., 2021[43])), resulting in differences in capacity between the faculties or other components of the HEI.

Students and actors across the wider learning environment need capacity to engage successfully with digital education

Students and (in some cases) parents need support to build capacity for successful digital learning

Efforts to build capacity for the adoption of digital education technologies should also be guided by an assessment of the degree to which learners or their parents (in the case of younger students) are ready, willing, and able to integrate technology into the learning process (Ganimian, Vegas and Hess, 2020, p. 23[44]). This can help authorities to detect challenges, resistance or inequities that may arise during the implementation of reforms due to a lack of preparedness in parts of the system (Ganimian, Vegas and Hess, 2020, p. 23[44]).

To make the most of digital technologies for learning, students must be equipped with a range of foundational skills, other than digital competence. Strong literacy, numeracy, and problem-solving skills in technology-rich environments support students' ability to progress from basic Internet use to more diverse and sophisticated applications (OECD, 2019[7]). Similarly, fostering students' socio-emotional skills can serve to promote safer and more responsible uses of digital devices (Burns and Gottschalk, 2019[45]). Students' cognitive and socio-emotional skills are thus determining the capacity to seize the benefits of digital technologies and address some of their risks. Low-skilled students are, for instance, more likely to use the Internet for recreational rather than instructional activities (van Deursen and van Dijk, 2014[46]; OECD, 2019[7]).

The share of 16-24 year-olds lacking basic skills (literacy, numeracy and problem solving in technology-rich environments) is lower than among adults aged 25-54 or aged 55-65, on average across OECD and EU countries with available data in the OECD Programme for the International Assessment of Adult Competencies (PIAAC) (OECD, 2019, p. 166[7]). At the same time, some countries display relatively similar shares of youth and prime-age adults lacking basic skills, suggesting that there is scope to enhance the equity and quality of their initial education systems. This is the case in Japan, Norway, New Zealand,

Greece, the Czech Republic, the Slovak Republic, Australia and Denmark, where the difference was smaller than 2 percentage points (OECD, 2019, p. 167[7]).

Evidence from PISA (2018) also shows that significant challenges remain in building students' capacity to make the most of digital environments for learning. For instance, fewer than 1 in 4 students in Bulgaria and Greece displayed strong abilities to navigate digital environments in contrast to more than half of students in B-S-J-Z (China), Hong Kong (China), Korea, Singapore and Chinese Taipei, and around 40% of students in Finland, Ireland and the Netherlands (OECD, 2021[47]).[6] Strong navigation abilities were highly correlated with students' reading performance and effective reading strategies.

Parents also play an important role in facilitating and shaping school students' access to and use of digital resources at home. Parents' attitudes and practices, as well as their awareness of the opportunities and risks involved in the use of digital education technologies will affect whether and how they encourage their children to play educational or collaborative video games, support them in the use of digital devices for their homework or, for example, restrict their access to digital devices (OECD, 2019[48]). Parents can thereby help their children maximise the benefits they derive from the use of digital technologies, while minimising the associated risk of harm.

Evidence suggests that low-skilled parents are more likely to adopt restrictive mediation strategies, reducing their children's exposure to online risks but also the likelihood that they benefit from the opportunities of digital technologies. In contrast, confident and high-skilled parents tend to take more enabling approaches to their children's Internet use that support their emerging digital skills and interests in ways that are responsive to their needs and safety (Livingstone et al., 2017[49]). Given the important role of parents in promoting their children's safe and effective use of digital technologies, gaps in adults' digital literacy are particularly concerning. Around 12% of prime-age (25-54) adults in OECD countries participating in the Survey for Adults Skills (2013, 2015) lacked basic literacy, numeracy and problem-solving skills in technology-rich environments on average (OECD, 2019[7]). Data from European countries from Eurostat also underline this issue and points towards large cross-country inequalities in adult digital skills (Eurostat, 2022[50]).

Sub-central authorities need to build capacity in line with their responsibilities for digital education

The role of sub-central authorities (i.e. local authorities and, depending on the system, state-level or regional-level authorities) in digital education policy and practice varies significantly across countries. Particularly in more decentralised systems, local or intermediate level authorities can play an important role in supporting successful digital education. Sub-central authorities may hold responsibility, for example, for allocating capital expenditure to schools and for authorising or taking decisions on the procurement of digital education technologies (OECD, 2017, p. 253[51]). In 2019, sub-central authorities in 20 of 27 OECD countries and economies with available data were involved in the allocation of capital funding to public primary schools (regional or provincial authorities in 11 countries and local authorities in 19 countries). At the lower secondary level, sub-central authorities in 19 of 26 OECD countries were involved in the process (OECD, 2021[52]).

Local authorities in some education systems also have significant responsibility for implementing education policies or supporting the digitalisation in schools directly, for example by managing local advisory or school improvement support services (Vincent-Lancrin, Cobo Romaní and Reimers, 2022[53]). Comparative data are lacking on the involvement of sub-central authorities in the acquisition, management and use of digital education technologies and their capacity to fulfil these specific responsibilities. Nevertheless, sufficient capacity of sub-central authorities to effectively carry out their responsibilities is known to be an important condition for the effective implementation of policies in the context of multi-level governance (OECD, 2017[51]), and the digital transformation of schools is no exception.

Promising approaches for building capacity to use technology effectively for teaching and learning

Pay more attention to preparing educators and other staff for the effective use of digital education technology

Further integrate capacity building for the effective use of digital education technology into initial training for educators

At the school level, several OECD countries have updated their initial teacher education programmes in order to ensure that they provide prospective teachers with a solid foundation to make effective use of digital education technologies. This included the introduction of compulsory or voluntary courses in ITE, national accreditation standards or certifications, or placing greater emphasis on digital skills across the ITE curriculum:

- The **Norwegian** Government established the Centre for Professional Learning in Teacher Education (ProTed) as a partnership between the universities in Oslo and Tromso. In addition to running innovative teacher preparation programmes, ProTed conducts research projects and disseminates research findings on what constitutes excellent teacher education. One of the Centre's five focus areas is "teacher education for the digital future" and innovating the training of teacher educators. As part of these activities, the Centre fosters collaborations between universities and schools and is leading teacher educators' collaborative work on revising the ITE programme guidelines to increase their coherence and links with practice (OECD, 2019, p. 36[54]).
- In **Denmark**, efforts to strengthen teachers' digital skills go back to at least the 1990s, with the introduction of the voluntary Pedagogical ICT Licence (*Pædagogisk IT-kørekort*). The Licence combined pedagogical knowledge of digital technologies and basic digital skills training and has become a European standard in the provision of digital skills to teachers. Implemented for in-service training at first, the Licence was later integrated as a voluntary element into the curriculum of student teachers in teacher education colleges (Rizza, 2011[55]).
- **Denmark** has also experimented with developing concurrent and linked capacity building initiatives for students and teachers together. In line with an increasing emphasis on students' role as active learners capable of creating with technology (Arstorp, 2021[56]), a new subject – technology comprehension (*teknologiforstaelse*) – was introduced in 46 pilot schools between 2018-2021. In conjunction, a multiple universities and teacher professional colleges collaborated to develop a corresponding ITE course for teachers. A 2021 evaluation found the teachers' ITE course to have strengthened teachers' content knowledge for the technology comprehension course and, to some extent, their pedagogical knowledge on the subject. The evaluation also provided recommendations for the programme's further improvement, including the establishment of fora for professional exchange with practicing teachers and allowing more time for reflections on the course content's interaction with other subjects (Danish Evaluation Institute, 2021[57]).
- **France** strengthened the role of digital competencies in its teacher education system to put a greater emphasis on digital skills in students' curricula. In 2019/20, France introduced new courses related to digital technologies in teacher training at the upper secondary level and a new Reference Framework of Digital Competences (*Cadre de référence des compétences numériques*), covering primary, secondary and higher education with end-of-cycle assessments to ensure their ability to foster students' digital skills, new teachers obtain a corresponding certification. In addition, a new programme aims to develop specialist ICT teachers and a mandatory three-day training course for all lower secondary teachers was introduced in 2016 (OECD, 2020, p. 22[58]).

At higher education level, because of the greater dispersal of autonomy throughout the system, governments do not play as strong a role in the initial training of academic staff, and there are few

formal system-level teaching qualifications for staff at this level. However, governments in some countries are aiming to stimulate the uptake of professional teaching qualifications for both new and existing academic staff, which can also provide opportunities to train staff on digital pedagogy. For instance:

- In **the Netherlands**, the government encouraged universities to develop a teaching qualification for higher education educators, and all of Netherland's research universities currently use and mutually recognise the University Teaching Qualification (Basiskwalificatie Onderwijs – BKO), first created in 2008 (VSNU, 2018[59]). The training programme allows lecturers to develop and document their teaching practice with support from a senior lecturer or educationalist, with certification based on evaluation of a portfolio submitted at the end of the teaching development phase. In a 2018 review of the university teaching qualifications, Universities Netherlands advised its member institutions to pay extra attention to "ICT and blended learning", including both "specific skills in dealing with new applications" and "how digitalisation makes education even more teamwork, with instructors being supported by specialists in areas such as online didactics instructional design, video, and social media" (VSNU, 2018[59]). In other higher education systems, such as Hungary, there are plans for a centrally developed and common digital competence training for the higher education system, the scope and depth of which remain to be determined.
- In **New Zealand**, a range of national certificates and diplomas in tertiary teaching have been introduced, aimed at both tertiary vocational and higher education teachers, with related education programmes offered by more than 20 providers. The certificates and diplomas can be achieved at several levels of New Zealand's national qualification framework (level 4 to level 8). The related education programmes often include a focus on technology-enhanced learning (New Zealand Qualifications Authority, n.d.[60]).
- In **Korea**, the Ewha Womans University offers an example of an ITE institution embedding innovative uses of technology and interdisciplinary research in the development of ITE programmes. One example of this approach is the university's integration of flipped learning techniques based on the intensive use of technology and Internet-based resources. The pedagogical approach seeks to improve the personalisation of ITE instruction and ensure that there is more time in the classroom for meaningful face-to-face interactions while also familiarising candidates with digital pedagogical methods. Initial research and development funded by the Ministry of Education was carried out to investigate how technology can support flipped learning techniques using experimental piloting. Once the technique's effectiveness had been established, it was introduced formally as a core method in ten ITE courses. The technology component of flipped learning was supported by the work of other institutions such as the Research Institute of Distance Education. Ewha Womans University has received the highest evaluation rating by the Korean Educational Development Institute in all four national evaluations of ITE undertaken between 1998 and 2015 (OECD, 2019[61])
- In **France,** training for assistant professors is compulsory when they take up their first job. Candidates are provided 50 hours of leave to attend mandatory pedagogical courses. Among other aspects, these courses include training on the delivery of online and hybrid teaching. Whilst each institution offers its own training courses with its pedagogical support service, the Ministry of Higher Education and Research runs a MOOC to train higher education educators ("Se former pour enseigner dans le supérieur") (France Université numérique, n.d.[62]).

