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Digital equity and inclusion in education: An overview of practice and policy in OECD countries

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Abstract

Digital technologies can be used to support the inclusion of diverse student groups in education in a number of ways including enhancing accessibility of educational content, increasing personalisation and providing distance learning opportunities, as was the case during the COVID-19 pandemic. However, persistent digital inequalities can undermine digital equity and inclusion and equity and inclusion in education generally, particularly for the most disadvantaged students. This paper explores the themes of digital equity and inclusion, and maps some of the policies and practices adopted in OECD countries for the equitable and inclusive use of digital tools in education. It highlights the importance of inclusive design and implementation of digital technologies, as well as the need for education systems to focus on capacity building such as teacher training, as well as adequate resourcing of digital tools. It discusses advantages and disadvantages of different approaches, and concludes by highlighting research and policy gaps.

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Introduction

In recent decades, digitalisation in and out of education has steadily increased. The need for adequate technological resources and for clear plans regarding teaching and learning with digital technologies has become more apparent during the COVID-19 pandemic as systems turned to digital distance learning while schools were closed. The pandemic shone a spotlight on the depth and width of digital inequities and some exclusionary practices that were barriers to success for some students, particularly the most disadvantaged. As systems increasingly incorporate digital tools into the teaching and learning process, an important question is: how can digital technologies support equity and inclusion so that all students can succeed?

An overview of the theory and research in Section 1. shows that digital technologies can help make education more equitable and inclusive, when designing or capitalising on functions for improved flexibility and personalisation, in the attempt to meet the needs of diverse students. However, digital inequalities, especially in terms of access to digital tools and differences in digital skill levels, risk undermining digital equity and inclusion, and the potential for digital tools to advance equity and inclusion in education. In order to use digital tools to promote equitable and inclusive outcomes, education systems must focus on ensuring equity in terms of access to digital resources, and promoting digital skills, as well as using digital technologies that are designed with inclusion in mind.

Emerging evidence shows how the strategic incorporation of digital technologies in education can make education more equitable and inclusive for diverse student groups in new ways. Digital tools can be used to empower and encourage students while creating a sense of belonging and supporting mental health. Furthermore, academic and special education needs can be more closely targeted and addressed with digital tools, especially those that have been designed and implemented with inclusivity in mind. Certain student groups that often face added challenges, such as students with an immigrant background, and students from different ethnic groups, national minorities and Indigenous peoples, can benefit from the inclusive use of digital technologies. Additionally, students with special education needs (SEN), gifted students, students along the gender spectrum and LGBTQI+[1] students can be supported in their learning and well-being by effectively incorporating digital tools into the teaching and learning process (Cerna et al., 2021[1]). Differences in socio-economic status and geographic variation also affect access, usage, and outcomes for different student groups.

Digital technologies can offer many benefits by diversifying not just what is learned but where, when and how it is learned. However, technology is not a magic wand or cure-all. It cannot replace low quality teaching and without proper planning and precautions can amplify existing exclusions and inequities. Some challenges include integrating digital tools with pedagogy and cultural sensitivity for inclusivity, while safeguarding children's safety and privacy. There are also some concerns about the potential effects of digital technologies on children's health and well-being.

[1] LGBTQI+ is an acronym for lesbian, gay, bisexual, transgender, queer and intersex, and the "+" represents other gender orientations and sexual identities.

Section 3. explores how governments have addressed some challenges associated with digital technologies and education. Many policies focus on equity by seeking to close the gap in access to technology. However, more attention recently is being given to how technology is used, the digital skills required by students and teachers to use it well, and on the importance of digital safety and privacy. This section will also outline some advantages and disadvantages of different approaches. However, many advantages and disadvantages of policy approaches do not specifically focus on equity, even less so on inclusion, and generally apply to all students more broadly than specific groups.

Digital equity and inclusion matters at every level of education, from early childhood, primary, and secondary to higher education. It is also vital for adult education and lifelong learning as society becomes more digitalised. While considering diversity and inclusion is essential at each stage, this paper focuses on the evidence and policies most relevant to compulsory education at the primary and secondary levels. It highlights how different digital tools, ranging from computers, tablets and mobile phones to more innovative and emerging technologies can be used to promote and support learning outcomes for all students.

Looking forward, technological advancements have the potential to improve educational and well-being outcomes. When designed and implemented in education with diversity, equity and inclusion in mind, digital technologies can be used to support students from diverse backgrounds, and help enable all students in reaching their potential.

1. Digital equity and inclusion in education

1.1. Defining digital equity and inclusion

This paper will look at digital equity and inclusion in education from different angles. Table 1.1 displays a categorisation of different terms, namely digital equity and inclusion in education, and digital technologies for equity and inclusion in education.

In the literature, terms such as digital (in)equality, digital (in)equity and digital inclusion are often used interchangeably and there is a lack of differentiation in their definition. Differentiating these terms can help pinpoint the specific targets of certain policies and practice, underscoring whether policy goals are to enhance digital equity and inclusion in education, or use digital technologies to promote equity and inclusion in education. Apart from the policy aims, considering the differences among these terms can help policy makers critically evaluate who they are trying to reach with specific policy actions which can also make a difference for the policies they implement. Some policy and practice examples presented in later parts of this paper will match conceptually into one of the four quadrants outlined in Table 1.1. However, many will map onto different quadrants, addressing several objectives, or may have implications for equity and inclusion despite that they were not developed and implemented necessarily with goals to promote equity and/or inclusion at the forefront.

Table 1.1. Conceptualising equity and inclusion regarding digital technologies in education

	In education	*For equity/inclusion* in education
Equity	Digital equity in education: Promoting fairness and equity in access to digital technologies (including hardware, software, high-quality broadband etc.), digital skills, uses and attitudes for all students.	Digital technologies for equity in education: Using digital technologies to promote equity in education, such as providing additional learning resources for students in need to promote equitable outcomes to help them participate fully in (digital) education.
Inclusion	Digital inclusion in education: Overcoming barriers to participation in digital education based on student differences. This would also involve ensuring digital tools in education are designed and used in a way that promotes participation and inclusion of all learners.	Digital technologies for inclusion in education: Adapting digital technologies and learning environments to promote inclusion in education, acknowledging, accepting and respecting student differences. Using digital technologies to promote inclusion in education should aim to ensure students feel included, promote belonging and a sense of well-being, while ensuring non-discrimination.

Digital equity requires that all individuals have the digital capacity (including access and skills) to fully participate in society (NDIA, n.d.[2]). In this paper, *digital equity in education* will also refer to the distribution and use of tools in a way that does not disadvantage or reduce learning opportunities of certain groups. Alternatively, *using digital technologies for equitable education* would refer to the use of digital tools to promote equity in education, such as by providing additional resources through digital means to support

students' needs. This type of policy or practice would aim to ensure equitable outcomes by supporting all students to full participate in digital and non-digital education.

Digital inclusion in education requires the minimising of digital inequalities, thereby widening access, and also enhancing the quality of teaching and learning with the intent to provide education that is fair and equitable (European Commission et al., 2021[3]). Digital inclusion is a multi-dimensional concept, in that it encompasses factors such as access, infrastructure, use and outcomes (Park, 2017[4]; Helsper, 2012[5]). Promoting digital inclusion for students in school should encompass features, as with digital equity in education, such as establishing sufficient digital infrastructure and access, support in integrating digital technologies into the teaching and learning process, and a focus on promoting digital literacy in students and teachers (Kim, Yi and Hong, 2021[6]). It is important to note that much of the research, specifically on the digital inclusion of disadvantaged young people, is still in its infancy, tending to be sparse and consisting of single-country studies (Helsper, 2017[7]). Most of the research on digital inclusion for children has focused on those from low-income or ethnic minority backgrounds, or children with special education needs (SEN) (Mascheroni et al., 2022[8]).

This paper will provide examples of how education systems promote *digital inclusion in education* by using digital technologies to include and avoid excluding certain student groups from benefiting from digital learning resources and environments, supporting them in achieving their potential, and ensuring non-discrimination. Additionally, it will look at how *digital technologies are used to promote inclusion in education*, or the ways in which tools can be used to include certain groups such as assistive technologies for students with special educational needs. How digital tools are used and which tools are used are key areas of concern regarding equity in and through education, and keeping in mind that not all digital technology (in particular educational technology) is created equally, or with diversity, equity and inclusion in mind, is key.

The following section will explore the rise of digital technologies both in and out of education, and the associated inequalities that undermine both digital equity and inclusion in education. Next, it provides insights into digital equity and inclusion in education, and the importance of design, pedagogy and frameworks for inclusion. It then gives an overview of some of the different digital technologies that can be leveraged for inclusion in education, ranging from assistive technologies to newer developments such as artificial intelligence and robotics.

1.2. The rise of digital technologies in and out of education

Digital technologies encompass a range of tools and devices, from the radio to smartphones to robots. Not limited to physical devices/hardware, technologies are also software, innovative technology, and applications. Some research or policy documents refer to Information and Communication Technologies (ICT), which also refers to different digital devices used in the classroom.

Digital education, or the incorporation of digital tools in the teaching and learning process, is an often-used term in recent policy documents, and has become a strategic topic in almost all OECD countries (van der Vlies, 2020[9]). There are many ways in which digital tools can be used within education to support equity and promote inclusion. Some examples include digital curriculum, scaffolds and tools, more opportunities for feedback and revision, building community (both local and global) and teacher training to support student-centred pedagogy.

At home, students require both devices and access to high-speed broadband Internet. Looking at Internet connection across European Union (EU) households, however, there are wide variations. For example, 97% of households with incomes in the highest quartile to only 74% of households in the bottom income quartile had broadband Internet (European Union, 2020[10]). From 2009 to 2018, the proportion of 15-year-olds in OECD countries with home Internet access increased from 85% to over 95% (OECD, 2019[11]).

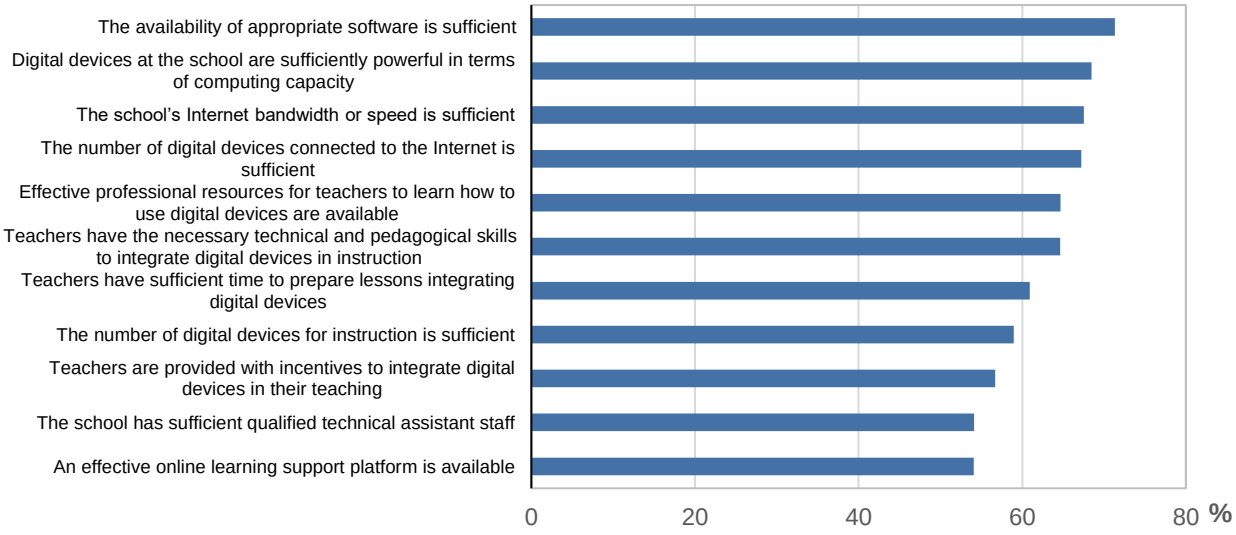
The rise in connectivity has been accompanied by both an increase in time spent in the digital environment, as well as an increase in the variety of activities children engage in online (Burns and Gottschalk, 2020[12]).

Digital activities vary in their broadband requirements. For example, video consumes greater bandwidth than text. For this reason, the EU points to the need for high-speed Internet as a necessity for education (European Union, 2020[10]). This is important both in the home and in schools. Trend data shows the increasing use of digital technology in schools (Hooft Graafland, 2018[13]), and half of OECD countries have adopted a specific policy strategy regarding digital education and many have set out strategies of investing in digital education (van der Vlies, 2020[9]). For all students to take advantage of digitalisation, schools require a baseline level of digital infrastructure and capacity. However, there is wide variation in digital infrastructure across OECD countries according to the Programme for International Student Assessment (PISA) 2018 (OECD, 2020[14]).

As shown in Figure 1.1, PISA 2018 reports that while the majority of principals felt that schools had appropriate digital capacity, there is much room for growth, especially in the areas of learning platforms and technical support staff. More than 30% of principals reported that teachers did not have necessary training in the pedagogical applications of digital tools. According to school leaders who participated in The OECD's Teaching and Learning International Study (TALIS) 2018, 25% reported a shortage or inadequacy of ICT as hindering the provision of quality instruction. For teachers, 35% reported that investing in ICT should be of "high importance" in terms of spending priorities (OECD, 2019[15]). Schools with funding disadvantages will adopt innovative technology later and see the benefits later than schools with more resources (OECD, 2021[16]).

Figure 1.1. Availability of digital resources in schools

Percentage of students in schools whose principal agreed or strongly agreed with the below statements



Source: Table V.B1.5.15.OECD (2020[14]), *PISA 2018 Results (Volume V)*, https://doi.org/10.1787/ca768d40-en.

1.2.1. COVID-19 and the shift to distance learning

The COVID-19 pandemic shone a spotlight on the importance of digital technologies for ensuring continuity of education. It also highlighted worldwide digital disparities that hinder both equity and inclusion. According to data from the United Nations Educational, Scientific and Cultural Organisation (UNESCO), nearly 1.6 billion students were affected by school closures in 194 countries (Ikeda, 2020[17]), and many

systems turned to digital means of providing education. The rapid shift to digital learning was more difficult for particular student groups, especially those from vulnerable or disadvantaged backgrounds, and for those who lacked the requisite access and infrastructure (OECD, 2020[18]). However, the challenges and lessons learned can create opportunities for more equitable and inclusive digital technology use.

Digital inequalities were among the threats to student well-being and academic outcomes during school closures. These challenges were compounded by the capacity of education systems, or often lack thereof, to shift to digital modes of teaching and learning. The lack of access to devices and the Internet, combined with poor digital skills, disproportionately affected vulnerable populations such as those in the Roma community in Europe (OECD, 2020[18]). Thinking beyond access, many students lack skills for independent learning and online education (OECD, 2020[19]), which also affects students unequally. Students from low socio-economic backgrounds tend to have lower levels of digital skills and tended to have less parental oversight of their schooling during the pandemic, thus were more likely to struggle to keep up with digital and distance learning (OECD, 2020[20]). Evidence from England (United Kingdom) suggests that advantaged students spent 30% more time on home learning than their disadvantaged peers, and their parents reported feeling more able to support them. Additionally, students from more advantaged schools had access to more individualised learning resources such as chatting with teachers or online tutoring (Sevilla et al., 2020[21]).

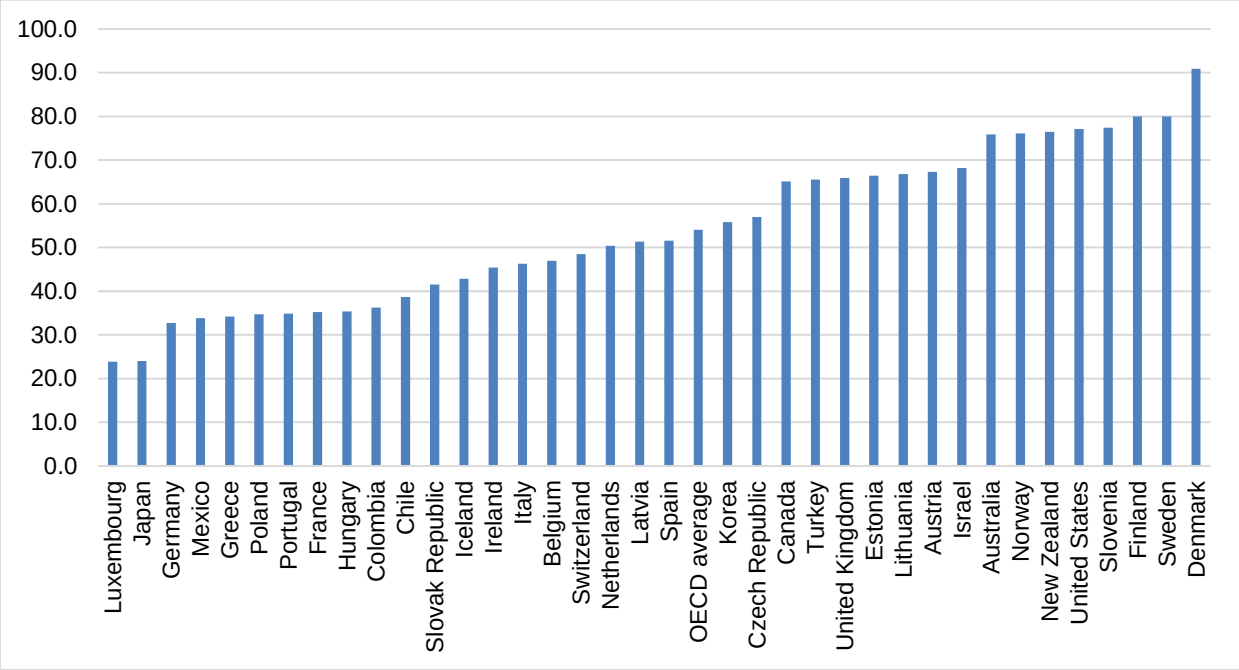
In general, school systems and teachers were unprepared for the sudden transition to digital education, which was worse for schools from disadvantaged areas (OECD, 2021[22]). Education systems found that during school closures, one of the most challenging priorities to address was supporting students who lacked the skills for independent or online study (Gouëdard, Pont and Viennet, 2020[23]), particularly as remote learning solutions meant that students and parents were required to engage in a great deal of independent learning, for which they tended to be unprepared (Dorn et al., 2020[24]).