Provide opportunities for professional learning on the use of digital education technology throughout the working life of educators

Ensure that educators have access to relevant and impactful opportunities for continuing professional learning

While teachers' initial education is critical to ensure that new school teachers are prepared for their work, continuing professional learning (CPL) is vital to broaden and deepen teachers' knowledge, to help them keep up with new research, tools and practices and to respond to their students' changing needs (Boeskens, Nusche and Yurita, 2020[8]). As discussed earlier in this chapter, international surveys suggest that teachers' training is an important condition for the effective integration of digital technologies in the classroom (Gil-Flores, Rodríguez-Santero and Torres-Gordillo, 2017[15]; Fraillon et al., 2014[10]).

CPL is also increasingly recognised as vital for the development of digital capacity within higher education systems, although CPL may be organised in more diverse ways, compared to schools. Professional development programmes for digitally enhanced instruction may be organised and implemented across the entire higher education sector, developed and implemented by individual HEIs, or by some combination of central and local capacity building. The precise mix of these approaches will vary according to national policy making traditions and existing institutional capabilities – for example, systems with a large number of small institutions that have modest capabilities for digital learning will likely want to invest in building system-wide sharing capabilities, and these may take a variety of legal and administrative forms, such as a co-operative association, private charitable organisations to which HEIs subscribe, or university-based centres that serve as a service provider for the entire higher education sector.

Effective forms of CPL can help teachers improve their practice throughout their career (Kraft and Papay, 2014[63]; OECD, 2018[64]). Some countries have thus taken steps to strengthen CPL for digital skills and provide teachers with the necessary resources to engage in professional development:

- With the 2015 Good School reform (*La Buona Scuola*), **Italy** has emphasised school autonomy and teachers' responsibility for their professional learning as key levers for educational improvement while providing targeted support for strengthening digital competencies. The reform made teachers' participation in in-service training mandatory and provided EUR 1.5 billion for training in areas of system skills (school autonomy, evaluation and innovative teaching), "21st century skills" (including digital skills) and skills for inclusive education. The reform left teachers with significant autonomy to tailor their professional learning to their needs, providing them with EUR 500 per year via a "Teachers' Card" to participate in training activities, purchase resources (books, conference tickets, etc.) and offering matching processes to align training offers with training demands using a digital platform (OECD, 2017[65]). An evaluation focused on teachers' digital skills concluded that the training offer was in line with European Parliament's resolution "Learning EU at school" and promises to provide relevant and effective professional development opportunities (Rosa and Taddeo, 2021[66]).
- Teaching staff in the **United States** often access CPL through micro-credentials programmes specifically designed for teachers, which often can be counted as satisfying the CPL requirements of teachers. The Digital Promise collaborative micro-credentials initiative "Digital Promise" offers over 450 research-backed micro-credentials relevant to early childhood education, school education, higher education and adult learning. Educators who participate can earn continuing education credits with their employing state or district. The offer includes a range of education programmes leading to credentials in areas such as assistive technology, digital literacy, digital citizenship, technology planning and virtual reality (Digital Promise, n.d.[67]).

Although the literature specifically concerned with CPL on the use of digital technologies is limited, over recent decades a wealth of new evidence has caused a paradigmatic shift in the way school systems conceive of effective forms of professional learning more generally (Boeskens, Nusche and Yurita, 2020[8]).

Traditionally, professional development has often taken the form of single or short series of externally provided learning courses. Evaluations frequently found that these courses fail to lead to meaningful improvements in teaching quality or student outcomes (Glazerman et al., 2010[68]; Jacob and Lefgren, 2004[69]; Garet et al., 2016[70]; Garet et al., 2008[71]). Meta-reviews of randomised controlled trials have echoed concerns about the effectiveness of traditionally delivered professional development (Kennedy, 2019[72]; Kennedy, 2016[73]).

New forms of professional learning tend to stress features such as collaboration (Opfer, 2016[74]), the use of external expertise and individualised instructional coaching (Kraft and Blazar, 2017[75]; Blazar and Kraft, 2015[76]) or matching effective teachers with less effective ones (Papay et al., 2016[77]). In a systematic review of the empirical literature, Darling-Hammond et al. (Darling-Hammond, Hyler and Gardner, 2017[78]) find that professional development with demonstrated benefits for student learning generally displays one or more of the following characteristics:

1. It is content-focused.
2. It incorporates active learning utilising adult learning theory.
3. It supports collaboration, typically in job-embedded contexts.
4. It uses models and modelling of effective practice.
5. It provides coaching and expert support.
6. It offers opportunities for feedback and reflection.
7. It is of sustained duration.

At the same time, none of these design features can guarantee effectiveness in and of themselves (Timperley et al., 2007[79]). Many interventions with popular design features have no effect on student achievement, or smaller effects than cost-free interventions that encouraged teachers to engage in informal peer support (Papay et al., 2016[77]). In general, what matters for effective professional learning appears to be that its contents are well aligned with the intended learning goals and that they include a variety of activities to reinforce messages and allow teachers to test and interrogate their practice from multiple angles (Timperley et al., 2007[79]).

Create organisations that focus on professional learning, including digital capacity building

Knowledge centres and professional learning organisations can provide highly visible and specialised focal points for educators wishing to build capacity in digital teaching and learning. Such organisations are relevant to capacity building efforts at all levels of education. Examples of initiatives from across the OECD include:

- In **Denmark**, the Knowledge Centres for IT in Teaching promotes the use of advanced digital technology in VET, offering professional development courses for teachers. The centre has also established a network of pedagogical staff and a network of leaders to facilitate the exchange of ideas, practical and technical knowledge and to address common challenges. In addition, two knowledge centres for automation and robot technology each work with more than a dozen VET schools to support teachers to operate VR equipment and robots and incorporate them into their teaching practice (OECD, 2021[16]).
- In **Spain**, the Centre for Innovation in VET in Aragón is a professional training centre for VET teachers and acts as a hub to promote innovation across VET providers, universities and industry. The centre provides advanced technology and equipment for VET teachers in the logistics, transport and manufacturing sectors (such as VR vehicle simulators and an automated logistics chain reproducing the processes of a manufacturing company). The centre offers a wide variety of professional

development activities on the use of these technologies as well as learner-centred methodologies for teaching in VET (OECD, 2021[16]).

- Within higher education systems, national programmes may be used to supplement the in-house programmes. For instance, in the **United Kingdom**, the national higher education teaching and learning academy, Advance HE, runs programmes, conferences and events for educators to enhance their teaching (Advance HE, 2021[80]). There are similar centres outside of Europe as well, such as in **New Zealand**'s National Centre for Tertiary Teaching Excellence (*Ako Aotearoa*). These centres provide an effective means by which to scale and co-ordinate support for digital transformation in teaching. In **Ireland**, for example, the National Forum for the Enhancement of Teaching and Learning in Higher Education has made *Teaching and Learning in a Digital World* a priority area of focus.

Focal points for professional learning related to digital education can also be created at the level of individual education institutions, or as part of inter-institutional co-operative efforts. For example, many HEIs, in Europe and in other OECD jurisdictions, have set up institution-based professional development centres (Parsons et al., 2012[81]; Chalmers and Gardiner, 2015[82]).[7] These programmes aim to support higher education educators to improve and professionalise their teaching practice, including in preparing for and adapting to technology-enhanced approaches. HEIs in some OECD countries that are on the forefront of digitally enhancing learning have established executive leadership posts for digital transformation and central units for digital transformation (Keune, 2022[83]), (Office of the Provost, nd[84]), and implemented communities of practice and training to support the use of learning analytics among their educators. While evidence of the longer-term effectiveness of such programmes is still limited, university teacher development programmes more generally have been found to have a positive impact on teachers and students (Chalmers and Gardiner, 2015[82]).

As the adoption of digital approaches to higher education teaching becomes more widespread, there is an important role for professional development centres to help teachers become more proficient in the use of technologies (Rienties, Brouwer and Lygo-Baker, 2013[85]). The programmes co-ordinated by these centres should target teachers who are tentative and unconfident in using technology in their teaching; they need to minimise the risk of being overly focused on early and enthusiastic adopters (Tømte et al., 2019[86]).

Inter-institutional partnerships, associations or co-operatives as well as structured professional exchanges with researchers and EdTech firms can also support professionals to make informed choices when selecting digital education technologies and integrating them into their teaching (see Chapter 3). Support teams or teacher networks responsible for curating digital resources and tools as well as central or community-based databases of software can all support this process. There are several examples in Europe of platforms offering professional learning communities for teachers to exchange digital materials and practices or engage in networked e-learning:

- KlasCement is a resource network run by the Ministry of Education and Training in the **Flemish Community of Belgium**, which allows teaching resources and professional development materials to be shared with and among teachers. A team of moderators from the ministry manages the network, although there is no systematic quality control of the resources shared on the platform. During the COVID-19 pandemic, KlasCement curated teaching and learning resources from the network to support teachers in adapting to remote teaching and organised webinars with pedagogical experts on topics such as the use of digital tools for distance education. In early 2020, the platform had more than 250 000 active members (OECD, 2021, p. 13[87]; Minea-Pic, 2020[13]).
- The European Commission's **School Education Gateway** and **eTwinning** platforms provide education professionals with opportunities to communicate, share practices, create collaborative projects using digital technologies, access and share resources. In 2022, the two platforms will be merged into the European School Education Platform (European Union, 2022[88]; Kools and Stoll, 2016, p. 43[89]; European Commission, 2022[90]).

Encourage or directly support the creation of peer learning opportunities, including communities of practice.

Communities of practice can be particularly powerful ways to promote teachers' professional growth (Gil-Flores, Rodríguez-Santero and Torres-Gordillo, 2017[15]). Professional learning communities can be highly effective means to promote incremental improvements in teachers' instructional practices and foster innovative teaching (Kools and Stoll, 2016[89]; Stoll et al., 2006[91]).

- **Australia's** Digital Technologies in Focus project connects schools with curriculum officers who support clusters of schools and lead workshops for school leaders and teachers to foster collaboration on the implementation of the digital technologies curriculum (OECD, 2020[12]). This is complemented by free online MOOCs and professional learning events developed by the Computer Science Education Research Group at the University of Adelaide. The Digital Technologies Hub developed for the Australian Department of Education, is another platform offering learning resources related to the implementation of the digital technologies curriculum for teachers, students, parents and school leaders (OECD, 2020[12]).
- In **Germany**, the Digital Pact for Schools (*DigitalPakt Schule*) – a joint initiative between the federal and Länder level – aims to improve general digital education at all school levels (primary to upper secondary and VET schools). As part of a suite of measures, the pact supports investments in digital infrastructure, the development of digital content and curricula, and strengthening teachers' digital competencies through professional learning (OECD, 2018, p. 228[92]; OECD, 2021, p. 181[93]). A central website provides an overview of professional learning opportunities available online and in all 16 states (Deutscher Bildungsserver, 2022[94]). In addition to more traditional one-off training formats and online courses, previous evaluations of small scale interventions focused on groups of teachers developing digitally supported learner-centred practices for their school context (Bremer and Antony, 2017[95]) and using intensive coaching and communities of practice (Dinse de Salas, 2019[96]) have shown promising effects on teachers' self-efficacy and their integration of digital technologies in the classroom.
- In the **French Community of Belgium**, the Foundation for Education's initiative (*Entr'Apprendre*) organises short internships (two to four days) for VET teachers to update their knowledge of new technologies used in the workplace (OECD, 2021[16]).
- In the **European Union**, the Digital Education Hub[8] was set up as a cross-sectoral community of practice in June 2022. It brings together stakeholders interested in digital education and training and working in all sectors and levels (pre-primary, primary, secondary, vocational, higher and adult education and training). The aim of the Hub is to foster collaboration and exchanges, to promote peer learning and to upscale innovative solutions in digital education.

Supporting the adoption of assistive technologies to provide support for students with special education needs

A lack of training on the use of assistive technologies can compromise educators' ability to support students with SEN. At the school level, several empirical studies have shown that targeted professional learning can improve teachers' knowledge and sense of efficacy in using assistive technologies in schools, although as of now, there is little evidence on the longer-term effects of such interventions (Atanga et al., 2020[27]). For example:

- Student teachers in a mid-sized southern university in the **United States** were offered additional learning opportunities on the use of assistive technologies for students with visual impairments, either as part of class instruction or to earn extra credit. The training exposed them to computer software, such as ZoomText magnification and screen readers as well as iPad applications for digital audio media, such as Learning Ally, which provides audiobooks and other resources for those with dyslexia and other learning differences. Pre- and post-tests suggest that the training improved participants' knowledge of relevant assistive technology and their efficacy, although the

impact on future teaching practices could not be observed (Jones et al., 2019[97]). Previous studies of similar interventions had found comparable results (Poel, Wood and Schmidt, 2013[98]).

- In the **United Kingdom**, the Department for Education ran an Assistive Technology Training Pilot programme for 79 schools from January 2022 to March 2022. The intention of the training was to upskill school staff in identifying and implementing appropriate assistive technology for pupils with SEN in mainstream schools. The training received led to increased awareness among participating staff of different types of assistive technology applications and many participating staff reported being encouraged by the ease of use of the technologies. Participants also showed an increase in confidence ratings to use different types of assistive technology, with more than 40% reporting high levels of confidence for some forms of technology application after the training, compared to 10% or less beforehand. However, participants also highlighted the likely initial impact on their workload, and although they could envisage that the technologies may eventually reduce their workload, this was not observed during the pilot period (Department for Education, 2022[99]).
- Also in the **United Kingdom**, the UK NREN Jisc offers training programmes on needs assessment and decision making for higher education staff with regard to assistive technologies for students. Jisc also co-ordinates an Assistive Technology network, which acts as a community of practice for all further and higher education staff with an interest in incorporating assistive technology in their practice (Jisc, n.d.[100]).

Digital technologies have also created greater opportunities for HEIs to provide higher education to students with SEN. A survey of the literature on supporting those with physical impairments and learning disabilities in higher education (Bong and Chen, 2021[31]) found that training of staff in the HEI is a key to moving beyond mere physical access. Training needs to cover matters such as accessibility standards (such as web content accessibility guidelines, privacy and information standards), and knowledge and experience of assistive technology devices. In particular, there is a need for programmes to be structured in ways that are flexible and that keep learners motivated. HEI staff involved in teaching or supporting those with special education needs should be trained in universal design for learning (UDL) which provides a guide to structuring teaching in flexible ways to accommodate the learner's special needs. Yet, while UDL is a proven, research-based method, it carries a high resource cost for HEIs. So governments can provide or encourage the provision of training for HEI staff in managing delivery to higher education learners with SEN, but they should also ensure that their per student funding formulae provide appropriate additional resourcing for HEIs with a distinct coefficient taking account of students with SEN.

Support education institutions to build a strong culture of digital education

The importance of cultivating schools as learning organisations built on an active professional exchange of practices has been stressed in the context of building digital competencies and effectively implementing digital technologies (Krumsvik, 2008[101]). Collaborative forms of professional learning are also an effective means to help teachers move from the mastery of technical skills to finding ways of tailoring the use of technology to their subjects' specific contents and instructional activities (OECD, 2020[35]). In TALIS 2018, a culture of professional collaboration in schools has been associated with a more frequent use of ICT for instruction (OECD, 2022[28]). Nevertheless, among 15-year-old students in PISA 2018, only 36% across the OECD and 34% across the EU attended a school that had a programme to promote collaboration amongst teachers on the use of digital devices (OECD, 2020[36]; OECD, 2020[9]).

Creating a school culture that allows for teachers' professional growth, that stimulates peer observation, constructive feedback and mentoring or coaching structures requires skilled pedagogical leadership at the school level (OECD, 2018[64]). School leadership teams therefore play a central role in preparing teachers for the successful integration of digital education technologies. They are critical to ensure that teachers remain motivated to engage in professional growth, to appraise teachers and link their individual learning with the school's overall priorities and strategies for the adoption of digital technologies. School level

decisions (e.g. on the management of staff time) also shape teachers' opportunities to engage in collaborative practices and other forms of peer learning that are critical to build school level capacity for the successful adoption of education technology (Boeskens, Nusche and Yurita, 2020[8]).

While fulfilling these basic infrastructural needs is a prerequisite for the delivery of high-quality digital education, infrastructure alone is not sufficient. In order to exploit the potential of digital education technologies, education institutions need to be prepared and supported. This requires strengthening their digital capacity and their digital culture, i.e. "the extent to which culture, policies, infrastructure, and digital competence of students and staff support the effective integration of technology in teaching and learning practices" (Castaño Muñoz, Pokropek and Weikert García, 2022[6]; Costa, Castaño-Muñoz and Kampylis, 2021[5]).

Explore the potential benefits of providing central guidance for institutions

Even in contexts where education institutions enjoy a high degree of autonomy over the use of digital education technologies, central authorities can offer vital support, by giving them access to tools developed at the system level or by offering guidance on how to use digital devices effectively and safely in the classroom. Even higher education institutions, which usually enjoy vast pedagogical freedoms, can benefit from these central supports, especially in the case of smaller institutions or institutions with less resources to build their own capacity. Central authorities may formulate such guidance themselves or encourage and support actors at the local or school levels to develop them. In 2018, 62% of 15-year-old students in OECD countries attended a school with a general written statements about the use of digital devices, but only 46% had one that specifically addressed their use for pedagogical purposes (OECD, 2020[36]; OECD, 2020[9]).

Adapting curricula at different education levels to recognise the use of digital education technologies can be another means to support their integration into teaching practices (see Chapter 3). Likewise, some education systems have developed central libraries offering digital education materials to education institutions and educators or video libraries with examples of successful ways to integrate digital technologies in teaching:

- During school closures caused by the COVID-19 pandemic, the government of **France** facilitated access to 17 banks of digital education resources for school (*Banque de Ressources Numériques pour l'Ecole*, BRNE) to help teachers and schools ensure pedagogical continuity. These banks of resources were developed by publishers and EdTech companies prior to the COVID-19 crisis based on a public tender. BRNEs provide teachers with learning activities for their pupils as well as the means to modify or create their own digital learning materials. The banks of resources are portals that provide access to thousands of pages of content, tools for creation, services for dissemination and interaction between teachers and students (discovery, training, revision, learning and assessment activities). Contents are fully aligned with the French national curriculum in all disciplines and grades and tagged accordingly to make them easily accessible. Throughout their deployment, the BRNEs benefitted from extensive support from the French academies (regional sub-divisions) in the form of teacher training and the dissemination of information on teaching methods. The procurement phase allowed the Ministry to develop strong relationships with the contractors, who developed a better understanding and competency around the ministry requirements. According to the BRNE contractors, the number of new registrations increased 5 to 15-fold during the COVID-19 pandemic and several hundred thousand teachers used learning management systems (*espaces numériques de travail*) where the BRNE are deployed (Thillay, Jean and Vidal, 2020[102]).
- Also in **France**, there have been efforts to provide open education resources for hybrid courses. Government funding is provided for this purpose and the National agency for research is responsible for monitoring content. The FUN RESSOURCES platform has encouraged education institutions to

share their learning material, resulting in 32 000 uploads since the creation of the platform (France Université Numérique, n.d.[103]).

Invest in the capacity of school leadership

Pedagogical leadership plays a key role in driving and sustaining school improvement processes (Pont, Nusche and Moorman, 2008[104]). Ensuring that school leaders are motivated and enabled to lead the digital transformation of their schools is vital to achieve meaningful change in the classroom. School leaders represent an important interface between public authorities and the staff working in schools and play a critical role in promoting and sustaining technology-enhanced pedagogical innovations and in creating the conditions to strengthen teachers' capacity for digital education (e.g. through systematic collaboration and communities of practice) (Paniagua and Istance, 2018[105]). Public authorities should therefore consider targeting capacity investments specifically at this group.

Assessing the degree to which school leaders, educators, and learners are ready, willing, and able to integrate technology into the learning process is an important step informing the implementation of digitally enhanced education in schools. Listening to and evaluating the concerns of stakeholders can also flag challenges that could prevent the take-up of technologies and lead to cynicism or resistance to reforms. It can also yield important insights on the types of support that schools and teachers need and should inform interventions designed to strengthen their capacity, including the provision of adequate training (Ganimian, Vegas and Hess, 2020, p. 23[44]).

Some systems have sought to strengthen the digital capacity of their schools by investing directly in the professional development of school leaders, although only one-third of European education systems explicitly stated this goal as part of their strategic objectives in 2019/18 (European Commission/EACEA/Eurydice, 2019, p. 95[106]). For instance, the **Slovenian** 2016-20 strategy for the implementation of digital education included strengthening e-competences among all actors of the education system as one of six main objectives. To attain this objective, the ministry sought to offer counselling and training to school leaders related to digital technologies, strengthen professional e-communities, the active exchange of good practice and peer learning (European Commission/EACEA/Eurydice, 2019, p. 94[106]). Slovenia's middle leadership programme, managed by the National School for Leadership in Education, brings together leadership staff from different types of schools to take part in structured school visits followed by reflections and training in order to promote the sharing of good practices (OECD, 2021, p. 89[93]). Annual evaluations rate the programme highly and provide evidence of successfully implemented changes in schools. One of the main challenges reported by participants is the need to develop incentive mechanisms to reward participation and performance in the programme (OECD, 2019, p. 494[107]).