A lack of effective digital infrastructure within many education systems also made the shift to remote learning a challenge. While remote education is best administered on an online platform, only half of 15-year-olds from OECD countries went to a school with such a resource (Ikeda, 2020[17]). Pre-pandemic, the proportion of principals who reported that their school had an effective online learning support platform varied widely across OECD countries from around 23% in Luxembourg to 91% in Denmark (as seen in Figure 1.2). About 15% of the difference in equity in OECD countries in reading performance[2] can be accounted for by the percentage of students in schools where the principal agreed or strongly agreed that "an effective online learning support platform is available" (OECD, 2019[25]).

[2] Equity in reading performance is measured by the percentage of variation in reading performance accounted for by differences in students' socio-economic status; the smaller the variation in performance explained by socio-economic status, the greater the equity in performance (OECD, 2020[14]).

Figure 1.2. Availability of an effective online learning support platform, PISA 2018

Percentage of students in schools whose principal agreed or strongly agreed that an effective online learning support platform is available



Source: Table V.B1.5.15.OECD (2019[25]), PISA 2018 Results (Volume II), https://dx.doi.org/10.1787/b5fd1b8f-en.

Despite the challenges, the rapid shift to digital education has also presented many opportunities. For example, 95% of respondents to a survey of education stakeholders from the EU in 2020 "consider the COVID-19 crisis to be a 'turning point' for how technology is used in education" (European Union, 2020, p. 6[10]). Despite the limitations, online learning was the best choice for many schools, but going forward, the underlying issues must be addressed (Xiao, 2021[26]). According to Quilter-Pinner and Ambrose, "the question is not: Should we use digital technology? It is: When and how should we use digital technology to best effect?" (2020, p. 18[27]). As a result of the pandemic, there is both a greater openness to digitalisation, and an urgency to increase digital equity and inclusion.

1.3. Digital inequalities

Without connectivity, devices and the requisite digital skills, students will face additional obstacles to digital inclusion and to benefiting from digital opportunities. Digital inequalities, or digital divides, operate across different levels. In order to use digital tools to promote equity and inclusion, these divides need to be taken into account and mitigated. The first-level digital divide refers to the difference in access to digital technologies (Van Deursen and Helsper, 2015[28]). In recent years, many OECD countries have seen a closing of this gap between those who have access to suitable devices and quality broadband Internet connection, and those who do not (Burns and Gottschalk, 2019[29]). At the end of 2017, a new milestone in OECD countries was reached as the number of broadband subscriptions for the first time exceeded the number of people (OECD, 2019[30]). Furthermore, in 2018 almost every student in the majority of OECD countries reported that they had a link to the Internet at home (OECD, 2019[11]).

However, challenges remain and there are inequalities in digital access both within and between countries. Around the OECD, education systems report a number of barriers in enabling adequate access to digital

technologies including geographic distance (e.g. challenges in equipping more rural areas with broadband), lack of equipment in schools and socio-economic inequalities (Burns and Gottschalk, 2019[29]). Specific student groups, such as Roma students in Europe, for example, tend to lack access to the Internet or when they do have access, it is sporadic (Garmendia and Karrera, 2019[31]). Socio-economic disadvantage constitutes a common barrier to access, and in families with parents from higher socio-economic status (SES) backgrounds there tend to be a higher variety of devices available in the home. Access to more devices can both increase flexibility and personalisation that digital tools can afford, and it is particularly important as privacy concerns are becoming more prominent in public and private discourse. It is likely that newer devices can be better at addressing privacy concerns (Zhang and Livingstone, 2019[32]).

Ensuring individuals have digital access can help them feel more confident about actively participating in everyday educational activities. Some research suggests students report an increased ease in completing schoolwork and communicating with friends when this barrier in access is overcome (Yelland and Neal, 2012[33]).

The second-level digital divide refers to differences in digital skills, uses and motivations (Burns and Gottschalk, 2019[29]). Young people and their uses of digital technologies cannot be understood as a homogeneous group, and there is data across a range of countries to support this (Eynon, 2020[34]). For example, data from PISA 2018 suggests that socio-economically advantaged students are more likely to use the Internet to search for information about careers or higher education programmes than their less advantaged peers (OECD, 2019[25]). Students from disadvantaged socio-economic backgrounds also tend to perform more poorly on tasks related to computer skills than their peers from more affluent backgrounds (Scherer and Siddiq, 2019[35]).

Digital skills are necessary in order for learners to harness the opportunities of the digital environment and to ensure that all young people are digitally included (Eynon and Geniets, 2015[36]). While today's students may have more exposure to digital technologies from younger ages, it cannot be assumed that they have the necessary digital skills to use technology effectively (Eynon, 2020[34]). Children and young people are often assumed to be "digital natives", who "pick up" the digital skills they need, as if spontaneously (Livingstone, Mascheroni and Stoilova, 2021[37]), however this discourse can be harmful and undermine inequalities and the support students need to develop digital skills. In reality, education systems and other actors such as parents play important roles in supporting digital skill development in children (Burns and Gottschalk, 2019[29]). Digital skills are generally categorised in the following broad categories:

- operational skills to use the Internet and other computer equipment
- information-navigation skills to search, find and understand information on the Internet and to verify and evaluate sources
- social skills to communicate and interact online and build digital social capital
- creative skills to create and share quality content online (van Deursen, Helsper and Eynon, 2016[38]).

This second-level divide also affects different groups in different ways. For example, those who are particularly affected include students from lower socio-economic backgrounds or those with an immigrant background. Disadvantaged students tend to have less access to digital tools, and often have limited support networks, which are important resources that can help them effectively navigate the digital environment (Eynon and Geniets, 2015[36]). Especially in socio-economically disadvantaged settings, parents or other trusted adults may have low levels of digital skills, and factors such as parental level of education are associated with digital skill levels of children (Gui and Argentin, 2011[39]). There might also be a gap in media expertise between children and their parents that is more pronounced in immigrant families with low income and education levels (Livingstone et al., 2015[40]). Without access to digital tools or appropriate support, developing digital skills becomes more difficult (Eynon, 2020[34]).

A lack of digital skills was a barrier to inclusion during COVID-19 school closures (European Union, 2020[10]), despite the fact that researchers have been highlighting these digital inequalities for decades (Eynon, 2020[34]). A combination of issues, such as lack of appropriate access, social support and the digital pedagogy choices of schools during the COVID-19 school closures resulted in disadvantaged students being less engaged (Greenhow, Lewin and Staudt Willet, 2020[41]).

The third-level digital divide refers to differences in offline outcomes such as material or social benefits/outcomes based on engagement with digital technologies (Helsper and Van Deursen, 2019[42]). The inability to make the most of digital opportunities can magnify existing offline inequalities (Hooft Graafland, 2018[13]). Individuals need the requisite resources to use their digital skills in ways that they can bring about tangible beneficial outcomes, whether this concerns education or work, health or other areas more broadly (Van Deursen and Helsper, 2018[43]).

"Digital inequality stack" is a recently coined term that suggests the different layers of digital divides or inequalities are stacked and interdependent (Robinson et al., 2020[44]). It also highlights the loop of digital inequalities and social inequalities, whereby digital inequalities can both amplify and reinforce social inequalities. Therefore, focusing on ways in which equity can be achieved in the digital domain, but also how digital technologies can be used to promote equity and inclusion in offline spheres is important. Removing barriers and ensuring individuals are able to maximise the benefits can help education systems become more digitally equitable and inclusive.

1.4. Digital inclusion in and for education

Despite the numerous challenges to achieving inclusive education, the strategic incorporation of digital technologies can support the teaching and learning process, enhance accessibility for those who need it, and provide more individualised learning experiences. If used appropriately, digital tools can contribute to more inclusive education systems (See Box 1.1 for an overview of inclusive education).

On the one hand, digital technologies can be used to promote inclusion in education, when they are used in an inclusive way that does not exclude particular student groups and when needs relating to access, skills and use are met. On the other hand, digital technologies can be used to promote inclusive education, for example by incorporating design features or functions that are specifically intended to support students with different educational needs. This subtle, but important difference will be expanded upon in the following sub-sections.

Box 1.1. Inclusive education

UNESCO has defined inclusive education as "an ongoing process aimed at offering quality education for all while respecting diversity and the different needs and abilities, characteristics and learning expectations of the students and communities, eliminating all forms of discrimination" (UNESCO, 2009[45]). Research on inclusive education has traditionally focused on students with SEN, and many education systems have different understandings of what inclusion in education means. However the conversation around inclusive education is expanding to include other groups of diverse students in a bid to benefit all (Mezzanotte, 2022[46]).

Ensuring education systems are inclusive depends on many factors, an important one being teachers, who play a fundamental role in designing and implementing inclusive teaching practices. Inclusive teaching has been defined as "the ways through which teaching is developed and carried out to promote inclusive learning and well-being of all students in the classroom. In this process, key elements such as pedagogy, curriculum and assessment, and core competences, including critical reflection, global competence and a growth mindset, play fundamental roles" (Brussino, 2021[47]). Achieving education systems that are truly inclusive is no easy feat; even the most equitable education systems in the world still see disparities in educational outcomes in different diverse student groups not limited to students with a migration background, those from disadvantaged backgrounds or students with SEN[3].

The rationale for inclusive education is strong. Grounded in a rights-based approach, it can promote positive outcomes for both individuals and society as a whole by improving educational and well-being outcomes for all. Evidence suggests that improved education outcomes are related to higher levels of income, and better health and well-being outcomes for individuals, with greater societal benefits, including social cohesion and political participation (Mezzanotte, 2022[46]).

1.4.1. Digital inclusion in education

A 2021 Ecorys report defines digital inclusion as "leveraging digital tools to widen access and enhance the quality of teaching and learning for the purpose of delivering a fair and equitable education" (European Commission et al., 2021[3]). Digital inclusion requires that a few prerequisites be met. According to the National Digital Inclusion Alliance in the United States, these factors are: affordable, robust broadband Internet service; Internet-enabled devices that meet the needs of the user; access to digital literacy training; quality technical support; and applications and digital content is designed to enable and encourage self-sufficiency, participation and collaboration (NDIA, n.d.[2]). Therefore, digital equity and reducing digital inequalities are precursors for digital inclusion.

Despite the focus over recent decades on enabling equitable access to digital resources in school and at home, this is only one element of digital inclusion. Digital inclusion in education moves beyond questions of access towards a more comprehensive model of teaching for diversity, incorporating the unique functions that digitalisation can provide. Indeed, the first principle of The Rewired Global Declaration on Connectivity for Education is to "Centre the most Marginalised", suggests that digital education strategies should think about how digital tools can benefit marginalised groups from the starting point rather than as an afterthought (UNESCO, 2021[48]). Therefore, beyond equity, digital technology designed with inclusion in mind and facilitated by inclusive teaching, can be used as a tool to support academic and well-being outcomes for all students.

[3] For a complete overview of diverse student groups, see Cerna et al. (2021[1]).

The understanding of how digital technology can support education has evolved since the early 2000s. The benefits and opportunities to enhance learning while motivating students are rich. However, research has shown that technology is not meaningful or inclusive on its own (Warschauer, 2003[49]), and its design and how it is used in the classroom can make all the difference. On their own, digital tools cannot solve complex social issues, but they can amplify existing human capacity and intent (Hernandez and Roberts, 2018[50]). For example, when considering inclusion, elements like specific design features are crucial. When incorporating digital tools in the teaching and learning process, they should be designed to have inclusive content (representations of diverse populations, values and preferences), an inclusive interface (visual and auditory) and inclusive instructional structure (pedagogy, tools for minority languages, student input) (Heemskerk et al., 2005[51]). Without consciously designing for specific needs, the use of digital tools runs the risk of further disadvantaging or excluding those who are most vulnerable (Hernandez and Roberts, 2018[50]).

1.4.2. Frameworks, design and pedagogies for digital inclusion in education

International frameworks, such as UNESCO Children's Rights in the Digital Environment call for digital inclusion on a large scale. Non-discrimination is one of the four main pillars of this framework, and UNESCO recommends that systems consider a number of features for policy design for digital inclusion such as balancing benefits and safety, addressing the needs of students from vulnerable or disadvantaged backgrounds, and allocating resources to provide access to digital tools and connectivity (United Nations, 2021[52]).

Frameworks for inclusive digital technology use aspects such as good pedagogy, student-centred learning and Universal Design that considers the input of student users and sensitivity to diversity. While the potential is excellent, digital technology even when used alongside effective pedagogies and in inclusive ways, cannot solve underlying social issues (Selwyn, 2016[53]).

Universal Design for Learning

Evidence from neuroscience and the learning sciences has found that learners learn in very different ways, and that these differences tend to be the norm and not the exception (Glass, Meyer and Rose, 2013[54]). Therefore, a "one-size-fits-all" approach to teaching and learning overlooks the many facets of diversity that are present in classrooms. In response to increasing diversity, the Universal design for learning (UDL) approach can be used to design technology-rich learning environments that are flexible and meet the needs of diverse groups of students, with specific thought paid to students with special education needs (Rose and Strangman, 2007[55]). Arising from the architectural concept of Universal Design (Centre for Applied Special Technology, 1998[56]), whereby public spaces are designed to be accessible and inclusive to all, UDL extends to the domain of education with the aim of facilitating access to the curriculum and teaching and learning process to all students (McGhie-Richmond and Sung, 2013[57]).

UDL is organised around three main principles, namely the *why*, the *what* and the *how* of learning and expressing what we know (Rose and Meyer, 2002[58]). To address variability in learning, learners should be given different ways of acquiring information and knowledge and the ability to express and demonstrate what they know in various ways. Methods of engagement should be varied to the extent that they can harness the power of learners' interests and thereby appropriately challenge and motivate them to learn (Edyburn, 2005[59]). Using UDL principles in practice will support the creation of educational environments that are flexible and enhance access to all learners by reducing barriers and providing accommodations or supports when needed (Pisha and Coyne, 2001[60]), yet that are also proactive by designing tools that are accessible from the offset and do not promote inequalities (Burgstahler, 2015[61]).

Harnessing the power of digital technologies is a key point of UDL, as these tend to be innately flexible and can provide more efficient opportunities for individualisation and removing barriers for students with different capabilities (Rose and Strangman, 2007[55]). For example, the flexibility afforded by digital tools in

terms of changing format, media or content can provide a higher degree of individualisation for students in the classroom (Rose and Meyer, 2002[58]). Digital technologies that are used with the goal of fostering inclusion must be designed in a way that they can adequately facilitate this, and not create additional barriers. The Participatory Design framework recommends consulting with end-users when designing technology (Frauenberger, Good and Alcorn, 2012[62]). By consulting with targeted diverse end-users, assessments can be made into what is needed, and it empowers and gives ownership to marginalised groups (Frauenberger, Good and Alcorn, 2012[62]).

Digital technology and cultural sensitivity

Digital inclusion should also be conceptualised from a cultural perspective. The primary debate centres on whether technology is dominated by Western culture or a whether digital tools can amplify multiculturalism and supporting minority cultures (Dyson, 2004[63]). When designing digital resources to be culturally appropriate, certain design principles are important and instructional methods should be attuned to the cultural context of the target group (Mcloughlin, 2000[64]).

Since the turn of the century, scholars have noted that designing for cultural sensitivity is important, and certain features can be incorporated into the design process to promote equity among diverse learner groups. Henderson's (1996[65]) multiple cultural model of instructional design suggests that learning resources should be designed to allow variability and flexibility for students, while also being able to interact with materials that reflect multicultural realities present in society, include different cultural ways of teaching and learning and promote equity in learning outcomes. Important features with this model include that the design of tools should be validated by the group (e.g., students belonging to ethnic groups, national minorities or Indigenous peoples) or groups for whom the learning materials are designed, and that they should be tested within these groups during development (Henderson, 1996[65]). McLoughlin (2000[64]) suggests additional dimensions of design to be considered within this framework: cultural maintenance (i.e. incorporating elements such as values, styles of learning and cognitive preference of the target group in the decision making process); ownership of the target group over their learning; communities of practice; and the provision of multiple perspectives.

Depending on the technologies themselves, the ways in which they are used and the pedagogical approaches taken, the use of digital tools in the classroom may inadvertently miss meeting the needs of certain student groups. For example, in a small survey of Indigenous university students in Australia, the ways in which learning management systems[4] were used did not necessarily correspond to the students' cultural needs or learning expectations (Dreamson et al., 2018[66]). This further underscores the point that digital tools alone cannot support inclusivity and equity. Rather, it is how they are employed and the pedagogies that go alongside that make the difference.

Pedagogy and inclusive digital technology

Inclusive teaching can be defined as how teaching is developed and put into practice to promote the learning and well-being of all students in the classroom (Brussino, 2021[47]). Digital tools, when combined with effective pedagogy, can be used to promote inclusion and enhance learning outcomes. In order for this to happen, teachers need appropriate training and technological competencies in order to tailor their use of digital tools in the classroom to specific subjects and subject-specific activities. According to TALIS, "Rather than narrowly focusing on the tools, training on ICT skills for teaching should reflect how technology can amplify great teaching and empower teachers to become better instructors" (OECD, 2019, p. 31[15]). Indeed, in order to be digitally competent, teachers need more than fundamental technological skills so they can leverage these skills as a pedagogical resource in the classroom (Ulferts, 2021[67]). Innovation

[4] Such as Blackboard or Moodle.

and change in this domain is essential, and learning in the digital environment requires different forms of teaching and learning, taking advantage of the capabilities of digital tools (UNESCO, 2021[48]).