Support education institutions' efforts for self-evaluation of their digital capacity and their development of digital education strategies

Evaluation practices at the system- and institution-levels can play an important role in improving the use of digital education technologies in education institutions. The relationship between digital technologies and evaluation practices is complex. On the one hand, digital technologies can facilitate the implementation of self-evaluations in schools (e.g. principals might use online surveys to solicit feedback from educators, students and other stakeholders). On the other hand, educators' practices regarding the use of digital technologies can be subject of internal and external evaluations and may be included in system-level guidelines for evaluations (OECD, 2019, p. 33[48]).

Several countries have adapted their evaluation frameworks to account for the use of digital education technologies in education institutions. At the school level, in 2018/2019, 10 EU countries had included evaluation of digital education specifically in their external school evaluation frameworks, with varying evaluation methods and data sources (e.g. surveys, classroom observation) (European

Commission/EACEA/Eurydice, 2019[106]). Others encourage schools to emphasise the assessment of digital capacity in their self-evaluation practices and support them in the process (for an in-depth discussion, see Chapter 9).

Enabling education institutions to take stock of their strengths and weaknesses when it comes to the use of digital education technologies is an important condition for their development of digital education strategies and improvement plans (European Commission, 2020[1]). Self-evaluation tools can provide a useful framework for education institutions to take stock of their current position and structure conversations around strengths and areas for improvement. Examples include:

- The Self-reflection on Effective Learning by Fostering the use of Innovative Educational technologies tool (SELFIE) is an online tool launched by the **European Commission** in 2018 to assist schools in evaluating their digital capacity. The tool uses a questionnaire to gather views of the whole-school community – school leaders, teachers and students – and generates an interactive online report that provides aggregated data on strengths and weaknesses in the schools' use of digital technologies for teaching and learning. SELFIE is available for schools at the primary to post-secondary non-tertiary levels and is based in the Digitally-Competent Educational Organisations framework DigCompOrg (Kampylis, Punie and Devine, 2015[108]). It covers eight areas emerging from the literature on conditions for an effective use of digital education technologies: leadership, collaboration and networking, infrastructure and equipment, continuing professional development, pedagogy (support and resources), pedagogy (implementation in the classroom), assessment practices, and student digital competence (Castaño Muñoz, Pokropek and Weikert García, 2022[6]; Costa, Castaño-Muñoz and Kampylis, 2021[5]). SELFIE was expanded in October 2021 with a module on work-based learning (SELFIE WBL) to further support the VET sector. In addition to self-assessment of the digital capacity of schools, SELFIE for teachers provides individual educators with an opportunity to assess their digital competences and identify further learning needs.
- A similar strategic reflection tool for higher education institutions, entitled DIGI-HE, and which will be built on SELFIE and the DigCompOrg framework, is currently in development (Ehlers and Bonaudo, 2020[109]). The "Digital Transformation and Capability" element of the HEInnovate self-assessment tool can also support higher education institutions wishing to reflect on their current digital capacities (European Commission, 2022[110]).
- **Estonia** has developed a national tool, the Digital Mirror (*DigiPeegel*), for schools to measure the digital competences of their teachers and students, to assess their digital maturity and to develop an improvement plan (OECD, 2021, p. 92[93]). Over 400 general education schools had undergone the self-evaluation process between 2016 and 2019 (OECD, 2020, p. 17[111]). Evaluations of the tool's implementation were mixed and it has not been in used beyond 2019. Although some school leaders saw the process as a useful exercise to take stock of their schools' digital capacity, other leaders and teachers reportedly did not see the benefit of undergoing the exercise besides the extrinsic incentive to become eligible for public investments in digital infrastructure. Some also expressed uncertainty about the use of the evaluation's results or felt like the Digital Mirror duplicated existing surveys and assessments or was not well aligned with the schools' work on their development plans (Tammets et al., 2019[112]).

Monitor and address equity issues related to digital capacity in schools

More equitable digital education also requires bridging remaining divides in schools' digital capacity. Countries across the OECD need to devote further efforts in identifying the existence of equity gaps in access to schools with high digital capacity, as well as the nature (e.g. geographic, socio-economic, school size-related) of such gaps. Such inequalities can stem from structural policies (e.g. due to the difficulty of some education systems in attracting, developing and retaining qualified teachers or staff in the most disadvantaged schools) or may be the result of school or local-level factors or resource management

decisions. Better mapping and identifying the factors that drive gaps in schools' digital capacity is therefore essential.

Countries can also envision the development of funding schemes that account for the characteristics of schools in the allocation of resources for digital capacity building. Often, countries have relied on a mix of approaches to compensate schools for general additional needs, including i) the provision of additional resources as part of regular funding allocation to schools and ii) targeted programmes/grants (OECD, 2021[113]). While targeted programmes can allow better steering for equitable resource allocation, they can also translate into inefficiency and a lack of predictability of resource allocations. In this respect, striking a balance between regular and targeted funding appears desirable. Such approaches can also be considered for the design of funding schemes seeking to bridge equity gaps in digital capacity between schools.

- Since 2017, **France** has aimed to strengthen digital capacity in rural schools with the targeted programme Innovative Digital Schools and Rurality Programme (*Programme Écoles numériques innovantes et ruralité*). Initially endowed with EUR 20 million , and with another EUR 15 million added in 2020, the programme supported around 7 000 schools with digital equipment to promote learning, enrich relationships with families and reinforce the attractiveness of rural schools and territories (Ministère de l'Éducation Nationale et de la Jeunesse, 2018[114]). This programme complements previous efforts to build capacity in rural schools, for example by fostering collaboration and by regularly letting teachers visit rural schools to promoting the use of educational materials and digital equipment in the classroom (*Équipe mobile académique de liaison et d'animation*, EMALA) (Echazarra and Radinger, 2019[115]).

Higher education

Supporting institutions in assessing and advancing their digital maturity

Focusing on organisational digital maturity not only supports the resilience of HEIs to manage future disruptions, but also creates opportunities for HEIs to enrich and transform teaching, learning and administration. Digital maturity can be enhanced by systematic planning, and commitment of resources to digital infrastructure and staff training (Đurek, Kadoic and Begičević Ređep, 2018[41]), (Marshall, 2012[116]).

Given their generally high levels of autonomy, leadership teams in HEIs will bear primary responsibility for development of their digital maturity. However, governments and public authorities have a role to play in steering HEIs to prioritise and plan for digital maturity. Self-reflection can be encouraged by the promotion of evidence-based toolboxes for HEIs to assess their current position such as the DigCompOrg framework (European Commission, 2015[117]).Governments can also stimulate an increased institutional focus on digital maturity through national level frameworks and strategies. For example, the Norwegian Digitalisation Strategy for the Higher Education Sector 2017-2021 placed requirements on higher education institutions to define related goals, as part of the central funding process (Regjeringen.no, 2017[118]).

Assessing digital maturity may expose shortcomings in an institution's capital resources. Advancing digital maturity will also require ongoing commitment of resources to upgrade relevant digital infrastructure. Managing that challenge at HEI level will depend on the country's approaches to capital funding and procurement. As discussed in Chapter 6, NRENS are increasingly providing higher education institutions with a range of digital services that can support advancement in digital maturity (Géant, 2020[119]; SURF, 2022[120]; JISC, 2022[121]). Beyond direct funding of digital infrastructure, governments can also stimulate institutions to invest in their own digital advancement through topping up or matching their financial commitments to specific projects (whether directly or through partnerships with private businesses). For example, **Ireland**'s Higher Education Strategic Infrastructure funding rounds are open for application to all higher education institutions and provide up to 50% of funding for strategic investment projects, including projects that maximise the use of digital technologies (Government of Ireland, 2019[122]).

Finally, given the increasingly competitive environments in which many higher education institutions operate, governments can highlight the competitive advantages that digital maturity can bring to organisations, such as greater satisfaction of staff and students with their experiences, greater efficiency in administrative processes and improved readiness to innovate and adopt new technologies (Boston Consulting Group, 2021[123]). Devising means to publicly highlight advancements or innovations that promote organisational digital maturity can also support this objective. Such mechanisms have already been successfully implemented by governments in many countries in the sphere of teaching and learning (OECD, 2021[124]), and through "digital innovation awards" provided by international commercial ranking bodies.

Supporting systematic survey-based student feedback to encourage high-quality teaching with digital education technologies

Students continuously make their own assessments of their teaching and learning experience. Such insights can help improve teaching quality, but only if they are collected and analysed in an appropriate way (Hénard and Roseweare, 2012[125]). Student feedback can help lift the effectiveness of course design and delivery, facilitate dialogue between an HEI and students, identify good practice, assess student satisfaction and contribute to staff development (Brennan and Williams, 2004[126]).

HEIs can obtain student feedback through surveys, course evaluations, "instant feedback" techniques (Hénard and Roseweare, 2012[125]), while digital technologies and video recording of classes also provide mechanisms to capture student feedback (Deeley, 2018[127]), (MacKay, 2019[128]). At an HEI level, the challenge is to harness feedback to enable systematic analysis that can contribute to the enhancement of quality across the HEI and to feed into the institution's strategy for teaching and learning.

At the system or national level, there is scope as well to use existing survey instruments, such as the **UK** National Student Survey or the **Danish** Learning Barometer, neither of which currently contain questions eliciting information about the effective – or ineffective – use of digital technologies in instruction. Alternatively, governments may choose to field a dedicated survey instrument focused on the digital learning environment as the **Irish** government did in 2019. The Irish National Digital Experience (INDEx) survey, conducted in 2019, asked students (and higher education teachers) about how much and what types of technology were used in their classes, how well the technology was deployed and how their experience could be improved (National Forum for the Enhancement of Teaching and Learning in Higher Education, 2020[129]). The results of the survey have been used by HEIs to modify their approaches – for instance, as a result of reviewing their students' responses in the INDEx survey, some HEIs purchased additional laptops for their laptop rental scheme, one HEI redesigned its Virtual Learning Environment (VLE) and some HEIs developed and disseminated guidance materials for students and educators (National Forum for the Enhancement of Teaching and Learning in Higher Education, 2021[130]). The survey results were also used by HEIs in developing their pandemic responses.

The Irish INDEx survey shares questions with a similar UK post-secondary education student and staff survey conducted annually by the British NREN JISC and also taken by a number of universities in Australia and New Zealand (JISC, 2020[131]); this allows for some cross-jurisdiction comparisons of students' digital experiences.

The value that the INDEx survey brought to Irish HEIs suggests that governments should encourage those who manage national student surveys to include a digital experience focus in their national student surveys or, if there is no national student survey, they should encourage HEIs to focus on the digital experience in their institutional surveys.

Prepare students and actors across the wider learning environment for digital education

Successfully implementing education policies and achieving tangible improvements in teaching and learning requires co-ordinated efforts and capacity building among many actors at multiple levels of the educational system (Viennet and Pont, 2017[132]). The form that capacity building efforts should take across the wider learning environment depends on an education system's governance arrangements (e.g. the degree of local and school autonomy) and will vary across levels of education (e.g. parents and local authorities are important mediators of digital policies the school level but not at the higher education level).

Build students' skills for digital education

Beyond general policies to enhance the quality and equity of education systems that can support students' skills overall, countries can rely on a range of strategies for building students' skills for digital education. OECD countries have thus relied on a combination of approaches by teaching new competencies from an early age, adapting school curricula to changing skills requirements, designing extracurricular activities focused on digital skills development, and enhancing teachers' digital competence. For instance, evidence from 22 education systems, which responded to the OECD 21st Century Children Policy Questionnaire, shows that many education systems put an emphasis on teaching both "hard" and "soft" digital skills including critical information, social and creative skills, as well as basic operational skills at the primary level and particularly more at the secondary level (Burns and Gottschalk, 2019[45]).

In this respect, the definition of digital competence has also been constantly evolving. The focus has progressively shifted towards developing a mix of skills, including understanding algorithms, critical application of digital technologies, collaborative problem solving using such technologies, media literacy, and resilience online. There has also been a trend, observed in some countries, to integrate digital skills transversally across the curriculum (for example as "computational thinking") rather than through stand-alone classes (OECD, 2019[7]). For instance, Australia, Chile, Estonia, Hungary, Ireland, Japan, the Netherlands, New Zealand, Scotland (United Kingdom) and Wales (United Kingdom) reported introducing digital technologies and skills as a cross cutting theme across multiple subjects or the entire curriculum (OECD, 2020[133]).

Support parents and caregivers as digital education facilitators

In addition to providing school-based support to students for their use of digital learning technologies through curriculum and digital skills training, home-based support for learners and support opportunities for parents should also be envisioned. This could take the form of monitoring student and family access to connectivity and devices at home to identify accessibility gaps; training parents and caregivers (e.g. using the school facilities for digital skills training of adults and caretakers in the community); providing digital solutions to help students and caregivers trouble-shoot whenever they face an issue with the digital education technology (e.g. hotlines and helpdesks). Building digital skills strategically across the life course through a system-wide approach can strengthen capacity among stakeholders beyond the classroom to support students' learning with digital education technologies:

- **Estonia** integrated a digital transformation programme in its lifelong learning strategy, with the aim of providing a digital focus in lifelong learning by i) incorporating a digital culture in the learning process, ii) supporting digital learning resources in schools, iii) accessing a modern digital learning infrastructure, iv) creating and implementing assessment models for digital competence and v) creating learning opportunities for adults to acquire digital competence (Estonian Ministry of Education and Research, 2014[134]) (see Chapter 2 for further examples of holistic system-wide approaches to digital skills).

Some countries have worked on the provision of guidelines to parents on the use of digital technologies for educational purposes.

- For instance, the Office of Educational Technology in the **United States** has prepared a Parent and Family Digital Learning Guide to support parents in helping their children thrive in digital education (US Office of Educational Technology, 2021[135]). The Guide was prepared to support all parents, starting with more foundational steps for those lacking the necessary skills and building upon for those who are more at ease with digital technologies.
- Through its Digital Education Territories (*Territoires Numériques Éducatifs*), **France** has created a regional structure for capacity building on digital education. Among other things, digital education territories offer resources and workshops to parents on topics related to the use of digital tools for learning and digital risks for children. They also provide opportunities for parents with more digital capital to certify as mentors and help other parents or students with the use of digital technologies (République française, n.d.[136]).

Ensuring that parents have the necessary digital competence to support their children's learning with digital technologies is critical to bridge inequities between students of different backgrounds.

- In the **United Kingdom**, the government funds free qualifications for adults lacking the essential digital skills needed for work and everyday life (UK Government, 2022[137]). Education and training providers carry out an initial skill level assessment in order to ensure eligibility and enrol individuals at an appropriate course level. Beyond government provision, local communities, libraries and associations also can also support the development of adults' and parents' digital skills. The United Kingdom's Good Things Foundation has co-designed free online learning resources to help individuals build their digital skills. It also ran the Future Digital Inclusion programme in partnership with the Department for Education to support the digital inclusion of the hardest to reach groups in society, focusing on learners with low skills and confidence (Good Things Foundation, 2021[138]).
- The City of Ghent (**Flemish Community of Belgium**) runs the Digitaal.Talent@Gent programme to support digital inclusion, by combining a range of interventions: lending hardware to schools and organisations, providing coding summer camps for students from socio-economically disadvantaged backgrounds, setting up digital banks where citizens can go for accessing digital devices, receiving training and support, etc. In addition, the programme provides supports to vulnerable families in introducing digital education games for young children and getting started on digital communication and media literacy (through lessons parents of primary children can attend in schools) (City of Ghent, 2022[139]).
- Across **Belgium**, **Bulgaria** and **Romania**, the ERASMUS+ funded project Digital Education Among Roma Minorities in Schools (DREAMS) fostered the social, civic and intercultural competences of Roma parents through digital education (All Digital, n.d.[140]). Roma parents from Belgium, Bulgaria and Romania were taught how to tell and edit digital personal narratives in collaboration with local schools. Through fostering digital skills among Roma parents, the project strengthened their bonds with school communities and provided them with a digital platform to share their stories.

Beyond the provision of such support programmes for building adults' and parents' digital skills, schools and local communities play an important role in ensuring that potential beneficiaries know about these programmes. In this respect, fostering stronger school-parent links can also be an important mediating factor to foster parental capacity for digital education (e.g. raising awareness on parental digital skills needed to support their child's education, sharing information about capacity building activities available in the local community).

Finally, governments and providers of digital skills training programmes also need to ensure that such programmes are delivered in a way that caters for potential constraints of beneficiaries and enables them to effectively participate and engage. Participation in adult learning remains a challenge across most EU and OECD countries, where an average of only two in five adults engage in education and training every year according to data from the OECD Survey of Adult Skills (PIAAC) (OECD, 2020[141]). Governments

and providers of training programmes should thus address barriers preventing adults from engaging in training to raise their digital skills (e.g. through provision of training outside working hours, arranging childcare support during the training) and seek to raise the motivation to learn of those who are completely disengaged from learning by creating engaging and relevant training opportunities.

Build capacity among sub-central authorities with responsibility for digital education

When sub-central authorities have a key role in supporting digital education (e.g. through the acquisition of digital resources for education institutions or the provision of support to the latter), building their capacity is critical to ensure they can effectively deliver on their responsibility. Building capacity at the sub-central level should thus include a focus on resource management whenever the latter falls under the responsibility of sub-central authorities, as well as professional development programmes for staff in relation to digital education technologies. Such programmes could relate to the management of digital resources, quality assurance for digital education, financial planning for digital resources in education institutions, etc. Beyond professional development, encouraging collaboration and resource sharing can also be an effective way of building capacity among sub-central authorities with responsibilities for digital education (OECD, 2017[51]). Some countries maintain centrally co-ordinated networks of experts who can be dispatched to build capacity at the local and regional level:

- In **France**, a network of local digital advisors has supported local authorities in the implementation of digital education technologies since 2013. The advisors provide support on digital matters to the rectors of France's 30 education academies (or administrative districts), liaise with local authorities and companies, lead initiatives and facilitate networks around the uses of digital tools in education. The advisors also develop training programmes and mobilise knowledge for teachers to become more active in the use of digital tools for learning. Each academy has at least one digital education advisor, with most having less than 15, totalling several hundred advisors. In co-ordination with the ministry's Directorate for Digital Education, this strong network of skilled experts could be mobilised to prepare and oversee the transition to remote learning during the COVID-19 pandemic (Vincent-Lancrin, Cobo Romaní and Reimers, 2022[53]).

Key messages

The effective use of digital learning technologies requires sufficient capacity at all levels of the education system. As digital technologies increasingly permeate classrooms in OECD and EU countries, the capacity of educators to put these technologies to effective use is becoming a critical bottleneck in many education systems. The digital skills of educators vary strongly across countries but are consistently reported as one of the areas in which educators face the biggest training need. This chapter therefore highlights a range of policies aiming to build educators' capacity for digital education through initial training and continuing professional development. These include strengthening opportunities for peer learning as well as the creation of organisations providing teacher training in the area of digital skills and pedagogies. In this context, the chapter also points at the importance of specialised training to prepare teachers for the use of assistive technologies to support learners with SEN.

Education institutions play a critical role in encouraging and empowering educators to integrate digital technologies in their pedagogical practice. By creating a culture of professional learning and innovation, institution level policies can promote the take-up and more effective use of digital technologies. This chapter therefore presents policies that serve to build capacity at the institution level by strengthening instructional leadership, providing central guidance to education institutions and facilitating opportunities to benchmark and assess institutions' performance through self-evaluation or student feedback.

The effective digitalisation of education systems also requires the preparation of the wider learning environment. Students' digital skills are a prerequisite for their ability to navigate digital environments in a safe and productive way. Similarly, parents play a strong role in promoting their children's adequate use of digital technologies, especially at younger ages. The analysis in this chapter therefore emphasises the role of building students' and parents' capacity for digital education both to protect learners from harm and to allow them to seize the full potential of digital technologies. Lastly, the chapter considers the role sub-central authorities can play in supporting digital education and suggests some promising policies to build capacity for digital education at the local level.

References

Advance HE (2021), *Programme and events portfolio for 2021-22*, https://www.advance-he.ac.uk/programmes-events#Brochure. [80]

All Digital (n.d.), *Fostering the social, civic and intercultural competences of Roma parents through digital education • ALL DIGITAL*, https://all-digital.org/dreams-project-video/ (accessed on 1 June 2023). [140]

Arstorp, A. (2021), "25+ years of ICT in policy documents for teacher education in Norway and Denmark (1992 to 2020): A study of how digital technology is integrated into policy documents", *Education Inquiry*, Vol. 12/4, pp. 365-389, https://doi.org/10.1080/20004508.2021.1972594. [56]

Asselin, S. (2014), *Assistive technology in higher education in Information Resources Management Association USA Assistive technologies: concepts, methodologies, tools and applications*, DOI: 10.4018/978-1-4666-4422-9. [29]

Atanga, C. et al. (2020), "Teachers of students with learning disabilities: Assistive technology knowledge, perceptions, interests, and barriers", *Journal of Special Education Technology*, Vol. 35/4, pp. 236-248, https://doi.org/10.1177/0162643419864858. [27]

Basilotta-Gómez-Pablos, V. et al. (2022), "Teachers' digital competencies in higher education: a systematic literature review", *International Journal of Educational Technology in Higher Education*, Vol. 19/1, pp. 1-16, https://doi.org/10.1186/S41239-021-00312-8/FIGURES/6. [24]

Blazar, D. and M. Kraft (2015), "Exploring mechanisms of effective teacher coaching: A tale of two cohorts from a randomized experiment", *Educational Evaluation and Policy Analysis*, Vol. 37/4, pp. 542-566, https://doi.org/10.3102/0162373715579487. [76]