Several frameworks have evolved that mark the importance of integrating good pedagogy with digital technology use, and the importance of developing teachers' knowledge and skills to effectively use technology in the classroom. In terms of teacher knowledge, the Technological Pedagogical and Content Knowledge (TPACK) framework stresses the intersections between technological knowledge, pedagogical knowledge and content knowledge (Koehler, Mishra and Cain, 2013[68]). It underscores the complexity of all three knowledge domains, and how they can feed into the development of suitable context-specific strategies and representation of content (Ulferts, 2021[67]). Teachers with strong TPACK tend to exhibit characteristics that can promote inclusion such as offering pedagogical strategies that are appropriate for all students by knowing where they are academically, what they need to know and how a lesson should be taught (Grandgenett, 2008[69]). Incorporating UDL principles and TPACK within the same model could potentially be used to improve the outcomes of all students (Benton-Borghi, 2013[70]).

Hughes (2005[71]) defined an ICT Pedagogical Framework that differentiated between the types of digital technology use in education. The first, replacement, is content-focused and simply uses digital technology to replace analogue content digitally. The second, amplification, allows for reaching educational goals in more efficient ways through digital means. Finally, transformation rearranges content, cognitive processes, problem-solving, and new teacher roles in innovative instruction. Using digital technology in a transformational way is based on a shift in basic assumptions of education in the digital setting (Collins and Halverson, 2018[72]). It becomes student-centred, personalised and interactive, which are features that can contribute to inclusivity for diverse student populations.

1.4.3. Digital technologies for inclusive education

Many digital tools can be used to promote inclusion. Some examples include assistive technologies, e-learning, open education and Massive online open courses (MOOCs) and Robotics and Artificial intelligence (AI), as well as tools such as computers, phones and the Internet (European Commission et al., 2021[3]). Platforms that host open educational resources (Orr, Rimini and Van Damme, 2015[73]) or MOOCs allow learners access to materials that could be higher quality than what they can locally access (OECD, 2021[74]). Not only are these tools able to promote inclusion of students, but they can also support teachers' professional learning and to manage their workloads, for example. There are examples of MOOCs for teachers specifically focusing on inclusion (Brussino, 2021[47]).

Especially during the COVID-19 pandemic school closures, many systems relied on tools such as computers, tablets and mobile phones to stay connected to students and provide opportunities for distance learning. Indeed, pre-existing technologies such as computers and tablets were easier to integrate into the teaching and learning process than new innovations (Vincent-Lancrin, Cobo Romaní and Reimers, 2022[75]). Some systems have also made use of other more established tools, like television and the radio, to reach students who would have otherwise lacked access to digital education (ibid). However, remote classrooms are not necessarily smart ones, and with the advent of smart and adaptive learning technologies the possibilities for inclusion and personalisation are on the rise (OECD, 2021[74]).

When designed and/or used with inclusion and equity in mind, different digital tools can be used in different ways to promote inclusion. For example, digitalised assessments can support teachers in managing transitions, helping with small groups and giving feedback (OECD, 2021[74]). Technologies facilitate differentiation and individualisation in education, making it possible for educators to tailor the content of the subject matter and how it is presented to suit the needs, backgrounds and experiences of students (Heemskerk et al., 2005[51]).

Overall, digital tools can cater to diversity by allowing for choice, personalisation, and broadening access to online educational resources. Well designed tools can support varying student needs. Thinking through

how tools can be applied in the classroom to support different student groups can help education systems move to a more inclusive digital education. The following sections will explore more in depth the types of digital tools that can be used to support students, and different frameworks, design features and pedagogies that can support digital inclusion in education. This is not an exhaustive overview, but gives insights into some tools that are frequently used in OECD education systems.

Assistive technology

Assistive technology (AT) is based on helping students with additional needs. It can help bypass challenges and play to strengths academically (UNESCO, 2020[76]), and need not be specialised for specific needs. Research suggests that "assistive technology can improve students' ability to acquire and strengthen skills such as handwriting, reading, and visual skills, as well as enhancing their problem-solving ability and attention span" (Brussino, 2020, p. 57[77]). The use of AT can also contribute to students' independence, social interactions, motivation and self-esteem (Copley and Ziviani, 2004[78]). Examples of ATs include voice recognition, screen readers, Braille switchers and wearable technology (OECD, 2021[16]).

Using ATs in the classroom can be a cost effective way to accommodate students with different needs, supporting their inclusion in the education system. For example, digital exam papers can be a more cost-effective method of assessing learning for students with special educational needs than using readers or scribes (Nisbet, 2012[79]).

Despite the potential benefits of using ATs in the classroom, there are some drawbacks and challenges. Adequate teacher training on how to effectively use ATs can be an obstacle to implementation and achieving maximum support. Time and financial constraints can also hamper the use of ATs for students who could benefit from them (Brussino, 2020[77]). Furthermore, ATs comes with the risk of stigmatisation for the users by other students, or even by teachers who may have negative attitudes in supporting students with SEN who use AT in the classroom (Parette and Scherer, 2004[80]).

Artificial intelligence and innovative technologies

New advances in technology like artificial intelligence (AI) and machine learning[5] make personalisation more accessible and comprehensive without extensive teacher input. Learner choice of content and learning activity is more readily available through digital activities, allowing for better customisation of skills and interests (OECD, 2021[16]). Catering to a student's interests can encourage meaningful engagement, which is linked to enhanced learning (Heemskerk et al., 2005[51]). Furthermore, accommodating students' needs, such as language accommodation, can be facilitated through digital tools and for multiple student groups (OECD, 2021[16]).

Augmented reality (AR) facilitates combining and superimposing real objects with information and with virtual objects (Azuma, Billinghurst and Klinker, 2011[81]). The information that is augmented is not limited to the sense of sight. It can be applied to other senses including touch, hearing and smell for example (Azuma et al., 2001[82]). It can thereby favour multiple means of representation and engage students in different ways in the learning process (Meyer, Rose and Gordon, 2014[83]), making it an encouraging strategy in fostering inclusion in education (Sheehy, Ferguson and Clough, 2014[84]).

In addition to supporting how learning occurs, innovative technologies are rapidly changing how learning and well-being are assessed. Again, personalisation of assessments allows for better accuracy and depth, more quickly. For example, student engagement can be measured automatically by digital tools that track eye movements and facial expressions (OECD, 2021[74]). Game-based assessments can measure other skills like creativity and emotional regulation that are otherwise difficult to measure (OECD, 2021[74]).

[5] Machine learning is a sub-area of artificial intelligence, referring to when a system discovers patterns from data, and becomes more effective at doing so as it is presented with more data (OECD, 2021[74]).

Additionally, individualised analytics on learning outcomes of complex learning processes assess learning in a way that traditional recall assessments cannot (OECD, 2020[85]).

Algorithms and learning analytics

A younger discipline in data science, learning analytics, looks at the ways in which insights on learners can improve the learning process and teaching practices. It looks at how to use tools such as data mining, machine learning, natural language processing, visualisation and human-computer interaction approaches among others (OECD, 2021[74]). Most research on learning analytics targets higher education, although it has been adopted in secondary school settings as well (Sousa et al., 2021[86]). The research base on K-12 settings, though, remains scarce (Ifenthaler, 2021[87]).

Algorithms can be used to identify students likely to leave school early, and based on types of predictive data, recommend appropriate interventions (OECD, 2021[74]). The advantage of algorithms is that they are constantly updated as problems are solved and new ones arise. In the future, analytics can be used to create a system-wide curriculum (OECD, 2021[74]). Algorithms can be used to promote equity and inclusion in education for students, but can also be used to estimate things like future needs for staffing, and digital equipment and resources (OECD, 2021[74]).

Learning analytics has the potential to benefit students by offering personalised learning opportunities and can help increase student agency (Nunn et al., 2016[88]; Tsai, Perrotta and Gašević, 2019[89]). It does so by collecting, analysing and reporting data about both learners as well as the contexts within which learning takes place (Siemens and Gašević, 2012[90]), and the data collected and analysed can help address challenges such as early school leaving (Khalil and Ebner, 2015[91]), which disproportionately affects disadvantaged students. There is also the potential to use learning analytics to identify those students who might not be on track to graduate on time (Aguiar et al., 2015[92]; Jiménez-Gómez et al., 2015[93]), allowing teachers and school leaders to intervene if necessary. Teachers can use learning analytics to monitor student engagement and to redesign study programmes, and the personalisation it offers can help close achievement gaps in disciplines like mathematics (OECD, 2021[74]). The potential ability for teachers to retrieve data on students such as their knowledge of or interest in the content during and after lessons can help inform their teaching practice in the moment, as well as lessons and development of future learning materials (Ifenthaler, 2021[87])

Despite the potential benefits, some scholars call to attention that learning analytics can be discriminatory and potentially disadvantaging (Selwyn, 2020[94]), with concerns that they could reinforce existing social inequalities (Selwyn, 2019[95]). Without adequate data, computerised decisions (i.e. those made by algorithms) can lead to or sustain bias and result in discrimination (Williams, Brooks and Shmargad, 2018[96]), and they can encode the bias of both their developers and the society in which they are developed (Baker and Hawn, 2021[97]). Therefore, when using algorithms to make decisions in education, especially those that could affect diverse student groups, careful design and regulation is essential to avoid discrimination. There is also a question of whether schools can benefit from learning analytics in the same or similar ways as higher education institutions. Finally, further work needs to be done on regulation and policy surrounding learning analytics and ethical and privacy issues associated with its use (Ifenthaler, 2021[87]).

Robotics

A robot is “a physical machine with sensing, computing and actuating capabilities, able to carry actions automatically” (OECD, 2021, p. 21[74]), making autonomous decisions that it can adapt based on prior knowledge and input. “Social robots” that interact with learners are being increasingly developed in

different OECD countries and used for educational purposes (OECD, 2021[74]). Telepresence robots[6] not only allow for remote teaching, learning and studying, but they can offer opportunities for students with physical impairments or illnesses to attend classes when they would not be able to otherwise (ibid). They can also offer increased opportunities for personalisation in the classroom, thereby benefiting diverse learners.

For those who might be concerned that robots will replace teachers in the near future, these fears are likely misplaced. Not only are they expensive with limited commercial availability in OECD countries, but their capabilities are unlikely to be extensive enough to replace human teachers in the classroom (OECD, 2021[74]).

[6] Whereby the robot becomes the teacher's avatar.

2. Digital technologies and diverse student groups

2.1. Digital tools supporting diverse student groups

Digital tools can support inclusion and equity across education systems (Edyburn, 2021[98]; Heemskerk et al., 2005[51]) and can assist diverse student groups to reach their potential academically, while also supporting well-being. Broadly, digital technology can allow for more student choice in what and how they learn, allowing students to navigate vulnerabilities (Dudeney and Hockly, 2012[99]). By allowing students greater flexibility and personalisation, students can make choices that best fit their needs and preferences (Ibid). However, supporting equity and inclusion with digital technologies also requires equity in access, a focus on equitable skill development, and the use of tools that have been developed with equity and inclusion in mind. The following sections will explore some of the ways in which digital tools can support the inclusion of diverse student groups, the majority of which provide examples of the ways digital technologies are used to promote inclusive education. Some areas of this literature are more developed than others.

2.1.1. Migration-induced diversity

Migration-induced diversity refers to students who might be asylum seekers, refugees or other immigrants (Cerna et al., 2021[1]). Students from an immigrant background are not a homogenous group and have varying needs depending on their diverse multi-cultural and multi-lingual backgrounds (Cerna, 2019[100]). Some evidence suggests that providing access to digital tools can help students from immigrant backgrounds narrow the achievement gap (Kim, 2018[101]).

One concrete way in which digital tools can support students with a migration background is through supporting language learning and providing translation services. On the one hand, learning the primary language of the education system can help improve academic achievement, socio-emotional well-being, and social inclusion. On the other, maintaining the heritage language is also helpful to psychological and social well-being by encouraging a sense of belonging and identity (Cerna, 2019[100]).

For newcomers who speak a minority language, it can be difficult to source teachers who are also speakers of the same language. In this sense, digital classrooms remove geographic barriers and can reduce financial considerations (OECD, 2021[16]). Additionally, while traditionally used for students with special education needs, tools such as captions and subtitles can help language learners (Bird and Williams, 2002[102]; Danan, 2004[103]). Research suggests that captions (also known as same-language subtitles) can benefit students who are watching videos in their non-native language, to a larger extent even than subtitles in their native languages, and can improve listening comprehension (Gernsbacher, 2015[104]). Innovative technologies like social robots can also be used as tutors to guide children in language learning by interacting with them in the target language (OECD, 2021[74]).

In some systems, digital tools are used to offer study supervision to students in their mother tongue. This is the case in Sweden, where some municipalities work with digital platforms as it can be a challenge to find teachers who can teach in all the languages needed (Cerna et al., 2019[105]). Digital Storytelling is another example of how digital tools can be used to accommodate newcomers in their language development. Students practise their language skills while reflecting on their experiences by telling their own stories. The use of digital tools allows for the creative expression of cultural values like music and artwork. The multi-media aspect of storytelling was associated with increased understanding, critical thinking, and motivation while learning a new language (Yang and Wu, 2012[106]).

It is important to consider design, especially for minority-language speaking students; this is particularly relevant when using digital technologies to promote inclusion in education. For example, for students who speak languages that are read vertically or right to left, the positioning of menu and icon buttons can allow the user different choices that facilitate a more comfortable engagement with digital technologies (Benmarrakchi, El Kafi and Elhore, 2017[107]). Design features such as adapting timing or deadlines for online learning tasks and assessments depending on language proficiency can also be helpful for students who are non-native speakers of the local language (Jónsdóttir et al., 2021[108]). Design features such as these are also important for students from different ethnic groups, national minorities and Indigenous students who may need additional minority-language support and accommodations. Digital tools are not limited to assisting students with an immigrant background with language learning. They can also be used to facilitate cross-cultural and trans-national connections between different groups of students and teachers, and can support intercultural education (Resta and Laferrière, 2015[109]).

In some OECD countries, students with an immigrant background may be at a higher risk of early school leaving than their native-born peers, although the rates have been dropping on average (OECD/European Union, 2018[110]). With this in mind, digital technologies can be used to help predict and prevent students from dropping out of school. Early Warning Systems and Indicators can provide predictions of students who might be at risk of dropping out based on a number of factors (although not including factors that are not malleable like student socio-economic background, immigrant status, etc.) (Bowers, 2021[111]). By identifying students who are “at risk”, assuming predictions are correct, support can be targeted to try to prevent students from leaving school early. These tools are also relevant for students from other diverse groups who have higher rates of early school leaving such as Roma students for example (for more see Box 2.1). Despite advances in these technologies in recent years, there are some concerns that techniques that rely on processes such as data mining and machine learning may not transfer well across education contexts and also that indicators may be inaccurate (Bowers, 2021[111]).

2.1.2. Students belonging to ethnic groups, national minorities and Indigenous communities

Students belonging to ethnic groups, national minorities or Indigenous communities face multiple challenges relating to equity and inclusion in education, including discrimination, language and cultural barriers in accessing education (Cerna et al., 2021[1]).

Digital technologies can help address these challenges and promote inclusion by incorporating diverse cultures and languages to support a sense of belonging. A greater sense of belonging at school is associated with higher academic performance and life satisfaction (OECD, 2019[112]; OECD, 2017[113]). Promoting a sense of belonging can be aided by personalising content and learning activities that celebrate diverse perspectives and backgrounds while maintaining minority languages and cultures. For example, digital tools have been used to reinforce written language skills for Indigenous languages with only 200 speakers (Auld, 2002[114]). Digital technology can benefit students from different backgrounds by presenting a broader representation of diverse populations (OECD, 2021[16]). Representation of diverse populations can occur in content, as well as visually, in pictures and graphics. Increased representation and inclusion can aid in open-mindedness and tolerance for all students.

Digital tools can be used to broaden choice and increase personalisation, therefore suiting the needs and preferences better of diverse groups of users (Heemskerk et al., 2005[51]). However, digital technologies are often designed with the majority in mind, and can overlook the needs or preferences of minority groups. While design is central, the content and use of digital tools are also important to promote inclusion. Technology can be used to increase intercultural activities through fostering communication or allowing for collaborative activities with students from around the world, which research shows helps students maintain a more positive attitude to others from different backgrounds. This can reduce discrimination and increase the sense of well-being for students from ethnic, national and lingual minority groups (OECD, 2020[115]).

Box 2.1. Digital equity and inclusion of Roma students in Europe

Roma communities form Europe's largest ethnic minority, and tend to be one of the most marginalised groups. These communities often face challenges such as poverty, insecure housing, high rates of discrimination and low educational attainment (Rutigliano, 2020[116]). Roma students tend to have significantly higher rates of early school leaving compared to other student groups (Ferkovics, 2018[117]; Rutigliano, 2020[116]), and are often found in segregated classes or schools (European Commission et al., 2021[3]). Barriers to their inclusion and achievement in education include language barriers, discrimination, and a lack of sustained access to education or even regular access for those in travelling communities (European Commission et al., 2021[3]).

Specifically regarding digital equity and inclusion, Roma children might only have access to the Internet on a limited or sporadic basis, or not at all, and often lack a digitally skilled parent or adult who can guide and support them in the digital environment (Garmendia and Karrera, 2019[31]). Furthermore, social exclusion can also lead to digital exclusion (Jakupov, 2021[118]) which is a real risk for Roma students.

There are currently few specific programmes that use digital tools to promote inclusion of Roma children in education systems (see sections 3.1.4 and 3.4.3 for examples) (Rutigliano, 2020[116]). However, Roma students may benefit from the use of digital tools in education to assist with translation, and Early Warning Systems can potentially help identify students who might be more likely become early school leavers. OECD countries should ensure that Roma students also have adequate digital infrastructure at school and at home, including digital devices and broadband connection that is of a high quality and stable enough to allow them to do schoolwork and participate in distance education.

Digital tools, accompanied by the appropriate scaffolding tools, can also be used to encourage better communication and understanding among diverse students (Popov et al., 2014[119]). For example, Popov and colleagues developed a collaboration script[7] supplemented with elements developed for culturally diverse groups of students. Results from a small-scale study of university students in the Netherlands and Ukraine in a computer-supported collaborative learning environment suggest that the script elicited more sharing and collaborative behaviours between students studying in the two countries than the use of a non-adapted collaboration script (Ibid.).

2.1.3. Gender

Historical gender gaps in terms of access to digital technologies are decreasing on average in OECD countries (Hooft Graafland, 2018[13]). However, while digital technologies have been recognised as

[7] A collaboration script is a set of instructions which aims to guide and support two or more learners to interact and behave during collaborative learning in a way that all learning partners benefit from collaboration. (Mäkitalo-Siegl and Kollar, 2012[263]).

potential tools to promote gender equality and empower women and girls, research suggests that there remains a “digital gender divide”, in the sense that women in general access digital tools less than men, which can exacerbate inequalities (Davaki, 2018[120]). Furthermore, a new digital gender gap is emerging in terms of digital literacy, attitudes, and in the fields of science, technology, engineering and mathematics (STEM) (Cerna et al., 2021[1]). Addressing discrepancies early on, giving students of all genders equitable access and learning opportunities, and using the power of digital tools to mitigate gender gaps and promote inclusion is therefore essential.

Research suggests that there are differences in how boys and girls engage with digital tools, and the ensuing outcomes (Burns and Gottschalk, 2019[29]). For example, boys are more likely to use technology for non-educational and recreational activities, such as games, while girls use technology more for educational and task completion purposes (Kim, 2018[101]; Johnson, 2011[121]).

Studies show that there are few gender differences between boys’ and girls’ learning outcomes when using digital tools. However, considering variations in the use patterns and preferences between boys and girls can increase students' psychological and social well-being (Kim, 2018[101]). For example, if designing educational video games, accounting for gender preferences (e.g. while girls tend to prefer to play games with female main characters, boys might have less of a gender preference; boys tend to prefer opportunities for competition in a game) can help level the outcomes of boys and girls (Admiraal et al., 2014[122]; De Jean et al., 1999[123]; Heemskerk et al., 2005[51]). Designing for gender preferences requires thoughtfulness, awareness of the literature, and often choices within the digital technology for varying preferences and needs. This is particularly important due to the potential of perpetuating gender stereotypes (for more see (Brussino and McBrien, 2022[124])).

Inclusive use of digital tools more broadly can increase choices within learning that may appeal to different students’ preferences. For example, males and students with SEN showed better long-term retention from shorter, rather than longer, videos in a flipped classroom.[8] A study from Michigan (United States) with middle school students showed that videos that were 10 minutes in length instead of 20 minutes were associated with closing achievement gaps from pre-video and post-video science scores (Slemmons et al., 2018[125]). However, girls showed better retention from longer videos (Ibid.). The authors suggest that this could be related to how students chunk content, in that shorter videos can facilitate students categorising and compressing information into more discrete and organised compartments (Mathy and Feldman, 2012[126]). The authors hypothesise that these processes may be more imperative in males and students with SEN, and that developmental differences and ability to transfer content information is divergent between males and females (Slemmons et al., 2018[125]). Giving students choices, regardless of gender, may therefore allow them to engage with content in a way that suits them best.

2.1.4. Gender identity and sexual orientation (LGBTQI+)

Students who identify as LGBTQI+ face challenges of discrimination, social exclusion, and feeling unsafe at school (Cerna et al., 2021[1]). There are limited data and empirical studies that have measured how technology can help LGBTQI+ students. However, schools can support students by providing access to resources, such as guiding students to websites that help them in navigating this aspect of their identity and any associated challenges, allowing them to use them on school computers (GLSEN, 2018[127]). Research has shown that LGBTQI+ students can benefit by having this access through school (Allen et al., 2021[128]). For example, in a qualitative study in Israel and the United States, about one third of students in the United States and nearly half of students in Israel reported having access to websites at school

[8] A flipped classroom is a teaching strategy that gives students foundational knowledge, often in video format, for students to view outside a formal learning setting. Then, the time in the classroom is used more interactively and extends on the material learned outside the classroom. Because students have already reviewed the material on their own, they can use classroom setting to discuss and collaborate (Slemmons et al., 2018[125]).

about LGBT people, history or events (Pizmony-Levy and Kosciw, 2016[129]). Despite some findings on the potential benefits of digital technologies for the equity and inclusion of LGBTQI+ students in education, more research is needed in this area.

2.1.5. Students with special education needs (SEN)

The term special education needs is broad and includes a range of learning disabilities, physical impairments and mental health concerns (Cerna et al., 2021[1]; Brussino, 2020[77]). [9] Using digital tools in the classroom can support the inclusion of students with SEN in a number of ways. For example digital tools such as tablets can facilitate independent learning and create a more inclusive classroom environment when all students (those with and without SEN) are using the same or similar devices (Alepis and Virvou, 2014[130]). Creating the conditions for personalised learning is also helpful in supporting students with SEN (Burke and Hughes, 2017[131]).

For students with learning disabilities and physical impairments, unsupported needs in accessing and processing certain types of information can limit academic, psychological and social well-being. Research shows that digital tools can promote equity and inclusion through supporting academic learning and outcomes for students with SEN (Hehir, 2016[132]) and that their flexibility can help compensate for a diverse range of impairments including visual, motor, hearing and speech difficulties (Lidström and Hemmingsson, 2014[133]). More concretely, digital devices can facilitate communication for students with physical impairments, and can be beneficial for writing and spelling (Lidström and Hemmingsson, 2014[133]).Text-to-speech applications can help students with visual impairments, while providing captioned videos can help students with hearing impairments (Burgstahler, 2015[61]).

Students with SEN have also reported that using digital technologies can benefit their learning (Cranmer, 2019[134]) and can help them fit in, especially when they use the same apps and devices that their peers are using (European Schoolnet, 2014[135]). Furthermore, providing support specific to the nature of a child's disability can improve their access to the curriculum. For example, Good (2021[136]) mentions that using digital tools to support children on the autism spectrum with social and communication skills can help them more easily participate in curricular activities that involve collaboration and/or group work. Additionally, digital tools can be used to support children with attention deficit hyperactivity disorder (ADHD) with self-regulation skills, which can allow for deeper engagement in the topics being taught (Good, 2021[136]).

There are different applications of digital technologies for supporting students with SEN in education settings. For example, there are many studies on the potential benefits of digital games, which are wide-ranging and include enhancing social skills (Bernardini, Porayska-Pomsta and Smith, 2014[137]; Malinverni et al., 2017[138]; Stone, Mills and Saggers, 2018[139]) and supporting the development of fine motor skills and handwriting (Good, 2021[136]).

Digital devices can also make education more physically accessible. In many cases, these tools would be considered AT, which tend to be improving in both quality and availability. Newer technologies like refreshable Braille to text and finger readers, a wearable device with AI that reads aloud what the finger points to, can support students with visual impairments (Good, 2021[136]). AT can also be used to help children with specific disorders such as ADHD with specific tasks or with maintaining focus (Mezzanotte, 2020[140]). In addition, appropriate design of digital tools that allows for a customisable interface can support students with SEN. For example, design features that allow for choice of support, font size and style (to reduce cognitive overload), colour coding, size differentiation (to differentiate characters and positioning of letters), options for increased spacing, multisensory variety (visual and auditory), and positive verbal

[9] More information about the definitions and categories within SEN can be found in "Mapping policy approaches and practices for the inclusion of students with special education needs" (Brussino, 2020[77]).

feedback can be particularly beneficial for students with SEN (Benmarrakchi, El Kafi and Elhore, 2017[107]; Motzo, 2018[141]).

Innovative technologies used in the classroom can support academic and well-being outcomes for all students, especially those with SEN. For example, Augmented Reality (AR), can offer teaching aids for students that are exciting and fun, thereby catching their attention (Mohd Yusof et al., 2014[142]). It can also help children with SEN understand concepts more effectively and efficiently (Hrishikesh and Nair, 2016[143]). As it incorporates different means of representation, and different ways of engaging students in the teaching and learning process (Meyer, Rose and Gordon, 2014[83]), the use of AR in educational settings can potentially promote inclusion (Sheehy, Ferguson and Clough, 2014[84]). Research suggests benefits for a range of students including those with auditory limitations, visual limitations, autism, ADHD and dyslexia (Quintero et al., 2019[144]). Devices that use AR technologies provide students with different ways of interacting with others and ideas, and have been associated with increased motivation in students with SEN, along with supporting knowledge assimilation, problem solving and collaborating effectively with others (Cascales-Martínez et al., 2016[145]).

As mentioned above, digital tools can be used to support the well-being outcomes and socio-emotional skills for students with SEN. Effective digital technology use has been associated with increased motivation, engagement and confidence (Benmarrakchi, El Kafi and Elhore, 2017[107]; OECD, 2021[74]). Tools such as social robots have been associated with outcomes such as increased self-regulation and decreased anxiety in children with autism spectrum disorder (Brussino, 2020[77]). Other recent tools have been developed to help students practice emotional regulation, although are not yet widely in use. For example, Chillfish, a respiration game designed for children with ADHD, uses biofeedback to coach students through evidence-based activities to regulate their emotions (Sonne and Jensen, 2016[146]). In addition, in the United States, a smartwatch app called CoolCraig is still under development to support self-regulation. This could be helpful for many students with special education needs (Doan et al., 2020[147]), although potential drawbacks include data privacy concerns, children's hesitations about whether an app is the best way to receive support, and concerns that the support could be distracting (Cibrian et al., 2020[148]).

There are many ways in which digital tools can be used to support the inclusion, academic outcomes and well-being of students with SEN, and the application of advanced technologies such as AR and specialised tools seems promising moving forward. Digital technologies are also increasingly used for earlier and better diagnostics of special education needs, both academic and behavioural (OECD, 2021[74]). Identifying student needs allows teachers and schools to meet those needs better (Brussino, 2020[77]).

Despite the potential for digital technologies to promote inclusion of students with SEN in education, use in the classroom is traditionally narrow, and digital technologies can be further exploited as powerful educational tools (Lidström and Hemmingsson, 2014[133]). Furthermore, certain digital spaces can still be inaccessible for students with SEN (e.g. due to lack of accessibility features such as but not limited to closed captioning, text-to-speech software etc.) (Alper and Goggin, 2017[149]), and while digital tools can compensate for certain difficulties (e.g. reading, writing), barriers to accessing and exploiting the benefits of the digital environment persist such as physical or cognitive barriers, or lack of personal skills (Sorbring, Molin and Löfgren-Mårtenson, 2017[150]). While there is some research on how specific digital tools or practices can foster inclusion of students with SEN, there is a need for more empirical work on how children with SEN use technologies more broadly. Research should engage with children's perspectives and views (Cranmer, 2019[134]), taking into account how diverse groups of students with SEN engage with digital tools (Spiel et al., 2019[151]).

2.1.6. Giftedness

Gifted students can face a number of challenges in traditional education settings. For example, boredom can lead to poor academic outcomes (Rutigliano and Quarshie, 2021[152]). The exceptional abilities of gifted

students often also require curricular adaptations and differentiated pedagogical approaches (Cerna et al., 2021[1]).

Digital technologies in education can benefit gifted students by addressing some of the well-being challenges and by supporting academic outcomes. These benefits include expanded access to resources that can accelerate content and learning (Rutigliano and Quarshie, 2021[152]) and the potential for enrichment through differentiation (Siegle, 2013[153]). Expanded information, digital books, interactive projects, advanced classes in the digital environment, online publishing and virtual mentoring are examples of ways in which digital tools can facilitate enrichment for gifted students.

Several studies show that online personalised assessments can allow for better monitoring and evaluation of strategies involved in critical thinking for gifted students (Chen, Dai and Zhou, 2013[154]; Cope and Suppes, 2002[155]). For example, Computerised Adaptive Testing (CAT) personalises the difficulty of questions in real-time depending on correct or incorrect responses. It provides fast, precise and thorough feedback so that learning can be better personalised (Olson, 2005[156]). Furthermore, inclusive digital tools can improve motivation across content and tasks by stimulating and extending learning opportunities while giving more flexibility for students to pursue their individual interests (Olszewski-Kubilius and Lee, 2004[157]; Periathiruvadi and Rinn, 2012[158]; Rutigliano and Quarshie, 2021[152]).

While advanced technologies are proving promising for promoting inclusion of different student groups, in some cases simple uses can be beneficial, especially for gifted students. For example, a study conducted by Dixon, Cassady, Cross and William (2005[159]) found that gifted boys used 83% more words, sentences and paragraphs when typing instead of handwriting, closing the gap between boys' and girls' word usage. Additionally, a study on gifted students showed that the structure of the digital task assigned was correlated with the likelihood of task completion, which gifted students sometimes struggle with. In this case study, the majority of high-ability students engaged with the pedagogical learning model were able to maintain perseverance and completed all the required tasks in the digital programme (Ng and Nicholas, 2010[160]). Digital tools can be effective means of keeping gifted students engaged in educational content.

2.1.7. Overarching factors

In addition to focusing on the six diverse student groups, SES and geographic location can increase potential barriers to inclusion in education, and affect well-being and academic outcomes. Different digital tools can be used to address some of these issues, with varying degrees of effectiveness.

Socio-economic status

Evidence shows that students from low SES backgrounds face academic and well-being challenges, which can intersect with and exacerbate challenges associated with belonging to one of the six diverse groups discussed above (Cerna et al., 2021[1]). Not only do students from more advantaged backgrounds and who attend higher SES schools tend to have better access to digital tools, they also tend to be more active users of technology, whereas students from more disadvantaged backgrounds and schools are likely to be more passive in the digital environment (Dolan, 2015[161]). Closing the access gap and promoting digital equity in education is therefore important for less advantaged students, as is focusing on digital skills and uses.

Several studies have focused on the benefits of educational technology for students from a lower socio-economic background, with conflicting results. It is clear that the presence of technology without complementary digital skills can make it difficult for students to take advantage of digital opportunities that could positively affect their academic achievement and well-being (Heemskerk et al., 2005[51]). Even so, many of the well-being benefits discussed for other dimensions of diversity also apply here. This includes increased motivation, and participation for students from lower socio-economic backgrounds students when using inclusive educational technology. For example, using certain digital functions has been

associated with increased self-efficacy via problem-solving and perseverance. However, these particular results were only associated with emailing and gaming, but not other types of digital tools or activities (Shank and Cotten, 2014[162]). Digital benefits may therefore be best achieved with specific uses and accompanied by efforts to improve student digital literacy.

Geographic location

Geography is related to equity and inclusion in education. The dispersion and concentration of groups of diverse students, in some instances in quite concentrated pockets of disadvantage, can intensify challenges. Students in more remote geographical locations might lack adequate access to digital tools, and provision of high-quality broadband is not assured in many remote communities (Burns and Gottschalk, 2019[29]). The location of schools themselves and urban or rural differences can also limit inclusion (Cerna et al., 2021[1]). However, COVID-19 school closures and subsequent moves in many systems to digital teaching and learning have shown that the geographic location of school buildings does not have to determine where, what and how students learn.

Digital tools, adequate Internet access and the promotion of digital skills are important components for supporting students in remote areas and expanding the resources that would be otherwise unavailable (Bannister-Tyrell and Wood, 2021[163]; Cerna, 2019[100]). Digital tools alone cannot solve the challenges of geographic location, but must be accompanied by a push to improve digital skills and competences for students and education staff. Purely delivering courses online could fall short of fostering students' deep understanding of the content and engaging them in knowledge creation (Resta and Laferrière, 2015[109]; UNESCO, 2011[164]).

Innovative technologies like telepresence robots can also support inclusion of students who are unable to physically be in the classroom due to distance or other concerns. Often developed with the objective of including children with chronic illnesses in the classroom, these robots can act as an avatar for children in the classroom. Controlled from a connected device like a tablet or smartphone, the robots can be controlled to look around, raise their hand, speak in class and even change their eye expression (OECD, 2021[74]).

2.2. Teachers and parents

2.2.1. Teachers

Many stakeholders benefit from inclusive use of digital technologies including students, teachers, parents and communities. Teachers can benefit from the use of technology because it can facilitate access to virtual professional learning, help teachers tap into virtual networks and reduce their workload. Tools such as learning analytics and artificial intelligence can assist teachers in classroom management for example (OECD, 2021[16]), helping to reduce workload and freeing up time for other activities.

Increasingly, formal professional learning opportunities are being offered digitally, expanding course offerings and providing flexible schedules. Additionally, informal professional learning and peer support often occur through social media networks (Hrastinski and Ekman, 2017[165]). Virtual networks can facilitate professional learning activities, collaboration and exchange of best practices, contributing to personal knowledge, competence and teaching skills (Révai, 2020[166]). Digital technologies can reduce teacher administrative workload and improve the administration of assessments, record keeping, lesson planning and communication with stakeholders. (Lorenceau, Marec and Mostafa, 2019[167]).

Teachers can also employ digital strategies to enhance inclusion. For example, in the virtual classroom, teachers can place personal pronouns (e.g. she/her, he/him, they/them) next to their name to support inclusion of gender diverse students (Brussino, 2021[47]). Promoting interactions among students and between the teacher and their students can improve students' sense of belonging, their motivation and

participation (Washington University in St. Louis, 2020[168]). Teachers should be aware and think about the ways in which diversity can affect the online learning experience of students, and how it can hinder or promote positive outcomes (Brussino, 2021[47]).