Boeskens, L., D. Nusche and M. Yurita (2020), "Policies to support teachers' continuing professional learning: A conceptual framework and mapping of OECD data", *OECD Education Working Papers*, No. 235, OECD Publishing, Paris, https://doi.org/10.1787/247b7c4d-en. [8]

Bong, W. and W. Chen (2021), *Increasing faculty's competence in digital accessibility for inclusive education: a systematic literature review*, DOI: 10.1080/13603116.2021.1937344. [31]

Boston Consulting Group (2021), *Investing in Education Technology*, https://www.bcg.com/fr-fr/publications/2021/investing-in-education-technology (accessed on 28 May 2022). [123]

Bremer, C. and I. Antony (2017), "Einsatz digitaler Medien für den lernerzentrierten Unterricht:Konzeption und Evaluation der Lehrerfortbildung "Lernkompetenz entwickeln, individuell fördern"", in Igel, C. (ed.), *Bildungsräume. Proceedings der 25. Jahrestagung der Gesellschaft für Medien in der Wissenschaft*, Waxmann, New York, https://doi.org/10.25656/01:16148. [95]

Brennan, J. and R. Williams (2004), *Collecting and using student feedback: A guide to good practice*, https://www.advance-he.ac.uk/knowledge-hub/collecting-and-using-student-feedback-guide-good-practice (Accessed 11 5 22). [126]

Burns, T. and F. Gottschalk (eds.) (2019), *Educating 21st Century Children: Emotional Well-being in the Digital Age*, Educational Research and Innovation, OECD Publishing, Paris, https://doi.org/10.1787/b7f33425-en. [45]

Cabero-Almenara, J. et al. (2021), *Digital competence of higher education professor according to DigCompEdu. Statistical research methods with ANOVA between fields of knowledge in different age ranges*, https://doi.org/10.1007/s10639-021-10476-5. [43]

Castaño Muñoz, J., A. Pokropek and L. Weikert García (2022), "For to all those who have, will more be given? Evidence from the adoption of the SELFIE tool for the digital capacity of schools in Spain", *British Journal of Educational Technology*, https://doi.org/10.1111/BJET.13222. [6]

Chalmers, D. and D. Gardiner (2015), "The measurement and impact of university teacher development programs", *Educar*, Vol. 51/1, pp. 53-80, https://doi.org/10.5565/rev/educar.655. [82]

City of Ghent (2022), *Alle Gentenaars digitaal mee | Stad Gent*, https://stad.gent/nl/samenleven-welzijn-gezondheid/welzijn/alle-gentenaars-digitaal-mee (accessed on 31 May 2022). [139]

Costa, P., J. Castaño-Muñoz and P. Kampylis (2021), "Capturing schools' digital capacity: Psychometric analyses of the SELFIE self-reflection tool", *Computers & Education*, Vol. 162, p. 104080, https://doi.org/10.1016/J.COMPEDU.2020.104080. [5]

Crawford, J. et al. (2020), "COVID-19: 20 Countries' Higher Education Intra-Period Digital Pedagogy Responses", *Journal of Applied Teaching and Learning*, https://journals.sfu.ca/jalt/index.php/jalt/article/view/191 (accessed on 17 April 2023). [37]

Danish Evaluation Institute (2021), *Evaluering af teknologiforståelse i uddannelse af laerere og øvrigt paedagogisk personale [Evaluation of technology understanding in the training of teachers and other pedagogical staff]*, https://emu.dk/sites/default/files/2022-01/gsk_teknologiforst%C3%A5else_Evalueringsrapport_%20uddannelse%20i%20teknologiforst%C3%A5else_spor3.pdf (accessed on 26 July 2022). [57]

Darling-Hammond, L., M. Hyler and M. Gardner (2017), *Effective Teacher Professional Development*, Learning Policy Institute, Palo Alto, CA, https://learningpolicyinstitute.org/sites/default/files/product-files/Effective_Teacher_Professional_Development_REPORT.pdf (accessed on 26 March 2019). [78]

Deeley, S. (2018), *Using technology to facilitate effective assessment for learning and feedback in higher education*, DOI: 10.1080/02602938.2017.1356906. [127]

Department for Education (2022), *Evaluation of the Assistive Technology Training Pilot*, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1087254/AT_Training_Pilot_Evaluation_Report.pdf. [99]

Deutscher Bildungsserver (2022), *Lehrerfortbildungen zum Thema Digitalisierung [Teacher professional development on digitalisation]*, https://www.bildungsserver.de/lehrerfortbildungen-zum-thema-digitalisierung-12811-de.html (accessed on 25 July 2022). [94]

Digital Promise (n.d.), *Microcredential explorer*, https://digitalpromise.org/initiative/educator-micro-credentials/micro-credential-explorer/?a=Topics&b=Technology%20Planning%20%26%20Infrastructure. [67]

Dinse de Salas, S. (2019), *Digitale Medien im Unterricht-Entwicklung professionellen Wissens und professionsbezogener Einstellungen durch Coaching (Dissertation)*, Pädagogische Hochschule Heidelberg, https://opus.ph-heidelberg.de/frontdoor/deliver/index/docId/335/file/Dissertation_Dinse_de_Salas.pdf (accessed on 25 July 2022). [96]

Đurek, V., N. Kadoic and N. Begičević Ređep (2018), *Assessing the digital maturity level of higher education institutions*, doi: 10.23919/MIPRO.2018.8400126. [41]

Echazarra, A. and T. Radinger (2019), "Learning in rural schools: Insights from PISA, TALIS and the literature", *OECD Education Working Papers*, No. 196, OECD Publishing, Paris, https://doi.org/10.1787/8b1a5cb9-en. [115]

Ehlers, U. and P. Bonaudo (2020), "DIGI-HE – A strategic reflection tool on digitalisation at European higher education institutions", *European Distance and E-Learning Network (EDEN) Proceedings* 1, pp. 289-298, https://doi.org/10.38069/edenconf-2020-ac0027. [109]

Ejdys, J. and J. Kozlowska (2021), *Acceptance of e-learning at university level during the covid-19 pandemic situation-teachers' and students' perspective*, DOI: 10.17512/pjms.2021.23.2.07. [20]

Estonian Ministry of Education and Research (2014), *The Estonian Lifelong Learning Strategy 2020*, Ministry of Education and Research, Tallinn, https://www.hm.ee/sites/default/files/estonian_lifelong_strategy.pdf (accessed on 18 October 2021). [134]

European Commission (2022), *eTwinning*, https://www.etwinning.net/en/pub/index.htm (accessed on 13 May 2022). [90]

European Commission (2022), *HEIInnovate*, https://www.heinnovate.eu/en (Accessed 25 May 2022). [110]

European Commission (2020), *Commission Staff Working Document Accompanying the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions "Digital Education Action Plan (2021-2027)"*, European Commission, Brussels, https://eur-lex.europa.eu/legal-content/LT/TXT/?uri=CELEX:52020SC0209 (accessed on 7 April 2022). [1]

European Commission (2015), *European Framework for Digitally Competent Educational Organisations - DigCompOrg*, https://joint-research-centre.ec.europa.eu/european-framework-digitally-competent-educational-organisations-digcomporg_en (accessed on 27 May 2022). [117]

European Commission (2013), *Survey of Schools: ICT in Education - Benchmarking Access, Use and Attitudes to Technology in Europe's Schools*, Directorate-General for the Information Society and Media (European Commission), Brussels, https://doi.org/10.2759/94499. [14]

European Commission/EACEA/Eurydice (2019), *Digital Education at School in Europe*, Publications Office of the European Union, Luxembourg, https://doi.org/10.2797/763. [106]

European Union (2022), *School Education Gateway*, https://www.schooleducationgateway.eu/en/ (accessed on 7 April 2022). [88]

Eurostat (2022), *Individuals' level of digital skills*, https://ec.europa.eu/eurostat/databrowser/view/ISOC_SK_DSKL_I/default/table?lang=en (accessed on 30 May 2022). [50]

Eurydice (2017), *Modernisation of higher education in Europe: academic staff – 2017*, https://ec.europa.eu/info/sites/default/files/209_academic_staff_2017.pdf (Accessed 24 May 2022). [22]

Fraillon, J. et al. (2014), *Preparing for Life in a Digital Age: The IEA International Computer and Information Literacy Study International Report*, Springer International Publishing, Heidelberg, https://research.acer.edu.au/cgi/viewcontent.cgi?article=1009&context=ict_literacy (accessed on 24 January 2020). [10]

France Université Numérique (n.d.), *FUN Ressources*, https://www.fun-ressources.fr/ (accessed on 2 June 2023). [103]

France Université numérique (n.d.), *Se former pour enseigner dans le supérieur - Cours - FUN MOOC*, https://www.fun-mooc.fr/fr/cours/se-former-pour-enseigner-dans-le-superieur/ (accessed on 2 June 2023). [62]

Ganimian, A., E. Vegas and F. Hess (2020), *Realizing the Promise: How Can Education Technology Improve Learning for All?*, The Brookings Institution, Washington, https://www.brookings.edu/wp-content/uploads/2020/08/edtech_playbook_full_v2.pdf (accessed on 6 April 2022). [44]

Garet, M. et al. (2008), *The Impact of Two Professional Development Interventions on Early Reading Instruction and Achievement*, US Department of Education, Institute of Education Sciences, http://www.edpubs.org. (accessed on 13 July 2020). [71]

Garet, M. et al. (2016), *Focusing on mathematical knowledge: The impact of content-intensive teacher professional development (NCEE 2016-4010)*, U.S. Department of Education, Institute of Education Sciences. [70]

Géant (2020), *Compendium of National Research and Education Networks in Europe - 2020,*, https://about.geant.org/wp-content/uploads/2021/12/Compendium_FINAL2.pdf. [119]

Ghurbhurun, R. (2020), *If we don't upskill teachers in digital skills, learners will suffer*, https://www.jisc.ac.uk/blog/if-we-dont-upskill-teachers-in-digital-skills-learners-will-suffer-30-nov-2020 (Accessed 27 May 2022). [23]

Gil-Flores, J., J. Rodríguez-Santero and J. Torres-Gordillo (2017), "Factors that explain the use of ICT in secondary-education classrooms: The role of teacher characteristics and school infrastructure", *Computers in Human Behavior*, Vol. 68, pp. 441-449, https://doi.org/10.1016/j.chb.2016.11.057. [15]

Glazerman, S. et al. (2010), *Impacts of Comprehensive Teacher Induction: Final Results from a Randomized Controlled Study (NCEE 2010-4027)*, US Department of Education, Institute for Education Sciences, https://ies.ed.gov/ncee/pubs/20104027 (accessed on 5 December 2020). [68]

Goddard, R. et al. (2015), "A theoretical and empirical analysis of the roles of instructional leadership, teacher collaboration, and collective efficacy beliefs in support of student learning", *American Journal of Education*, Vol. 121/4, pp. 501-530, https://doi.org/10.1086/681925/ASSET/IMAGES/LARGE/FG2.JPEG. [33]