With the move to distance learning during the COVID-19 pandemic, teachers for the most part were reliant on digital tools to maintain connections with their students and to ensure educational continuity. In order to assist with this transition, many systems, such as Italy, provided information and resources for teachers on how to teach in the digital environment. (OECD, 2020[18]).

Despite the potential benefits of digital tools for teachers, they may struggle to provide adequate support to students and to help them maximise the opportunities available via online learning. This could be due to a lack of time, insufficient digital skills and lack of curricular guidelines (OECD, 2020[169]). Ensuring appropriate support through training, upskilling and adequate guidance for different stakeholders is thus necessary (see Section 2.3.1).

2.2.2. Parents

Beyond the classroom, parents and the wider community can benefit from the use of technology in education to increase connectivity and communication (Heemskerk et al., 2005[51]), potentially promoting greater collaboration among actors. Digital tools can foster communication among parents and schools. Specifically, digital translation services can promote the inclusion of parents who do not speak the language of instruction, and connecting with teachers virtually reduces barriers regarding participation for parents who would otherwise be unable to meet (e.g. due to childcare responsibilities, work, lack of suitable transportation, etc.). As is the case for teachers, there are barriers to parents providing adequate support to their children to make the most of digital learning opportunities, often due to lack of time due to balancing job and other family obligations (which is likely to be especially acute for single-parent households) and a lack of digital skills (OECD, 2020[169]).

Many education systems used digital means to communicate with and convey information to parents throughout school closures associated with the COVID-19 pandemic. Some systems created digital tools or guides to share with parents about the continuity of their children's education and their well-being (OECD, 2020[18]) (more examples can be found in Section 3.4.3).

UNICEF outlines some key points for strengthening communication between parents and schools through the use of different digital communication channels such as phone calls, online parent conferences (on Zoom or Skype for example), messaging groups, e-mails, school websites and social media platforms such as Facebook. Not all parents interact in the same way or can be reached in the same way, therefore using a variety of approaches can be more inclusive (UNICEF, 2020[170]).

In order for digital tools to better meet the needs of end-users such as parents and teachers, it is important to assess their needs and views. Technological tools benefit from stakeholder input to centre the community (parents, teachers, students) in the development and monitoring phase (OECD, 2021[74]). This will help create tools to promote more equitable and inclusive outcomes, and to better suit the different needs of different users.

2.3. Challenges

While digital technologies can provide benefits and have significant potential for promoting equity and inclusion in education, there are several challenges and drawbacks. The following section will discuss some of these challenges. The rapidly shifting role of technology in education means that challenges are still being explored and studied as research lags behind implementation (Thomas et al., 2019[171]).

2.3.1. Ensuring equitable resourcing and digital infrastructure in schools

A key challenge in achieving digital equity and inclusion in education is that digital infrastructure can vary across schools. Digital inclusion in schools relies on alleviating a number of the above challenges, including adequate infrastructure and resourcing, teacher preparedness and self-efficacy, and strong leadership. Resourcing digital technologies in education requires financial resources, personnel resources and material resources (OECD, 2021[74]), and in general socio-economically advantaged schools are more likely to fulfil the resourcing requirements of being "digitally inclusive" than socio-economically disadvantaged schools (Kim, Yi and Hong, 2021[6]). Evidence from PISA 2018 suggests that socio-economically advantaged schools tend to have a larger share of devices such as portable computers and computers connected to the Internet than socio-economically disadvantaged schools. This is the case on average across OECD countries (OECD, 2020[14]). Rural schools are also more likely to have inadequate digital infrastructure than schools in cities (OECD, 2022[172]).

Education systems have generally been pushing to invest in schools' digital infrastructure in order to compensate for the limited access to digital technologies and the Internet at home faced by disadvantaged students (Bulman and Fairlie, 2016[173]; OECD, 2015[174]). A lack of access in disadvantaged schools can therefore compound the disadvantage faced by these students at home. Furthermore, a shortage in digital technology (such as software, computers, laptops, smartboards etc.) in schools with higher concentrations of socio-economically disadvantaged students or in rural settings is more likely to hamper the quality of instruction (OECD, 2022[172]).

Funding challenges to purchase, maintain, and upgrade devices and connectivity are frequent obstacles in ensuring equitable and inclusive infrastructure. As mentioned above, certain schools such as those in rural settings are more likely to have inadequate digital infrastructure than their more urban counterparts. This can be due to funding models that are dependent on the local tax base or on student enrolment (which are lower in rural settings), but do not necessarily reflect the higher cost related to delivering educational services in remote settings (OECD, 2017[175]; Echazarra and Radinger, 2019[176]).

Even with sufficient funding, budgeting can be difficult because there might be costs associated with ownership of digital tools throughout the lifespan of EdTech services, and if it is not made clear by companies, schools can be locked into tools and services that they do not necessarily need nor make use of (UK Department for Education, 2019[177]). Innovative and newer technologies can also come with a hefty price tag, meaning that only more affluent systems or schools will be able to afford them. It is important to balance the costs of developing, maintaining and acquiring digital technologies in education systems with the potential benefits (OECD, 2021[74]).

Ensuring digital access and infrastructure in schools is essential to promote digital equity and inclusion. The integration of digital technologies in schools may compensate for social inequalities in students, and can also contribute to a reduction in digital inequality (González-Betancor, López-Puig and Cardenal, 2021[178]). Diminishing digital inequalities and removing barriers to access for all students in the school environment is therefore a key step towards digital equity, digital inclusion, and the ability to use digital tools to promote equity and inclusion in education.

Another significant challenge regarding funding and infrastructure is that technology and education are interdisciplinary and often extend beyond one ministry or department. Working across ministries, public agencies, and also often in collaboration with private sector actors (i.e. in the case of equipping schools and students with devices or connectivity) is a notorious challenge due to traditionally siloed resources, responsibilities and policy spheres (Burns and Gottschalk, 2019[29]). While some of the aforementioned challenges are general challenges that are not necessarily specific to equity and inclusion, resourcing and distribution challenges that impede the equitable and inclusive rollout of digital tools in the teaching and learning process may negate the potential for these tools to promote equity and inclusion in the classroom.

2.3.1. Closing the (digital) skills gap

Students

As discussed in Section 1.3, different student groups tend to display different levels of digital skills. Factors such as socio-economic disadvantage, immigrant background and gender all play a part in influencing digital skill level and development. Students need the requisite digital skills in order to make the most of the opportunities of digital technologies in education, as well as outside of education. Despite big strides in improving access to digital technologies, many countries still face challenges in minimising the second-level digital divide (Burns and Gottschalk, 2019[29]).

In using digital technologies with the goal to promote equity and inclusion in education, special care should also be taken to avoid widening achievement gaps. For example, if technologies such as personalised learning work the same for everyone, students with stronger prior knowledge will be able to maintain or widen their advantage over their peers with less prior knowledge (OECD, 2021[74]). In this sense, the use of digital technologies can inadvertently widen not only the digital skills gap, but academic achievement and skills more broadly.

Parents

As mentioned above, there are barriers to parents providing adequate support to their children to make the most of digital learning opportunities. This is due to a number of reasons including lack of time due to balancing job and other family obligations (which is likely to be especially acute for single-parent households) and a lack of digital skills (OECD, 2020[169]). Research suggests that parents with higher levels of education and those from higher SES backgrounds tend to be more digitally advantaged, use more devices to go online and use more smart devices (Zhang and Livingstone, 2019[32]). Higher SES parents and those with higher levels of education also tend to have higher levels of digital skills (Zhang and Livingstone, 2019[32]; Livingstone et al., 2015[40]).

Parents who have lower levels of digital skills tend to take a more restrictive approach to their children's engagement in the digital environment, whereas parents with higher skills take a more enabling[10] approach (Burns and Gottschalk, 2019[29]). While restriction can limit exposure to digital risks, it can also hamper the development of children's digital skills. Indeed, some research has suggested that more restrictive parenting approaches have been associated with lower levels of digital skills in children, thereby lowering their online opportunities (Rodríguez-de-Dios, van Oosten and Igartua, 2018[179]; Haddon et al., 2020[180]). This can result in challenges to equity and inclusion as students from less advantaged backgrounds not only have lower access to digital technologies at home, but also might experience more restrictive mediation from their parents and have less support in taking advantage of digital learning opportunities.

In order to close the digital skills gap for students, one challenge to overcome is closing the digital skills gap for parents as well. Focusing on digital skill development in parents could result in higher uptake of more enabling rather than restrictive approaches to digital technologies, allowing children to explore the digital environment more freely and develop their skills at home. Digitally skilled parents will also be in a better position to support their children in digital education and in any instances when they encounter digital risks.

2.3.2. Supporting teachers

Teachers are important stakeholders in incorporating digital technologies into the classroom in ways that support equity and inclusion of their students. However, simply providing teachers with access to digital

[10] Enabling mediation incorporates safety efforts and responds to child agency, encompassing active mediation with safety mediation and activities such as using technical controls and parental monitoring (Livingstone et al., 2017[265]).

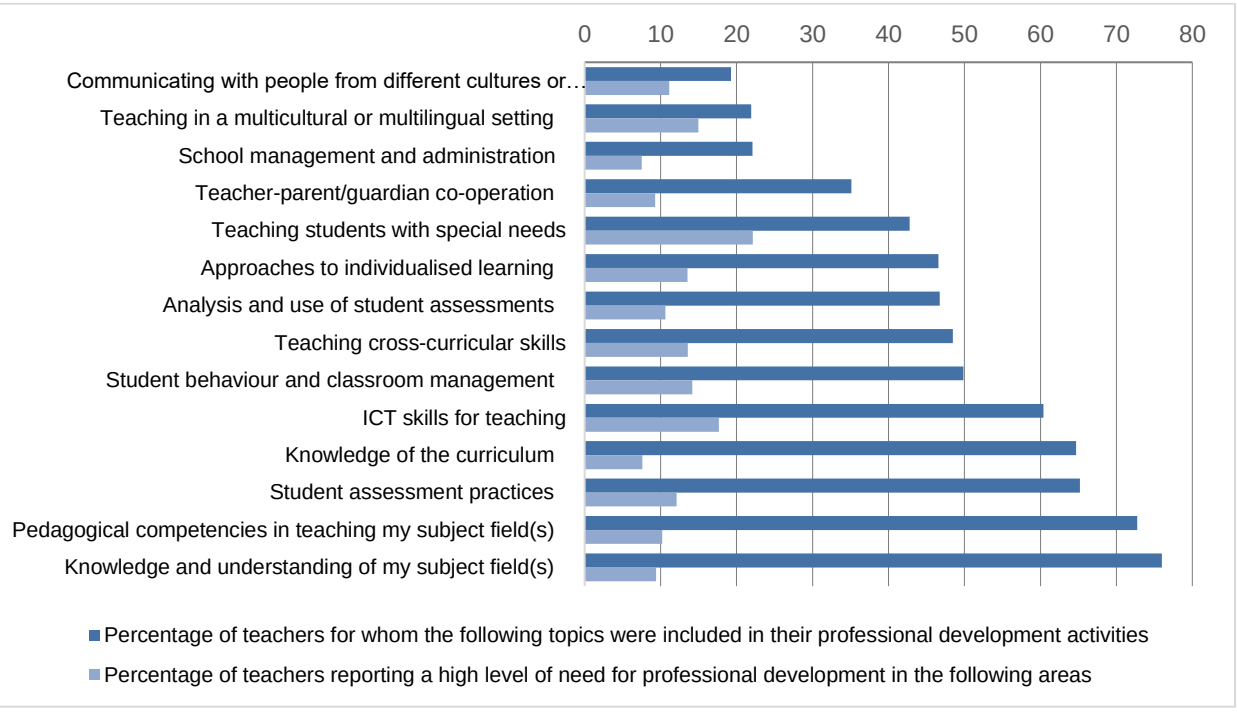
resources in the classroom does not translate directly into good pedagogical practice, nor does it ensure the integration of digital tools into the teaching and learning process (Earle, 2002[181]). Teachers need access to high quality professional learning opportunities, and require support from school leaders and the school community to effectively incorporate digital technologies into their teaching practice.

Professional learning

For teachers to effectively implement digital technologies as learning devices in the classroom, they require technological knowledge and digital competence, as well as pedagogical and content knowledge (Voogt et al., 2012[182]). Teachers who are confident and possess the requisite skills are able to employ practices in the classroom, such as blended learning, which can help them improve differentiation of instruction according to different student needs, while also fostering higher levels of classroom interaction (Paniagua and Istance, 2018[183]).

The combination of rapidly increased digitisation alongside increasingly diverse classrooms means that teachers need increased training and support (Brussino, 2021[47]). Ideally, teachers would have ongoing training throughout their career to help choose digital tools, while implementing effective pedagogy with socio-cultural awareness (Tondeur et al., 2016[184]). However, according to TALIS 2018, only 60% of teachers reported that they received continual professional learning in ICT in the 12 months before the study as seen in Figure 2.1 (OECD, 2019[15]). The percentage of teachers reporting a high level of need for professional development in ICT in 2018 was the highest in Japan at 39% and the lowest in England at 5.3%. Teachers reported this need as second only to the need for training to support students with SEN, which has been a steady pattern throughout previous TALIS surveys.

Figure 2.1. Participation in professional development for teachers and need for it, TALIS 2018



Note: Results based on responses of lower secondary teachers (OECD average-31).
Source: Tables I.5.18 and I.5.21, OECD (2019[15]), TALIS 2018 Results (Volume I): Teachers and School Leaders as Lifelong Learners, https://dx.doi.org/10.1787/1d0bc92a-en.

This is consistently a highly reported area of need for teacher professional development, and is especially relevant for older teachers who often express problems with or barriers to their use of digital tools in the teaching and learning process (Scherer, Siddiq and Teo, 2015[185]). Additionally, teachers in many systems are not receiving training on the potential risks for students in the digital environment (Burns and Gottschalk, 2019[29]). According to a report on countries in the European Union, few countries offer training on how to use digital tools for supporting inclusion (European Commission et al., 2021[3]). Even when teachers receive training on using digital technologies in the teaching and learning process, sometimes this can be of poor quality (Gudmundsdottir and Hatlevik, 2017[186]). Despite these results, since the onset of the COVID-19 pandemic, many education systems have promoted and enhanced teacher training in using digital tools (OECD, 2021[187]).

Some digital tools available to teachers are underused because teachers report they lack the skills or that it is too time-consuming. There can also be perceptual gaps in understanding how they could be used in a culturally inclusive manner. For example, a study in Australia showed teacher belief bias that Indigenous students could not or chose not to use some digital tools, while Indigenous students felt teachers were disengaged (Dreamson et al., 2018[66]). Technology cannot make up for the lack of quality teaching, so digital skills must be supported by sound pedagogy and an inclusive mindset. Providing teachers with high quality initial teacher preparation and continuous professional learning to develop skills and competencies with using digital tools in their teaching, with a focus on technological pedagogical knowledge (and content knowledge) will be essential moving forward in more digital educational environments.

Teacher learning and readiness to use technological tools is one part of the equation. Teacher willingness and self-efficacy are also important determinants of whether digital tools will be incorporated into classrooms around OECD countries. Teachers' self-efficacy has been associated with the integration of digital technologies in teaching (Gerick, Eickelmann and Bos, 2017[188]; Drossel, Eickelmann and Gerick, 2016[189]). On the other hand, beliefs that digital technologies could be harmful to children or distracting in the classroom could reduce their implementation. A large proportion of teachers in European countries, for example, believe that the use of digital tools in education should be limited (European Commission et al., 2021[3]), despite the potential benefits that well designed and smartly used technologies can afford.

Ensuring teachers are capable and willing to incorporate digital tools to some extent into their teaching practice is important to maintain flexibility in light of potential future disruptions that could cause school closures or prompt distance learning. During the shift to distance learning during the COVID-19 pandemic, teachers who had previously incorporated technology into their teaching practice had more positive experiences with distance learning (van der Spoel et al., 2020[190]). In a small sample of Estonian teachers, perceived willingness to use technology made it easier for them to cope with distance learning and to overcome obstacles associated with digital teaching and learning (Adov and Mäeots, 2021[191]).

School leadership and support for teachers

One important point to address is school readiness and leadership regarding the integration of digital tools into teaching and learning. Factors such as pedagogical and technological support in the school are important, as is the technology infrastructure (Petko, Prasse and Cantieni, 2018[192]; Gil-Flores, Rodríguez-Santero and Torres-Gordillo, 2017[193]). The school climate around the use of digital tools, such as perceived support from other teachers, can also affect teachers' willingness to use technologies in teaching (Sánchez-Prieto et al., 2019[194]). Strong leadership that encourages learning about and using digital tools and establishing a collaborative culture in schools around digital technologies are important to promote the use of digital tools in the classroom (Pelgrum and Voogt, 2009[195]).

2.3.3. Promoting equitable distribution of teachers' digital skills across schools

The ability of teachers to use digital tools in the teaching and learning process depends on their digital competence, but also on factors such as the physical infrastructure in place in their schools, the level of

school support, the SES of the school and the availability of resources (Kim, Yi and Hong, 2021[6]). For example, urban-rural divides and the ensuing constraints on digital infrastructure can affect how teachers incorporate digital technologies in the classroom (Goh and Kale, 2015[196]).