Good Things Foundation (2021), *Future Digital Inclusion*, https://www.goodthingsfoundation.org/what-we-do/our-partnerships/digital-skills-safety/future-digital-inclusion/ (accessed on 31 May 2022). [138]

Government of Ireland (2019), *Almost €100 million investment under Project Ireland 2040 for five major building projects in higher education institutions*, https://www.gov.ie/en/press-release/5b1a84-almost-100-million-investment-under-project-ireland-2040-for-five-ma/ (accessed on 28 May 2022). [122]

Hanafin, J. et al. (2007), *Including young people with disabilities: Assessment challenges in higher education*, DOI 10.1007/s10734-006-9005-9. [30]

Hénard, F. and D. Roseweare (2012), *Fostering quality teaching in higher education: Policies and practices*, https://www.oecd.org/education/imhe/QT%20policies%20and%20practices.pdf. [125]

Hippe, R., A. Pokropek and P. Costa (2021), "Cross-country validation of the SELFIE tool for digital capacity building of vocational education and training schools (in preparation)". [17]

Ifenthaler, D. (2012), *Learning management systems.*, https://doi.org/10.1007/978-1-4419-1428-6_187. [40]

Jacob, B. and L. Lefgren (2004), *The impact of teacher training on student achievement: Quasi-experimental evidence from school reform efforts in Chicago*, https://doi.org/10.2307/3559005. [69]

Jaschik, S. and D. Lederman (2019), *Inside Higher Ed 2019 Survey of faculty attitudes on technology*, https://www.insidehighered.com/news/survey/survey-faculty-attitudes-technology [18]

JISC (2022), *Powering world-class education and research: Advice and guidance*, https://www.jisc.ac.uk/advice (accessed on 28 July 2022). [121]

JISC (2020), *Student digital experience insights survey 2020: question by question analysis of findings from students in UK further and higher education*, https://www.jisc.ac.uk/sites/default/files/dei-2020-student-survey-question-by-question-analysis.pdf. [131]

Jisc (n.d.), *Assistive technology network*, https://beta.jisc.ac.uk/get-involved/assistive-technology-network. [100]

Jones, B. et al. (2019), "Training pre-service general educators in assistive technology competencies for students with visual impairments", *British Journal of Visual Impairment*, Vol. 37/1, pp. 29-39, https://doi.org/10.1177/0264619618814066. [97]

Kampylis, P., Y. Punie and J. Devine (2015), *Promoting effective digital-age learning: A European framework for digitally-competent educational organisations*, Publications Office of the European Union, Luxembourg, https://doi.org/10.2791/54070. [108]

Kennedy, M. (2019), "How we learn about teacher learning", *Review of Research in Education*, Vol. 43, pp. 138-162, https://doi.org/10.3102/0091732X19838970. [72]

Kennedy, M. (2016), "How does professional development improve teaching?", *Review of Educational Research*, Vol. 86/4, pp. 945-980, https://doi.org/10.3102/0034654315626800. [73]

Keune, K. (2022), *Organizational changes announced for newly named Office of Technology and Digital Innovation*, https://it.osu.edu/news/2022/01/12/organizational-changes-announced-newly-named-office-technology-and-digital. [83]

Kools, M. and L. Stoll (2016), "What Makes a School a Learning Organisation?", *OECD Education Working Papers*, No. 137, OECD Publishing, Paris, https://doi.org/10.1787/5jlwm62b3bvh-en. [89]

Kraft, M. and D. Blazar (2017), "Individualized coaching to improve teacher practice across grades and subjects: New experimental evidence", *Educational Policy*, Vol. 31/7, pp. 1033-1068, https://doi.org/10.1177/0895904816631099. [75]

Kraft, M. and J. Papay (2014), "Can professional environments in schools promote teacher development? Explaining heterogeneity in returns to teaching experience", *Educational Evaluation and Policy Analysis*, Vol. 36/4, pp. 476-500, https://doi.org/10.3102/0162373713519496. [63]

Krumsvik, R. (2008), "Situated learning and teachers' digital competence", *Education and Information Technologies*, Vol. 13/4, pp. 279-290, https://doi.org/10.1007/S10639-008-9069-5/FIGURES/1. [101]

Kupriyanova, V., E. Bennetot Pruvot and T. Estermann (2020), *Autonomy, efficiency and effectiveness—Opportunities for higher education: A pilot study. In: Curaj, A., Deca, L., Pricopie, R. (eds) European Higher Education Area: Challenges for a New Decade*, DOI: 10.1007/978-3-030-56316-5_27. [38]

Livingstone, S. et al. (2017), "Maximizing Opportunities and Minimizing Risks for Children Online: The Role of Digital Skills in Emerging Strategies of Parental Mediation", *Journal of Communication*, Vol. 67/1, pp. 82-105, https://doi.org/10.1111/jcom.12277. [49]

MacKay, J. (2019), *Show and 'tool': How lecture recording transforms staff and student perspectives on lectures in higher education*, DOI: 10.1016/j.compedu.2019.05.019. [128]

Marshall, S. (2018), *Shaping the university of the future: using technology to catalyse change in university learning and teaching*, Springer. [42]

Marshall, S. (2012), *E-learning and higher education: understanding and supporting organisational change*, https://ako.ac.nz/assets/Knowledge-centre/NPF-09-025-Understanding-and-Supporting-Organisational-Change-in-e-Learning/E-learning-in-Higher-Education-Case-Study-University.pdf (Accessed 24 May 2022). [116]

Martin, F. et al. (2020), *Examining higher education faculty use of current digital technologies: importance, competence, and motivation*, http://www.isetl.org/ijtlhe/. [25]

Minea-Pic, A. (2020), "Innovating teachers' professional learning through digital technologies", *OECD Education Working Papers*, No. 237, OECD Publishing, Paris, https://doi.org/10.1787/3329fae9-en. [13]

Ministère de l'Éducation Nationale et de la Jeunesse (2018), *L'éducation nationale engagée en faveur d'une école rurale de qualité [National education engaged for high-quality rural schooling]*, https://www.education.gouv.fr/rentree-2018-l-education-nationale-engagee-en-faveur-d-une-ecole-rurale-de-qualite-8375 (accessed on 26 July 2022). [114]

National Forum for the Enhancement of Teaching and Learning in Higher Education (2021), *INDEx survey: final summary report*, https://hub.teachingandlearning.ie/resource/index-survey-final-summary-report/. [130]

National Forum for the Enhancement of Teaching and Learning in Higher Education (2020), *INDEx Findings from Students and Staff Who Teach in Higher Education*, National Forum for the Enhancement of Teaching and Learning in Higher Education, https://www.teachingandlearning.ie/index/ (accessed on 1 September 2021). [129]

New Zealand Qualifications Authority (n.d.), *Qualification Overview: New Zealand Certificate in Adult and Tertiary Teaching (Level 5)*, https://www.nzqa.govt.nz/nzqf/search/viewQualification.do?selectedItemKey=2993. [60]

OECD (2022), *Mending the Education Divide: Getting Strong Teachers to the Schools That Need Them Most*, TALIS, OECD Publishing, Paris, https://doi.org/10.1787/92b75874-en. [28]

OECD (2021), *21st-Century Readers: Developing Literacy Skills in a Digital World*, PISA, OECD Publishing, Paris, https://doi.org/10.1787/a83d84cb-en. [47]

OECD (2021), *Education at a Glance 2021: OECD Indicators*, OECD Publishing, Paris, https://doi.org/10.1787/b35a14e5-en. [52]

OECD (2021), *Education Policy Outlook 2021: Shaping Responsive and Resilient Education in a Changing World*, OECD Publishing, Paris, https://doi.org/10.1787/75e40a16-en. [93]

OECD (2021), *Supporting the Digital Transformation of Higher Education in Hungary*, Higher Education, OECD Publishing, Paris, https://doi.org/10.1787/d30ab43f-en. [124]

OECD (2021), *Teachers and Leaders in Vocational Education and Training*, OECD Reviews of Vocational Education and Training, OECD Publishing, Paris, https://doi.org/10.1787/59d4fbb1-en. [16]

OECD (2021), "Teachers' professional learning study: Diagnostic report for the Flemish Community of Belgium", *OECD Education Policy Perspectives*, No. 31, OECD Publishing, Paris, https://doi.org/10.1787/7a6d6736-en. [87]

OECD (2021), *The state of higher education One year into the COVID-19 pandemic*, OECD Publishing. [19]

OECD (2021), "Towards equity in school funding policies", *OECD Education Policy Perspectives*, No. 41, OECD Publishing, Paris, https://www.oecd-ilibrary.org/docserver/6a3d127a-en.pdf?expires=1642414595&id=id&accname=ocid84004878&checksum=1D53BFCFBDA3E73EFAE8B747DF0587C1 (accessed on 17 January 2022). [113]

OECD (2020), "Education Policy Outlook in Estonia", *OECD Education Policy Perspectives*, No. 13, OECD Publishing, Paris, https://doi.org/10.1787/9d472195-en. [111]

OECD (2020), "Education Policy Outlook in France", *OECD Education Policy Perspectives*, No. 15, OECD Publishing, Paris, https://doi.org/10.1787/debad1c1-en. [58]

OECD (2020), *Increasing Adult Learning Participation: Learning from Successful Reforms*, Getting Skills Right, OECD Publishing, Paris, https://doi.org/10.1787/cf5d9c21-en. [141]

OECD (2020), "Learning remotely when schools close: How well are students and schools prepared? Insights from PISA", *OECD Policy Responses to Coronavirus (COVID-19)*, OECD Publishing, Paris, https://doi.org/10.1787/3bfda1f7-en. [36]

OECD (2020), *Making the Most of Technology for Learning and Training in Latin America*, OECD Skills Studies, OECD Publishing, Paris, https://doi.org/10.1787/ce2b1a62-en. [12]

OECD (2020), *PISA 2018 Results (Volume V): Effective Policies, Successful Schools*, PISA, OECD Publishing, Paris, https://doi.org/10.1787/ca768d40-en. [9]

OECD (2020), *Resourcing Higher Education: Challenges, Choices and Consequences*, https://doi.org/10.1787/735e1f44-en. [39]

OECD (2020), *TALIS 2018 Results (Volume II): Teachers and School Leaders as Valued Professionals*, TALIS, OECD Publishing, Paris, https://doi.org/10.1787/19cf08df-en. [35]

OECD (2020), *What Students Learn Matters: Towards a 21st Century Curriculum*, OECD Publishing, Paris, https://www.oecd-ilibrary.org/docserver/d86d4d9a-en.pdf?expires=1641393149&id=id&accname=ocid84004878&checksum=F7EFAE4472E8B93B4E28B566B9CEAFB1 (accessed on 5 January 2022). [133]

OECD (2019), *A Flying Start: Improving Initial Teacher Preparation Systems*, OECD Publishing, Paris, https://doi.org/10.1787/cf74e549-en. [54]

OECD (2019), *Benchmarking Higher Education System Performance*, https://doi.org/10.1787/be5514d7-en. [21]

OECD (2019), *Education Policy Outlook 2019: Working Together to Help Students Achieve their Potential*, OECD Publishing, Paris, https://doi.org/10.1787/2b8ad56e-en. [107]

OECD (2019), *OECD Skills Outlook 2019: Thriving in a Digital World*, OECD Publishing, Paris, https://doi.org/10.1787/df80bc12-en. [7]

OECD (2019), *PISA 2021 ICT Framework*, https://www.oecd.org/pisa/sitedocument/PISA-2021-ICT-Framework.pdf (accessed on 8 April 2022). [48]

OECD (2019), *TALIS 2018 Results (Volume I): Teachers and School Leaders as Lifelong Learners*, TALIS, OECD Publishing, Paris, https://doi.org/10.1787/1d0bc92a-en. [11]

OECD (2019), "Transforming pedagogy in Initial Teacher Education: Strategic support for innovation at Ewha Womans University in Korea", *OECD Initial Teacher Preparation Study*, OECD Publishing, Paris, http://www.oecdteacherready.org/wp-content/uploads/2019/03/Korea_Final-REV_Promising-Practice-Korea-2-Flipped-learning-REV.pdf (accessed on 26 May 2022). [61]

OECD (2018), *Developing Schools as Learning Organisations in Wales*, Implementing Education Policies, OECD Publishing, Paris, https://doi.org/10.1787/9789264307193-en. [64]

OECD (2018), *Education Policy Outlook 2018: Putting Student Learning at the Centre*, OECD Publishing, Paris, https://doi.org/10.1787/9789264301528-en. [92]

OECD (2017), *Education Policy Outlook: Italy*, OECD Publishing, Paris, http://www.oecd.org/education/Education-Policy-Outlook-Country-Profile-Italy.pdf (accessed on 11 May 2022). [65]

OECD (2017), *The Funding of School Education: Connecting Resources and Learning*, OECD Reviews of School Resources, OECD Publishing, Paris, https://doi.org/10.1787/9789264276147-en. [51]

OECD (2014), *TALIS 2013 Results: An International Perspective on Teaching and Learning*, TALIS, OECD Publishing, Paris, https://doi.org/10.1787/9789264196261-en. [34]

Office of the Provost (nd), *Learning analytics at UW-Madison*, https://teachlearn.provost.wisc.edu/learning-analytics/. [84]

Opfer, D. (2016), "Conditions and Practices Associated with Teacher Professional Development and Its Impact on Instruction in TALIS 2013"*, OECD Education Working Papers*, No. 138, OECD Publishing, Paris, https://doi.org/10.1787/5jlss4r0lrg5-en. [74]

Paniagua, A. and D. Istance (2018), *Teachers as Designers of Learning Environments: The Importance of Innovative Pedagogies*, Educational Research and Innovation, OECD Publishing, Paris, https://doi.org/10.1787/9789264085374-en. [105]

Papay, J. et al. (2016), "Learning job skills from colleagues at work: Evidence from a field experiment using teacher performance data"*, NBER Working Papers*, No. 21986, https://doi.org/10.3386/w21986. [77]

Parsons, D. et al. (2012), *Impact of teaching development programmes in higher education*. [81]

Poel, E., J. Wood and N. Schmidt (2013), "Including assistive technology in teacher preparation: Exploring one approach", *Learning Disabilities: A Multidisciplinary Journal*, Vol. 19/1, pp. 29-37. [98]

Pont, B., D. Nusche and H. Moorman (2008), *Improving School Leadership, Volume 1: Policy and Practice*, OECD Publishing, Paris, https://doi.org/10.1787/9789264044715-en. [104]

Price, L. and A. Kirkwood (2014), "Using technology for teaching and learning in higher education: A critical review of the role of evidence in informing practice", *Higher Education Research & Development*, Vol. 33/3, https://doi.org/10.1080/07294360.2013.841643. [26]

Redecker, C. (2017), *European Framework for the Digital Competence of Educators: DigCompEdu*, European Commission, Joint Research Centre, https://doi.org/10.2760/159770. [2]

Regjeringen.no (2017), *Digitalisation strategy for the higher education sector 2017-2021* -, https://www.regjeringen.no/en/dokumenter/digitalisation-strategy-for-the-higher-education-sector-2017-2021/id2571085/?ch=4 (accessed on 28 May 2022). [118]

République française (n.d.), *Parentalité et Numérique*, https://tne.trousseaprojets.fr/parent (accessed on 4 April 2023). [136]

Rienties, B., N. Brouwer and S. Lygo-Baker (2013), *The effects of online professional development on higher education teachers' beliefs and intentions towards learning facilitation and technology*, http://oro.open.ac.uk/39488/. [85]

Rizza, C. (2011), "ICT and Initial Teacher Education: National Policies", *OECD Education Working Papers*, No. 61, OECD Publishing, Paris, https://doi.org/10.1787/5kg57kjj5hs8-en. [55]

Rosa, A. and G. Taddeo (2021), "Tematiche e prospettive educative e didattiche del digitale nella formazione degli insegnanti [Educational and didactic themes and perspectives on digital teacher training]", in Pettenati, M. (ed.), *Paese formazione: Sguardo d'insieme e viste particolari da esperienze nazionali di formazione degli insegnanti a cura*, Carocci, https://www.researchgate.net/publication/360866520_Tematiche_e_prospettive_educative_e_didattiche_del_digitale_nella_forma-_zione_degli_insegnanti (accessed on 26 July 2022). [66]

Scott, S. and K. Aquino (2020), *COVID-19 Transitions: higher education professionals' perspectives on access barriers, services, and solutions for students with disabilities.*, https://higherlogicdownload.s3.amazonaws.com/AHEAD/38b602f4-ec53-451c-9be0-5c0bf5d27c0a/UploadedImages/COVID-19_/AHEAD_COVID_Survey_Report_Barriers_and_Resource_Needs.pdf. [32]

Stoll, L. et al. (2006), "Professional learning communities: A review of the literature", *Journal of Educational Change*, Vol. 7/4, pp. 221–258, https://doi.org/10.1007/s10833-006-0001-8. [91]

SURF (2022), *About SURF Cooperation*, https://www.surf.nl/en/about-surf (accessed on 28 July 2022). [120]

Tammets, K. et al. (2019), *Aruanne: Koolide digivõimekuse toetamiseks enesehindamis- ja juhtimisinstrumendi Digipeegel arendamine [Report: Development of a self-assessment and management instrument Digital Mirror to support the digital capability of schools]*, Tallinn University/Institute of Digital Technologies/Center for Educational Technology, Tallinn. [112]

Thillay, A., A. Jean and Q. Vidal (2020), "France: Les banques de ressources numériques éducatives (BRNE) (Banks of educational digital resources)", *Education continuity during the Coronavirus crisis*, OECD Publishing, Paris, https://oecdedutoday.com/wp-content/uploads/2020/09/France-Banks-of-educational-digital-resources.pdf (accessed on 24 April 2022). [102]

Timperley, H. et al. (2007), *Teacher Professional Learning and Development: Best Evidence Synthesis Iteration*, New Zealand Ministry of Education, Wellington, http://educationcounts.edcentre.govt.nz/goto/BES (accessed on 26 March 2019). [79]

Tømte, C. et al. (2019), *Digitalisation in higher education: mapping institutional approaches for teaching and learning*, DOI: 10.1080/13538322.2019.1603611. [86]

UK Government (2022), *Free qualifications for adults with low digital skills - GOV.UK*, https://www.gov.uk/guidance/free-qualifications-for-adults-with-low-digital-skills (accessed on 31 May 2022). [137]

Ulferts, H. (ed.) (2021), *Teaching as a Knowledge Profession: Studying Pedagogical Knowledge across Education Systems*, Educational Research and Innovation, OECD Publishing, Paris, https://doi.org/10.1787/e823ef6e-en. [3]

US Office of Educational Technology (2021), "Parent and Family Digital Learning Guide". [135]

van Deursen, A. and J. van Dijk (2014), "The digital divide shifts to differences in usage", *New Media & Society*, Vol. 16/3, pp. 507-526, https://doi.org/10.1177/1461444813487959. [46]

Viennet, R. and B. Pont (2017), "Education policy implementation: A literature review and proposed framework", *OECD Education Working Papers*, No. 162, OECD Publishing, Paris, https://doi.org/10.1787/fc467a64-en. [132]

Vincent-Lancrin, S., C. Cobo Romaní and F. Reimers (eds.) (2022), *How Learning Continued during the COVID-19 Pandemic: Global Lessons from Initiatives to Support Learners and Teachers*, OECD Publishing, Paris, https://doi.org/10.1787/bbeca162-en. [53]

VSNU (2018), *Professionalisering van docenten aan de universiteit [Professionalisation of university lecturers]*, Vereniging van Universiteiten (VSNU) [Association of Universities in the Netherlands], The Hague, https://www.universiteitenvannederland.nl/files/documenten/Professionalisering%20van%20docenten%20aan%20de%20universiteit.PDF (accessed on 29 July 2022). [59]

Willermark, S. (2018), "Technological pedagogical and content knowledge: A review of empirical studies published from 2011 to 2016", *Journal of Educational Computing Research*, Vol. 56/3, pp. 315-343, https://doi.org/10.1177/0735633117713114/FORMAT/EPUB. [4]

Notes

[1] Among EU countries, the proportion was 66% on average and ranged from 49% in Ireland to 84% in Lithuania.

[2] On average across EU countries, 39% of lower secondary teachers felt well or very well prepared to use ICT for teaching when they completed their initial education or training (ranging from less than 25% in Austria and Finland to 60% and more in Cyprus, Hungary and Slovenia).

[3] 16% on average across the EU, ranging from 9% in Slovenia and the Flemish Community of Belgium to 26% in Croatia.

[4] For the purpose of the analysis of TALIS data, VET teachers were defined as those who reported teaching practical and vocational skills in the survey year, regardless of their type of programme or school. This data was available for Sweden, Portugal, Denmark, Slovenia, Canada (Alberta) and Türkiye (OECD, 2021, p. 17[16]).

[5] On average across EU countries, the relationship between the use of ICT and the share of students with SEN is not statistically significant.

[6] These include carefully selecting pages relevant to the tasks, limiting visits to irrelevant pages (strictly focused navigation), and actively navigating both single- and multiple-source items (actively explorative navigation) (OECD, 2021[47]).

[7] Such centres exist, for instance in **Ghent University, the University of Helsinki, Université Grenoble Alps, Ludwig Maximilian University of Munich, RWTH Aachen University, University of Hamburg, Delft University of Technology, Leiden University, Utrecht University, Universidad Autonoma de Madrid, among many others.**

[8] https://education.ec.europa.eu/focus-topics/digital-education/action-plan/european-digital-education-hub