The uneven distribution of digitally competent and capable teachers across schools underscores a need for minimising digital inequalities in teachers, specifically in skills and attitudes. TALIS 2018 data suggests that the distribution of teachers who are trained in and feel capable of using ICT and who regularly let their students use ICT for projects or class work are not randomly distributed across schools. In fact, there is a higher share of teachers who feel they can support student learning using digital technologies in private than in public schools in about a quarter of TALIS-participating countries and economies, and is larger in socio-economically advantaged than disadvantaged schools in seven education systems (OECD, 2022[172]). However, in some education systems teachers who were trained in the use of ICT are more concentrated in socio-economically disadvantaged schools. This is the case in countries like Australia, England (United Kingdom), France and Sweden (OECD, 2022[172]). In some education systems, the distribution of teachers who have been trained in ICT during their initial education is higher in schools with a higher share of students whose first language is different from the language of instruction. This is the case in Alberta (Canada), the Flemish Community of Belgium, Latvia and Türkiye.

According to PISA 2018, on average across OECD countries 65% of 15-year-olds are enrolled in schools where the school principal considers that their teachers have both the necessary technical and pedagogical skills to integrate digital devices into the teaching and learning process (OECD, 2020[19]). As with some of the findings from TALIS, the distribution varies in some systems in advantaged versus disadvantaged schools. For example in Sweden, this figure is 89% in advantaged schools versus 54% in disadvantaged schools (OECD, 2020[19]). In the majority of participating countries and economies, one finds the same pattern, although not necessarily to the same magnitude.

TALIS 2018 findings also suggest that in some systems, teachers with higher self-efficacy in ICT tend to work in more socio-economically advantaged schools. For example, this is the case in Austria, Belgium, Colombia and Mexico. High self-efficacy is associated with the use of digital tools in the classroom (Drossel, Eickelmann and Gerick, 2016[189]; Gil-Flores, Rodríguez-Santero and Torres-Gordillo, 2017[193]; Hatlevik and Hatlevik, 2018[197]). Therefore in these systems students from disadvantaged backgrounds who might be less exposed to digital learning and opportunities at home are also less exposed to digital learning in the classroom (OECD, 2022[172]).

It is important to note, however, that differences between schools in the use of ICT remain significant after controlling for factors such as teacher experience, self-efficacy and professional learning opportunities in the use of ICT. This was the case in all participating countries except for Malta (OECD, 2022[172]). It is therefore also important to account for school and system-level factors when thinking about how to promote the equitable and inclusive use of digital technologies in the classroom, and in promoting equity and inclusion with digital technologies.

2.3.4. Facing digital risks

The OECD identifies multiple digital risks to students, ranging from privacy concerns to access to inappropriate content to cyberbullying (OECD, 2021[198]). These digital risks can have real-world consequences for children, potentially affecting their well-being and future outcomes. Furthermore, children who are vulnerable offline, such as those from disadvantaged backgrounds, tend to be more vulnerable to risks resulting in harm in the digital environment (Burns and Gottschalk, 2019[29]). Risks in the digital environment can lead to harm or negatively affect well-being if children are not appropriately supported by parents, teachers or other trusted, digitally competent adults (Burns and Gottschalk, 2019[29]), and some students such as students with SEN, those facing mental health difficulties, and those with physical disabilities might be disproportionately vulnerable to exposure to digital risks (El Asam and Katz, 2018[199]).

This is important to take into account as research is clear that exposure to digital risks can cause harm to children (Burns and Gottschalk, 2019[29]; Burns and Gottschalk, 2020[12]). For example, one high-profile digital risk in OECD education systems is cyberbullying (Burns and Gottschalk, 2019[29]). Children who are victims of cyberbullying tend to report higher levels of internalising issues such as anxiety and depressive symptoms, and this may affect academic and later life outcomes (Gottschalk, 2022[200]). Certain students might be more vulnerable to being cyberbullied than others, such as students with SEN or those who identify as LGBTQI+. Girls are also more likely to be cyberbullied than boys are (Gottschalk, 2022[200]), highlighting that this is a digital risk that may be disproportionately experienced by different student groups and can therefore affect equity and inclusion in the school environment.

Children from disadvantaged backgrounds may be more exposed to newly emerging privacy risks and surveillance (Gangadharan, 2017[201]), and less able to leverage the benefits of newly emerging technologies such as AI systems (Lutz, 2019[202]). Data-driven systems and algorithms may also make decisions that are not necessarily more logical or less biased than decisions made by humans (Caplan et al., 2018[203]). They may replicate structural biases, by favouring those who are more advantaged than those from more disadvantaged backgrounds (Selwyn and Jandrić, 2020[204]). If the data used to train these systems does not sufficiently reflect the potential diversity of student backgrounds and characteristics, bias can be built into the system and further disadvantage students from already disadvantaged backgrounds.

Furthermore, the risks associated with newer technologies are not necessarily clear. In light of a changing risk landscape, education systems and researchers must maintain flexibility and keep a careful eye on the implementation of novel or innovative tools in the teaching and learning process. This is important not only to keep students safe, but also not to undermine equity and inclusion due to concerns that some digital innovations may not yet go far enough in terms of inclusive design or implementation.

2.3.5. Inclusive design of digital technology

If technology is not designed with diverse users in mind, it can be problematic for specific student groups. Digitised curriculum, online learning and applications must make general assumptions about users' interests, background knowledge and perspectives. This creates a “hidden curriculum”[11] that can interfere with learning for diverse student groups who do not align with these assumptions (Heemskerk et al., 2005[51]). Lack of consideration for all students can create barriers especially those from diverse groups such as students with SEN (Burgstahler, 2015[61]). As mentioned previously, some digital spaces remain inaccessible for children with SEN, and limited personal skills, or physical/cognitive barriers, could hamper the ability of this diverse student group to exploit the benefits of digital technologies both in and out of education.

Barriers to inclusion are amplified where there is insufficient consideration of diversity. Some argue that educational technology is not culturally neutral and has a Western bias that is not inclusive of Indigenous and marginalised cultures unless intentionally designed (Smith and Ayers, 2006[205]). The promotion of Western cultural values through software and applications can be detrimental if at odds with to Indigenous and marginal cultural values that differ (Smith and Ayers, 2006[205]). Technological design can espouse certain implicit values while undermining others, especially Indigenous knowledge systems (Dreamson et al., 2018[66]). A lack of representation of people from diverse backgrounds themselves to help design and create culturally sensitive content for education worsens the issue (Dyson, 2004[63]). There is also debate around miscommunication and intercultural misunderstandings. Some researchers argue that virtual learning solves these issues, while others contend that they are worsened (Jung-Ivannikova, 2014[206]). Online interactions can be hampered by differing attitudes, coordination, and expectations for

[11] A hidden curriculum refers to the unintended, indirect and usually informal lessons that are taught to students (OECD, 2020[264]).

engagement. In addition, there can be wide cultural variations of anonymity, engagement and communication styles.

Another major challenge is the potential design biases in advanced technology. The design of technological tools and applications used by students, teachers and administrators can be biased in ways that may impede equity. There is broad evidence of a pattern of bias affecting gender and minorities in other sectors that can amplify existing biases and patterns of discrimination. There is also evidence of bias against people with diverse abilities (OECD, 2021[74]).

There is a lack of transparency about how algorithms, for example, are developed and how they work. There are several examples of bias and discrimination with extensive evidence on AI bias in facial recognition software, healthcare and criminal justice towards ethnic minorities (Whittaker et al., 2019[207]). Evidence also shows gender bias in voice recognition and discrimination in resume screening against women (ibid.). Other research shows that AI can interpret people with learning or physical impairments as unfavourable, furthering social stigmatism and potentially creating barriers to opportunity (Whittaker et al., 2019[207]).

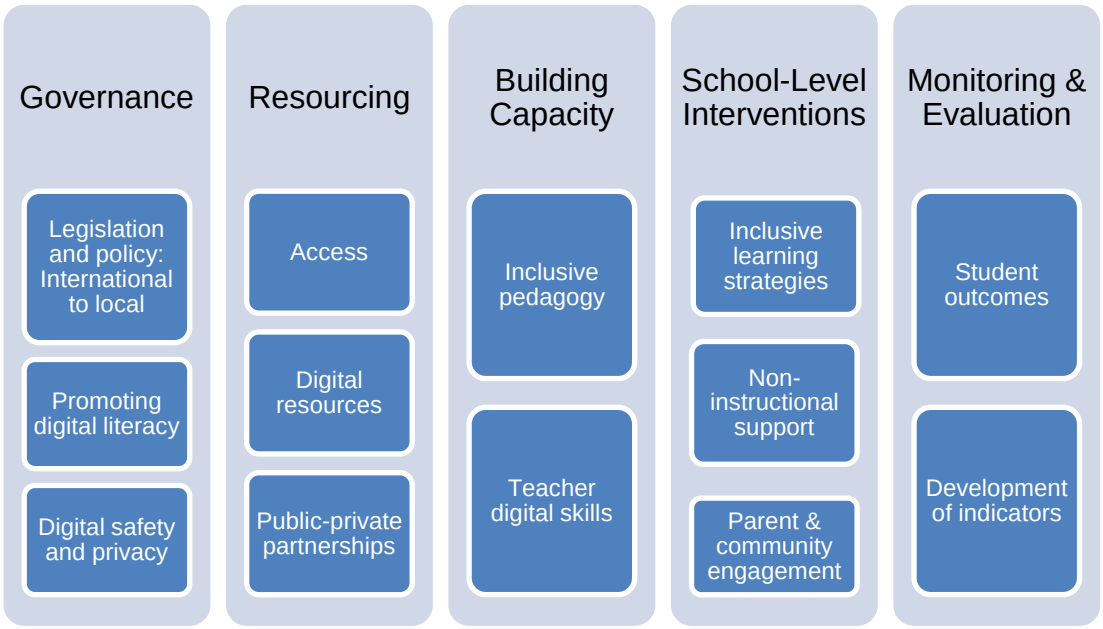
3. Policies and practices in OECD countries

Digital technology has many benefits that support inclusive education, but several key challenges can be barriers to effective implementation. Therefore, policies and practices aim to take advantage of the benefits while minimising the obstacles. This section will highlight examples of policies, using the analytical framework developed by the OECD Strength through Diversity Project, which focuses on the key policy areas of:

- Governance.
- Resourcing.
- Developing capacity.
- School-level interventions.
- Monitoring and evaluating (Cerna et al., 2021[1]).

Figure 3.1 gives an overview of some of the more common policies for each key area. It is not a comprehensive catalogue, but instead, a high level look at how the use of digital tools in education is sometimes approached.

Figure 3.1. Policies for inclusive use of digital technologies in education



Note: A general overview of some practices and policies mapped to the Strength through Diversity framework that is not meant to be comprehensive or exhaustive. The authors acknowledge that other policy areas might exist which have not been included in the mapping conducted.

With the increase in digitalisation in education in recent years, many systems have evolved to emphasise pedagogy, student-centred learning, and later economic progress and lifelong learning all in relation to digital technologies (Conrads et al., 2017[208]). However, according to a 2017 study of 43 policy interventions focused on digital intervention, only a few integrated inclusion and equity considerations (Ibid.). In many countries, ongoing work is being undertaken to increase access to digital devices and the Internet. Moving past access, newer policies have expanded the agenda by focusing on digital skills for students and teachers, promoting inclusive digital environments and protecting children in the digital environment. Moving forward, certain digital policy measures could be strengthened to focus on equity and inclusion of diverse student groups.

The subsequent sections provide examples of policies and practices, predominantly in OECD countries, that have been put in place in the attempt to target digital equity and inclusion. In many instances, these strategies and policies might be quite broad in practice, and do not necessarily focus on specific student groups. However, when possible, examples will be provided of policies and practices that target specific student groups. Policy challenges will also be discussed, as relevant.

3.1. Governing digital technologies in education

While comprehensive legislation to address equitable and inclusive use of digital technologies in education is not common, there are many policies to address digital inequities. These include providing devices and Internet access to students to reduce obstacles to digital education. The capacity to use the devices effectively and safely is also essential, so digital literacy and an emphasis on building digital skills from basic operational skills to higher order skills has been integrated into the curriculum in many cases (Burns and Gottschalk, 2019[29]). Additionally, in response to digital safety and privacy concerns, digital safety is being taught to students in some systems. In terms of privacy, data protection regulation is often managed outside of education and involves a range of different stakeholders.

3.1.1. Policies at the international and regional level

Policies to address digital inclusion are not necessarily constrained by country borders because of the nature of the globalised Internet. Furthermore, international and regional policy frameworks and incentives often drive national directives. For example, at a regional level, the European Commission has been highly influential. The European Commission Digital Action Plan (2021-2027) calls for inclusive digital education to be developed and implemented (European Union, 2020[10]). The comprehensive and overarching plan is an excellent example of an integrative policy framework that addresses many of the key challenges such as access while also including skills for teachers and students founded on pedagogy. By increasing inclusivity to higher education and reskilling, it plans to meet current and future labour market demands. Additionally, a goal is to create a “Digital Education Ecosystem” with shared resources to improve access, skills, training and security, addressing all three levels of digital inequities. Plans include improving household access to digital equipment and broadband connections. In addition, digital skills will be addressed, both basic and advanced, to improve gender balance in science, technology, engineering and mathematics (STEM) fields. Teacher training will be provided to support students with the use of digital tools based on inclusive pedagogical practices. Additionally, there are goals for high quality, user-friendly, and security measures for privacy and ethics (Ibid).

In support of the new EC Digital Action Plan, Erasmus+ has a EUR 26 million budget to allocate to projects that enhance inclusion through digital technologies (European Commission, n.d.[209]). The programme complements and supports education projects that focus on factors such as social inclusion which is encouraged through informal transnational experiences and support for language instruction. Furthermore, Erasmus+ helps support Digital Action Plan goals by providing funding for teacher training. Overall, its goals and activities are quite broad and extend beyond digitalisation and inclusion.

Another example of international co-operation is the Global Partnership on Artificial Intelligence (GPAI).[12] The organisation is committed to human-centred AI use. It includes a Committee on AI and Education and a cross-cutting Diversity and Inclusion Committee to engage more stakeholders for shaping inclusive and responsible practices and data governance within the AI field (GPAI, n.d.[210]). This organisation addresses some of the challenges of data governance and inclusion concerns about potential bias in AI by guiding research on diverse and inclusive considerations for AI development. GPAI also promotes international co-operation on these issues while sharing domestic research to better coordinate efforts. Subgroups meet regularly to make recommendations and facilitate international co-operation. The meetings also allow for opportunities for stakeholder input as an inclusive practice (Ibid).

The 2021 Guidelines to support equitable partnerships of education institutions and the private sector by the Council of Europe also serves as an important reference for countries when thinking about the use of digital tools in education and promoting digital citizenship.[13] These Guidelines describe the ways in which education and private sector actors can work together in an effort to empower learners through education, with the goal of acquiring the required competences to participate in an increasingly digital society (Council of Europe, 2021[211]). The Guidelines demonstrate good practice in both education and the private sector for promoting digital citizenship in 10 specific domains. For example, the first digital domain refers to "access and inclusion". Under this domain, recommendations include education systems putting in place policies to ensure all learners have safe and secure access to digital tools, and being mindful of policies such as "Bring Your Own Device" policies that could further entrench inequalities (Council of Europe, 2021[211]).

3.1.2. Inclusive digital technology legislation and policy

Inclusive education is increasingly seen as valuable in education systems, and in some cases is recognised through specific legislation. However, this is often broader than specifically covering digital inclusion in education (UNESCO, 2020[76]). For example, Portuguese law includes components that can be aided by digital technology but does not directly regulate digital means. The Portuguese inclusive education law mandates inclusion to meet every student's individual needs and is not just focused on certain student groups. It allows for local flexibility where digital technology can be used but is not mandated. As another example, in Denmark, schools must use digital language dictionaries for Danish and all other languages (OECD, 2021[16]). However, legislation that requires digital education tools to support inclusive education are not yet widely seen.

Some systems are trying to take characteristics of diverse groups into account when creating digital policies and programmes. For example, Québec (Canada) takes into account the cultural and sociological characteristics of First Nations and Inuit students. The Ministry has asked students from these groups to recommend how policies and practices can best suit their digital needs (Ministry of Education and Higher Education of Québec, 2018[212]). Incorporating the voices of students in the policy and decision making process can help systems address equity concerns, and this is often overlooked (Burns and Gottschalk, 2019[29]).

[12] The GPAI has 25 members: Australia, Belgium, Brazil, Canada, Czech Republic, Denmark, France, Germany, India, Ireland, Israel, Italy, Japan, Mexico, the Netherlands, New Zealand, Poland, Korea, Singapore, Slovenia, Spain, Sweden, the United Kingdom, the United States and the European Union.

[13] Digital citizenship is defined as "the capacity to participate actively, continuously and responsibly in communities (local, national, global, online and offline) and at all levels (political, economic, social, cultural and intercultural)" (Council of Europe, 2021, p. 4[211]).

3.1.3. Access

Equity of access is primarily a matter of students owning devices, or having access to communal devices at school, and adequate provision of high-quality Internet access. Many countries have been working on these issues for years, but COVID-19 made this more urgent. Policies to address access will be discussed further in Section 3.2.

3.1.4. Student digital literacy

Digital literacy includes a range of knowledge, skills and behaviour that students use to access, interpret and create digital media (Reedy and Parker, 2018[213]). If students do not have the digital skills to use devices effectively, digital technology will not necessarily aid in improving outcomes for students. Instead, technology can widen the gap between students with requisite digital skills and those without. Therefore, many countries have updated curricula to integrate digital skills, ranging from basic operation skills to higher order skills such as computational thinking, both for immediate use and as future labour market participants (Burns and Gottschalk, 2019[29]).

For example, Finland incorporates digital literacy into its national curriculum as one of the seven key competencies (Lähdemäki, 2019[214]). It complements a 2015 initiative to increase digitalisation in schools. By including digital literacy as a key competency, it is highlighted as a critical objective and value for individual schools to apply to the local context. Moreover, it fits within the larger view of Finnish education that has a holistic view of student well-being. The rationale behind including digital skills in the curriculum is that they help students better take advantage of technology in education and provide a foundation for future skills needed in the labour market (Ibid).

There are also some examples of targeted digital literacy programmes for specific student groups. For example, *Head in the Clouds: Digital Learning to Overcome School Failure*, an EU funded Erasmus+ project, was launched in 2016 by the Vienna University of Technology with partners from five European countries. The goal of this project was to enhance the basic and transversal skills and digital literacy of Roma students to improve their quality of learning (Novak, Rabiee and Tjoa, 2018[215]).

3.1.5. Digital curriculum

Many countries are moving to an increasingly digital curriculum[14]. Although the stage of digitalisation of curricula is variable across countries, with some providing some digital version of the curriculum, some on the way to implementing a fully interactive digital curriculum, while others have already achieved this (OECD, 2020[216]). There are many advantages for all students when the curriculum is well designed, assuming that access and digital skill issues are addressed so that students can fully engage with the material. Designing a digital curriculum gives the opportunity for policy makers to co-construct a curriculum with actors such as learners, teachers and leaders from minority groups, recognising them as change agents to avoid marginalising students from these groups (Schönfeld, 2020[217]).

However, a digital curriculum that is not designed with inclusivity in mind can create systemic discrimination while not appreciating student's unique experiences and knowledge, and can worsen inequities (European Commission, n.d.[218]). Furthermore, understanding that not all students, teachers and parents have equitable access to or understanding of digital resources could complicate efforts to achieve inclusion through digitalised curricula (OECD, 2021[16]). When planning a curriculum to be truly inclusive, "opportunities must be deliberately embedded into the design of an inclusive curriculum, and they depend

[14] A digital curriculum can include digital content or organisational features to implement curricular elements, online materials, tools, depositories, hardware, software and other applications. This definition can vary across countries and/or jurisdictions (OECD, 2020[216]).

on other, concurrent equity measures, such as equal access to infrastructure (computers, laptops, broadband, etc.) and guidance and information for parents on the benefits of such resources" (OECD, 2021, p. 41[16]).

3.1.6. Digital safety

Given that the nature of digital privacy and safety includes data governance, cyberbullying and other forms of digital safety, regulations can overlap with policy areas beyond education. Some countries have a national digital strategy to promote privacy and security, a holistic strategy that cuts across all governmental bodies and increases coordination among actors (OECD, 2020[219]). However, broad strategies do not necessarily focus on children specifically, who may have different needs in terms of privacy and security in the digital environment than adults. They also might not account for the knowledge (or in some cases lack thereof) that children have of their digital privacy and security, and unless the information is presented in an understandable and child-friendly way, children might have a difficult time understanding what their rights are and who they can approach if they need assistance. This is particularly important for children from diverse backgrounds, such as those who do not yet speak the local language and do not have access to resources in minority languages for example.

A number of countries have more comprehensive policies to address both Internet safety and risks such as cyberbullying. For example, in Washington (United States) digital citizenship legislation was passed in 2016 (Hasse et al., 2019[220]). The law integrated components of digital literacy into the state curriculum, including Internet safety, digital citizenship and media literacy. The new curricular standards for technology also included objectives to prevent cyberbullying and hate speech. Following Washington's lead, similar legislation has been adopted in the states of California, Connecticut, New Mexico and Rhode Island (Ibid). Similarly, in Chile, as part of a programme to expand digital access for schools, a campaign was launched for *Internet Segura* ("Secure Internet"). The programme encompasses Internet privacy, safety and cyberbullying prevention. It also encourages partnerships with private and civil society, facilitates teacher training specific to digital citizenship and provides teaching materials to schools (Ministerio de Educatíon, n.d.[221]). This programme addresses many of the challenges that would otherwise prevent all students from benefiting from educational technology.

However, the research on how digital risks affect diverse student groups on the whole is lacking. For example, there are few studies that explore how cyberbullying affects students from ethnic minority backgrounds specifically, and there is also a lack of targeted interventions for diverse populations (Gottschalk, 2022[200]). More research is needed to understand whether specific policies or practices on digital privacy and safety can be used to promote equitable and inclusive outcomes for students from diverse backgrounds.

Data protection regulation

Many countries have regulations to protect data collection by education systems. Generally, in data protection regulation, stipulations are made for "vulnerable" groups. Children are often included in this definition of vulnerable groups, so data protection regulation does not necessarily have specific recommendations or rules for children from diverse backgrounds. Strong data protection regulations can be particularly helpful in supporting children from disadvantaged backgrounds, who may be less aware of their rights to privacy, and who (alongside their parents) may have lower levels of digital skills.

Data is routinely collected on students, including grades, exam results and personal data, as well as data of parents, teachers and other staff. A few international frameworks call for protecting children's data generally but are not specific to education. While it does not have specific provisions for children, the European General Data Protection Regulation (GDPR) stipulates the right to personal data protection covering all individuals in the European Union and the European Economic Area including the export of their data out of these areas (OECD, 2021[198]).

Many countries' privacy and data protection laws include or cover children in some way, but the approaches differ greatly (OECD, 2020[219]). For example, in England (United Kingdom), several steps have been taken to protect children's digital privacy rights. This includes minimum security standards for all EdTech companies and a Data Security Toolkit for schools that align with the 2018 Data Protection Act (UK Department for Education, 2019[222]). The Irish Data Protection Commission launched a public consultation regarding children's rights as data subjects under GDPR and the processing of their data (Data Protection Commission, 2018[223]). The view was to publish guidance material on data processing for children themselves as well as the organisations who process their data (Data Protection Commission, 2018[223]).

In some countries, such as Australia and Canada, consent is needed before sharing personal information. In Australia, consent is needed for children of less than 15 years-old. In Canada, consent is needed from the subject of the information, and although it does not specifically refer to children, this was done to protect the rights of children and other vulnerable groups. Consent must be fully informed; therefore there is a need for child friendly and appropriate language (OECD, 2020[219])[15].

Digital safety policy

Digital safety policy tends to be broad, often without specific emphasis on equity, inclusion or students from diverse backgrounds. They can be specific for certain digital risks, such as to cyberbullying, or more general. For example, Australia has a broad and cross-cutting digital safety policy geared towards protecting all citizens. The Office of the e-Safety Commissioner has specific resources for children, as well as individuals from diverse groups (e.g. Aboriginal and Torres Strait Island Peoples, people with disabilities, LGBTQI+ and those who are culturally/linguistically diverse). There are resources available that are specific to needs of children and the privacy and security concerns they might face, as well as educational resources for teachers such as trainings and frameworks for online safety education (Australian Government, n.d.[224]).

While the agency is not education-specific, it does provide an evidence-based framework for best practices digital safety in schools. Other resources include a toolkit and implementation guide for schools, professional learning webinars for teachers and webinars for parents and carers (Australian Government, n.d.[224]). This multi-faceted policy addresses many of the safety challenges to digital inclusion.

Education systems can promote digital resilience for all students, especially the most vulnerable, by investing in teacher training on digital risks and implications, incorporating ethics and e-safety in the curriculum, and schools should foster zero-tolerance approaches to behaviours such as cyberbullying that might disproportionately affect more vulnerable students (OECD, 2018[225]). UNICEF suggests that "efforts to protect children need to focus particularly on vulnerable and disadvantaged children, who may be less likely to understand online risks – including loss of privacy – and more likely to suffer harms" (UNICEF, 2017, p. 4[226]).

3.1.7. Fragmented policy spheres

The digital space is complex and global, challenging policy makers across multiple government agencies and requiring coordination with actors in the public and private sectors. Responsibility for governance can fall to separate ministries or is shared between ministries, including education, health and justice. A lack of coordination can cause both unnecessary overlap and gaps in other areas, leading to inappropriate or missing measures (Burns and Gottschalk, 2019[29]). Furthermore, responsibility must be shared across

[15] More information on data protection regulation concerning children in OECD countries can be found at (OECD, 2020[219]).

wider stakeholder groups, including civil society and private firms (OECD, 2020[219]), and due to the truly global nature of the Internet international coordination is also important (Burns and Gottschalk, 2019[29]).

While working within existing structures can be agile and efficient in the short run to govern the inclusive use of technology in education, there are also many disadvantages. Fragmented policy spheres make it more challenging to design comprehensive, overarching policies that can integrate technological advances. Indeed, weak collaboration between education stakeholders, across government levels and across different sectors can impede the implementation of ambitious policies (UNESCO, 2020[227]). For example, EU law does not currently integrate anti-discrimination rights with technological advances. Therefore, new laws integrating data protection and anti-discrimination are needed to defend against challenges such as algorithmic bias (Hacker, 2018[228]). These fragmented policy approaches and responsibilities for equity are not sustainable when not integrated into larger strategies (Conrads et al., 2017[208]).

3.2. Resourcing digital technology to support diversity, inclusion and equity in education

To overcome digital inequities, policies provide resources in four primary areas, including providing equipment and devices, expanding Internet access, providing digital tools and resources and encouraging innovations in educational technology. The first three, namely devices, access and digital resources, are prerequisites to ensuring that students can build digital skills and fully engage in all the possibilities and opportunities digital technologies offer. Additionally, some governments recognise that technological advancements in public education can lag behind other sectors. As a result, governments often collaborate with other organisations and firms to incentivise innovation. Many countries have various combinations of similar policies, spurred by the rapid digitisation of education during the pandemic.

3.2.1. Access to equipment and devices

There are various approaches to bridging the first-level digital divide, ranging from giving devices to individual students and/or schools, and enhancing digital infrastructure more broadly (Burns and Gottschalk, 2019[29]). Providing personal devices to individual students has been implemented in many systems. For instance, the governments in England (United Kingdom) and New Zealand paid for and helped schools distribute laptops so that each student would have access to one (OECD, 2021[16]). This included making sure that each child within a family had their own device (Ibid). Some countries, like Singapore, focused only on older students, giving a laptop to every secondary student, but not to primary students (OECD, 2021[16]).

Other policies focus on ensuring students have access to digital education through mobile devices like tablets. For example, in 2015, Hungary started the Hipersuli programme, a public-private partnership with Telenor Hungary and Microsoft Hungary, which offered mobile learning opportunities to decrease the first-level digital divide and reach rural students at the primary and secondary levels. It also focuses on expanded access to fast Internet for students and teachers (Conrads et al., 2017[208]). The FATIH (*Fırsatları Artırma ve Teknolojiyi İyileştirme Hareketi* / Movement to Increase Opportunities and Technology) programme in Türkiye focused on building digital infrastructure in schools, including facilitating access to high-speed Internet access and cloud computing in schools, as well as distributing 17 million tablets to students and 1 million to teachers and administrators (Burns and Gottschalk, 2019[29]). In Portugal, the Ministry of Education finances digital facilities for schools to provide to students either at school or at home (OECD, 2021[16]). Many of these programmes are general programmes, focusing on equipping all students with devices regardless of background or socio-economic disadvantage.

The COVID-19 pandemic accelerated the need for access to devices and equipment as systems moved to distance learning. According to the OECD Survey on Distance Education for Young Children 2020, different measures were taken in countries specifically focusing on inclusion of students from vulnerable groups in primary and pre-primary education. For example, some systems took an approach to providing access to devices for students who would be otherwise excluded, while others implemented measures such as providing specific digital tools or material to children with specific educational needs, or materials and tools adapted to children who are speakers of minority languages (OECD, 2021[229]).

Another approach regarding devices is the more flexible Bring Your Own Device (BYOD) policies found in several countries. For example, in Estonia, BYOD policies in schools allowed students to bring their own devices to school (OECD, 2021[16]). The rationale is that students are more familiar and comfortable with their own devices and can learn from each other. In addition, accessing existing devices instead of supplying extraneous unneeded devices can be more efficient. Alongside BYOD, grants were offered for schools to upgrade digital infrastructure so that schools could support multiple device connectivity to the Internet (Ibid). However, when implementing a BYOD policy, efforts should be taken to ensure that students who do not have a device or a suitable device are not excluded. Providing devices or upgrading old devices of those who need them can help make BYOD policies more inclusive.

In some cases, especially pre-COVID-19, policies focused on meeting needs at the school level instead of household or individual level. For instance, Japan provided schools with computer equipment, networking and cloud infrastructure, expecting that they would be used at school, rather than at home (OECD, 2021[16]). This wide variety of device provision to students helps ensure all students have the essential equipment needed for digital education. While access to digital tools is important, many current policies and practices to ensure access to digital tools in the classroom and at home focus on more basic tools like laptops and tablets. Access to more innovative, and expensive, technologies is less widespread and less of a focus in many systems.

When thinking about resourcing and supplying access to digital technologies, governments should keep design and inclusiveness in mind from the offset. Designing with diverse student needs in mind can be more efficient, and designing with UDL is more cost effective if considered upfront. Retro-fitting increases costs by 5% instead of 1% if integrated from the beginning (UNESCO, 2020[227]).

3.2.2. Expanding internet access

Given that many education tools are cloud or Internet-based, reliable, affordable high-speed Internet is a prerequisite for accessing digital education. However, factors like SES and rural or challenging geographic terrain can be obstacles in ensuring all students have equal access to the Internet. In many countries, funding digital connectivity is a policy priority for the general population, without necessarily focusing on education. For example, in Canada, geographic factors can prevent high-quality broadband from reaching certain remote areas. In response, the Broadband Fund programme was created to reduce digital differences between urban and rural areas by extending internet access to rural areas in Canada. Up to CAD 750 million will be spent building and upgrading communications infrastructure. This measure was funded by contributions from telecommunication companies, not tax revenue (Canada, 2019[230]). Similarly, the EC is offering funding to help countries expand broadband access as part of the National Resilience and Recovery Plans (European Commission, n.d.[218]).

3.2.3. Providing digital resources

Various digital resources beyond devices and connectivity are offered to students in OECD countries. Sometimes their provision requires partnering with government agencies outside education and private firms.

Well-being resources

A greater understanding of the role of well-being in each student's ability to reach their potential has necessitated the development of supportive policies and practices. Mental health has been high on the policy agenda in many countries in recent years, and during the pandemic it received increased attention. In the United Kingdom, the National Health Services (NHS) developed an app for youth aged 10-18 to teach emotional regulation based on cognitive behavioural therapy principles during the COVID-19 pandemic. While the app was developed and provided through health services, it was promoted through schools (NHS, n.d.[231]). This collaborative effort between departments shows how schools can support well-being more broadly.

Digital textbooks

Digital textbooks offer many benefits, including the flexibility of online accessibility, personalisation, language translation, and sustainability and some systems such as Austria and Korea have incorporated them into classrooms (Avvisati et al., 2013[232]; Burns and Gottschalk, 2019[29]). E-Textbooks have also become a common feature in Estonian classrooms, with a sharp increase in their use noted during the COVID-19 pandemic (OECD, 2020[216]). Digital textbooks are also part of the Japanese digital education strategy (van der Vlies, 2020[9]). However, as with traditional textbooks and other learning materials, accessibility in terms of cost is an issue some students face (OECD, 2021[16]). An inability to purchase digital textbooks could prevent some students from realising the benefits they have to offer, and in systems where all textbooks are digital this could exclude some students. However, digitised textbooks have the advantage in that they can be more easily shared among groups of students than printed textbooks (OECD, 2021[16]).

Different countries have taken different funding and provision approaches. In some countries, digital textbooks have been provided free of charge to all students, while in others they are either subsidised or have been for purchase by families (Avvisati et al., 2013[232]). Mexico and Scotland (United Kingdom) have adopted strategies to make digital textbook and learning and assessment resources accessible to all students (OECD, 2021[16]).

Inclusive learning resources

In addition to textbooks, governments provide additional inclusive learning resources such as online tutoring, homework help and language instruction. For instance, in Korea, the Cyber Home Learning System (CHLS) is designed to balance the inequity arising from families with a higher socio-economic background who often provide private tutors for their children outside of school. Because not all students have access to private resources, the equity gap between socio-economic groups has widened. To compensate, the CHLS tool for distance learning provides free online tutors who can help students regardless of socio-economic economic background (Avvisati et al., 2013[232]). A similar programme in France offers an online homework support tool as part of the Homework Done programme. It assists students who might not have support at home with their homework (Ministère de l'Éducation Nationale, de la Jeunesse et des Sports, 2018[233]).

Other inclusive resources such as online platforms can supplement content and instruction not otherwise available. For example, online platforms can be useful for providing difficult to access language instruction in minority languages. In Sweden, specialised teachers are available on digital platforms for students' heritage language instruction (Cerna, 2019[100]). These learning resources that provide tutoring, homework help and instruction in heritage languages are possible through digital education policies. The Ministry of Education in New Zealand provides guidance and digital resources to support learning of the Māori language (Education Review Office of New Zealand, 2018[234]). In Norway, online resources are available

for newly arrived children. Materials are available in Norwegian and six other resources to help students learn Norwegian, but also mathematics, science and English (OECD, 2021[235]).

Inclusive digital assessment resources

Digital assessments can give more detailed feedback and encourage personalised learning, making education more inclusive. Furthermore, the results of digital assessments can be more easily shared with stakeholders, including parents. For example, Korea uses K-Edu, a public-private platform with technology-based assessments, to give personalised learning activities based on assessments (KERIS, n.d.[236]). In addition, a separate public cyber-learning platform, e-Hakseupteo, will be used to diagnose content areas where students might need more help and give appropriate support via distance learning. Currently, e-Hakseupteo is being developed under the Korea Education and Research Information Service, a public agency within the Ministry of Education (Ibid).

3.2.4. Forming strategic private sector partnerships

The role of private businesses in supplying digital tools in education is expanding as educational technology becomes more complex (Lingard, Wyatt-Smith and Heck, 2021[237]). Private education technology suppliers provide hardware, software, storage, data collection, and data analysis products and services. Other businesses include publishers and telecom providers. Furthermore, education systems have increased needs for the storage of big data and for using advanced technologies (OECD, 2021[16]). In addition, the research and design of innovative educational technologies often rely on private-public partnerships. For example, in Norway, the Ministry of Education provides funding to private firms for developing digital tools and content. Public funding of private supply closes the gap where the market would otherwise be too limited to encourage investment in software for specialised diverse groups, including students with special education needs or students who speak minority languages (Avvisati et al., 2013[232]).

Needs for innovation, especially for diverse student groups, can be advanced through public-private partnerships. For example, England (United Kingdom) promotes EdTech innovation by creating a market conducive to innovative business needs (UK Department for Education, 2019[222]). Combining public and private resources in Korea, KERIS (Korea Education and Research Information Service) is a governmental organisation under the Ministry of Education. It focuses on different aspects of digital technologies in education. As part of a multi-pronged policy agenda, a platform, K-Edu, is being created where private and public EdTech content can be distributed (KERIS, n.d.[236]). The free provision of EdTech content to all students can promote a more equitable system.

As mentioned previously, the Council of Europe Guidelines gives a number of areas in which private sector actors can support access and digital inclusion. These include the provision of easy-to-use reliable digital tools and infrastructure; supporting affordable access and connectivity for all learners; ensuring platforms, devices and resources conform to international accessibility standards; using principles such as UDL to support all learners and avoid segregation and stigmatisation; and ensuring that the conditions of access to digital tools are transparent and that they are free from hidden forms of commercial content and subsidy (Council of Europe, 2021[211]).

Despite the potential for public-private partnerships in this domain, there are concerns over differing objectives between public and private organisations. For example, developing EdTech companies' goals might focus on reducing time-to-market, which could limit time for inclusive design based on UDL principles (Selwyn, 2016[53]). There could be conflicting interests between for-profit companies and public institutions such as education. Strong regulatory policy measures that take into account how private interests may conflict with the goal of advancing equity and inclusion in education will therefore be essential. These include policy measures to safeguard children's privacy and data and to ensure the involvement of private sector actors does not exacerbate existing inequalities.

Additionally, there are concerns that schools will become reliant on products as they become integrated into the teaching and learning process and then costs could rise (Selwyn, 2016[53]). If additional costs are passed on to students and families, this could have consequences for participation of students from low socio-economic backgrounds. This can also be a concern at the system level as the use of privately provided services and/or platforms can result in education systems becoming dependent on private companies. Although services such as platforms and tools might be offered free of charge or at low cost, services can become costlier over time (Barry, 2022[238]). Finally, forming partnerships with private sector actors can be difficult due to diverging agendas and expectations between the public and private sectors (Burns and Gottschalk, 2019[29]). These potential disadvantages are all important considerations for policy makers and require strong regulation and oversight.

3.3. Developing teacher capacity for using digital resources inclusively

The comprehensiveness of policies that develop teacher capacity for using digital resources inclusively varies along a continuum from digitally focused to increasingly integrating inclusive pedagogy. Many programmes focus on increasing teachers' digital skills, while some also include elements of inclusive pedagogy or a focus on diverse student groups.

3.3.1. Digital skills and knowledge

Due to the rapid pace of technological change and new EdTech developments, teachers need continuing training on how to effectively use these tools in the classroom. In many OECD countries, professional learning opportunities have been offered with the goal of furthering teacher knowledge and capacity in these domains. In Italy, for example, through the National Institute for Documentation, Innovation and Educational Research (INIDIRE), teacher training was provided alongside the provision of digital equipment and resources (Avvisati et al., 2013[232]). Whiteboards were put in classrooms to help with distance learning to reach geographically isolated areas. There is also a collection of multimedia resources available for teachers to use (Ibid). Similarly, in France, the *M@gistère* system is used to offer teacher training. It offers open-registration, self-guided online classes for teachers (Ministère de l'Éducation nationale, de la Jeunesse et des Sports, n.d.[239]). The digitalisation of continuing professional learning courses allows for flexible scheduling and a more comprehensive range of courses including topics such as virtual reality and AI in education, and how to use platforms like Moodle. As digital skills are taught online, teachers have the opportunity to learn and practice hands-on digital skills and tools.

Some systems take a more structured approach to ongoing professional learning. In Flanders (Belgium), schools set aside time coordination and training regarding digital technologies. The government funds these hours where a coordinator can assist educational leaders in implementing technology effectively within schools (European Schoolnet, 2017[240]).

Focusing on bolstering teacher skills and knowledge through effective and high quality teacher education is essential. Supporting teachers in non-formal and informal learning is also key. Teachers should have opportunities to collaborate with others within their schools, and supporting participation in digital (or non-digital) professional networks that facilitate knowledge transfer and sharing best practices can be of further assistance.

Not only is teacher professional learning necessary, but teacher attitudes and openness to new technological tools determine to a large extent whether they will be used in the classroom. For example, many teachers have reservations about the use of tools such as social robots in the classroom, while those who have a more favourable attitude towards technology have a more positive outlook on their applicability (Belpaeme and Tanaka, 2021[241])

3.3.2. Digital tools and learning about inclusive pedagogy

Other programmes build capacity for inclusive pedagogy via online professional learning opportunities or programmes. For example, in the province of New Brunswick (Canada) an online continuing professional learning course on teaching in culturally and linguistically diverse settings helps prepare teachers to implement inclusive pedagogy for immigrant students and students belonging to ethnic minorities, national minorities or Indigenous communities (OECD, 2020[18]). While this training can be applied to digital learning strategies, it is not a core objective of the professional learning course on inclusive pedagogy. Sweden offers online learning modules for teachers and school staff, some of which refer to inclusive education (Cerna et al., 2019[105]), while In Italy and Spain, the Erasmus Training Academy offers online continuous professional learning courses for teachers on topics such as enhancing diversity and tolerance in the classroom, addressing prejudice and discrimination, preventing conflict and early school leaving, and promoting socio-emotional learning (Erasmus+ School Education Gateway, n.d.[242]; Brussino, 2021[47]).

In Melbourne (Australia) the RMIT School of Education piloted a programme that used technology to promote greater understanding of other cultures to pre-service teachers. Named *eTutor*, this programme had the goal of creating an environment where pre-service teachers could interact and engage with students from different cultures in a safe, supportive, inclusive, challenging and engaging environment. Having the ability to digitally interact with children from different cultures helped shift the attitudes of many participants, and they demonstrated empathy and caring for children from different cultures (Carr, 2016[243]).

3.3.3. Using digital technology for inclusive pedagogy

Some training for teachers specifically focuses on how to use digital tools to facilitate the implementation of inclusive practices in the classroom. For example, in Sweden, there is a joint goal between the National Agency for Education and the National Agency for Special Needs Education to increase teacher knowledge of and access to digital tools designed to support accessibility for all students. Teachers have access to training and support on how to best use digital tools in the classroom, including specialised training in supporting students with special education needs (European Agency for Special Needs and Inclusive Education, n.d.[244]). In the Hillsborough County Public Schools, Florida (United States), free professional learning webinars were offered to teachers on using digital tools during COVID-19. The webinars focused on pedagogical methods to differentiate for individual students using technology and distance learning (Ali and Herrera, 2020[245]). In Flanders (Belgium), the i-Learn programme was launched in 2019 in an effort to encourage teachers to effectively use digital tools in the classroom to individualise and tailor learning to specific needs of students (European Commission et al., 2021[3]).

3.4. School-level interventions

3.4.1. Use of digital technology for learning strategies

As has been evidenced in previous sections, digital technology can support inclusion through several tools and strategies. Digital tools can be used to support students with diverse backgrounds through providing flexibility in teaching and learning, personalisation, access to virtual communities and through increasing motivation and interest in the subjects at hand. Technology designed specifically to support individual needs of diverse student groups is also important to promote inclusion. When inclusive policies ensure access, teacher training and inclusive pedagogy, digital technology can help minimise some of the barriers to inclusive education.

Digital and distance learning

Many OECD countries used online learning in some form during school closures due to the COVID-19 pandemic. However, some countries were integrating this practice before the pandemic. For example, in Ireland, alternative online school for early school leavers is personalised to their needs and interests, and has been associated with increased motivation and academic outcomes (OECD, 2021[16]). The online nature of the programme allows for greater flexibility for personalisation compared to an in-person setting without digital technology use. In addition, online learning has been used to reach remote students, helping to overcome geographic barriers (Cerna, 2019[100]).

In countries with large rural or remote populations, distance education can and has been used to help bridge gaps in educational access for those who are prevented from attending school on a regular basis or at all. Australia is an example of an OECD country with many children living in rural or isolated areas. Distance education has been used to offer real-time remote teaching and learning sessions through the use of technologies such as video conference, phone or satellite, as well as virtual excursions. Non-real-time or asynchronous practices have also been used such as email and online learning management systems like Moodle (New South Wales Government, 2017[246]). Distance education has also been used in immigrant education, specifically for those who are newly arrived and from other language backgrounds and when schools are unable to provide language support. Skype and Moodle have been used to support developing English language proficiency for these newcomers, and they receive one virtual conferencing session per week for a period of up to four consecutive years (Cerna et al., 2019[105]). Finland has also used digital classrooms to reach students living in remote communities (OECD, 2021[235]).

Distance learning can also support students in remote areas have more choice in their educational paths and increase outcomes for these students. In the Northwest Territories (Canada), the Northern Distance Learning programme allows for a greater variety of courses to be provided to high school students in small schools. The goal of the programme is increasing educational outcomes to the same level as the rest of Canada for students intending to enter post-secondary programmes. Through videoconferencing and learning management systems, students have the opportunity to follow online classes that may not be offered in their local high schools, as these schools, especially those in more remote regions of the Territory, tend to be small (Government of Northwest Territories, n.d.[247]). Despite potential disadvantages, such as students lacking the digital skills for online or independent study, distance learning opportunities can increase choice and educational opportunities for students in remote or rural settings.

Distance learning can also be increasingly done by using innovative technologies such as social robots. For example, the AV1 robot developed in Norway by the start-up *No Isolation* is a student telepresence robot and can take their place in the classroom. Controlled by a smartphone app or a tablet, the robot acts as the students' eyes and ears, enabling remote students to see, speak and hear in class as well as perform functions like raising their hand or whispering to classmates (Belpaeme and Tanaka, 2021[241]). This type of robot has also been developed in other countries, although implementation in the classroom is not widespread.

Assessment

Technological tools, such as assistive technologies, for assessment are used in several countries to accommodate students with special education needs and to better use assessment results with personalised recommendations and support. For example, in Scotland (United Kingdom) computers with text to speech are used by some students during national exams (OECD, 2021[16]). By using computers for the exams, all students can participate more equitably because their communicative needs are met and it can facilitate them in performing closer to their full potential.

In the United States, accommodations for students with special education needs are available when taking an exam "administered by any private, state, or local government entity related to applications, licensing,

certification, or credentialing for secondary or postsecondary education" (U.S. Department of Justice, n.d.[248]). Some of the tests covered include high school equivalency exams, university entrance exams and high school entrance exams, and the accommodations can include non-digital accommodations such as extended time or braille booklets, but also screen reading technology. New Zealand also allows for the use of assistive technologies for students who have an identified specific learning disability or a medical/physical/sensory disability. These can be used during formal school assessments such as the National Certificate of Educational Achievement, for example (Ministry of Education, 2021[249]).

3.4.2. Non-instructional support and services

Well-being support for students has become more widespread across OECD countries, and programmes with digital components have become more common. Evidence suggests that appropriate use of technology can help increase the effects of health and well-being interventions, especially as interventions can be adapted to participants' needs and preferences (Aston, 2018[250]).

For example, a programme in Flanders (Belgium) created a digital chat that makes it easier for students to reach out for psychological and mental health support (European Schoolnet, 2017[240]). Students can also ask for help academically or with general welfare concerns. The programme is run by local Pupil Guidance Centres, to which every school maintains a relationship. The schools still consider themselves to be the first point of contact, but the digital chat offers an alternative option (Ibid). Another example is "Second Step", a programme developed in Norway that offers holistic programming for social and emotional learning through a digital programme for K-8 grades (McBrien, 2022[251]). While the programme has not been specifically assessed in certain student groups, it could be promising to look at how this type of intervention can support diverse student groups.

The COVID-19 pandemic has further highlighted the need for non-instructional support and services, many of which can be more accessible via digital means. For example, during school closures, online services for personal counselling were provided in some parts of the United States. The San Antonio school district in Texas supplied virtual counselling for both students and their families, in English and Spanish (Ali and Herrera, 2020[245]). This approach was supportive of students' well-being and broadened access by supporting a minority language.

There are many other examples of how digital tools were used to support health and well-being in OECD countries throughout the pandemic and school closures (OECD, 2020[18]). For example, in Sweden a virtual platform was used to set up online meetings between native and newcomer students to help reduce the effects of social isolation. e-Mental health services and online counselling services were available in countries including Canada and Italy and many systems made use of online platforms to provide information in multiple languages to students and families about health and well-being (OECD, 2020[18]).

3.4.3. Using digital technology to engage with and assist parents

Technology can be a tool used to support communication, engagement and participation with parents and communities. It can support inclusion for a number of groups, especially in the case of parents who do not speak the language of instruction, parents with physical impairments or disabilities, or those who have work schedules that could prevent them from meeting with their children's teachers at school (Parents International, n.d.[252]). For example, in Ontario (Canada) a mobile-friendly digital curriculum was created in part to better engage with parents and students (OECD, 2021[16]). By accessing the curriculum anywhere, anytime on mobile phones, parents were more easily able to engage with their children's learning.

There are also examples of interventions for parents using digital technologies so they can better support their children, and to strengthen the ties between families and schools. For example, the Digital Education Among Roma Minorities in Schools (DREAMS) programme, implemented in Belgium, Bulgaria and

Romania between 2019-2021, was established as a means of strengthening collaboration among Roma parents and schools. Digital storytelling was used with low-skilled Roma parents to highlight specific problems faced by Roma children in education (i.e. early school leaving, segregation), with parents then learning how to edit and tell their own digital personal narrative (All Digital, n.d.[253]).

Schools also increasingly used digital tools to engage with parents during school closures due to the COVID-19 pandemic. For example, in Ireland the Ministry of Education provided various digital resources to parents including guidance on continuity of schooling for children, and specific documents with information dedicated to parents of children at risk of educational disadvantage and of students with SEN (OECD, 2020[18]). Many countries also made educational and well-being resources digitally available to parents, often in different languages to accommodate minority language speakers (Ibid.). Strengthening engagement between schools and parents can help improve information and guidance to parents on effective practices to support their children's learning (OECD, 2020[169]). Throughout the COVID-19 pandemic, digital tools were also used to support the well-being of parents. For example, UNICEF in Italy offered remote counselling and psychological services for refugee and immigrant children, and their parents and guardians (OECD, 2020[18]).

During school closures, many parents were able to engage more directly with teachers and schools due to the use of digital modes of communication, which is likely to persist after the pandemic has subsided. For example, a sample of school leaders in a Norwegian municipality responded that they planned to continue to have regular communications with parents and caregivers, facilitated by digital tools (Bubb and Jones, 2020[254]).

3.5. Implementation, monitoring and evaluation

3.5.1. Supporting equity and inclusion through implementation

Education policy implementation is inherently complex, often involving many stakeholders especially in the case of digital policy (Viennet and Pont, 2017[255]). There can sometimes be a disconnect between the implementation of laws and policies (UNESCO, 2020[227]).

For example, a qualitative study of rural German schools in Lower Saxony and Baden-Wuerttemberg showed that there was a discrepancy in Internet quality as measured by the monitoring tool versus the reality in the schools themselves. Furthermore, while additional funding was available for digital resources, teachers and authorities expressed concern over addressing pre-existing shortfalls (Federal Ministry of Transport and Digital Infrastructure, 2016[256]). In another example, Chile had a 2011 goal to achieve Internet access for all schools. However, the policy results were limited by slow speeds and it did not reach the most rural areas that needed it most (Lynch, 2019[257]). Administrative procedures can also be an obstacle to accessing and implementing resourcing. For example, rolling deadlines instead of hard deadlines for funding while avoiding complex procedures ensures some areas and populations are not left out. Germany revised its procedures for the 2018 Broadband Funding Programme to provide broadband access based on these challenges faced in the previous policy (BMVI, 2018[258]).

In Spain, *Escuela 2.0* was a policy implemented from 2009-2013, focused on increasing use of digital tools in classrooms by supplying equipment, Internet access, teacher training, digital materials and encouraging parental participation. However, implementation was uneven due to the decentralisation of schools and differing political influences within the education administration (Roig Vila, 2012[259]). As a result, not all students benefitted equally from the policy. It is thus important to carefully consider implementation in order to promote, rather than potentially undermine, equity and inclusion.

3.5.2. Evaluation of policies and programmes

While many countries support the general monitoring and evaluation of programmes targeting equitable and inclusive digital technology, results and outcomes are not as clear for targeted interventions. There tends to be limited research on whether or not policies are successful, and it can also be challenging to determine and measure markers of success. Furthermore, outcomes often take time to become evident (Viennet and Pont, 2017[255]).

Monitoring has generally focused on equity measures of device distribution and access to the Internet as these are easily quantifiable. For example, in Argentina, the Digital Inclusion Policy *Conectar Igualdad* ("Connecting for Equality") gave every secondary student and teacher a netbook. This policy included a teacher training component. However, outcome reporting was based on the number of laptops, not on digital skills or student academic or well-being outcomes (Conrads et al., 2017[208]). In contrast, a rare example is New Zealand, where an e-learning monitoring tool for digital capabilities helps to monitor student digital skills (Conrads et al., 2017[208]).

3.5.3. Development of indicators

Equity and inclusion can be challenging to measure and analyse, and indicators of the two concepts are often challenging to disentangle (Mezzanotte and Calvel, forthcoming[260]). There is a lack of consensus on data indicators to use, and some data are considered sensitive to gather such as information regarding ethnicity or sexual orientation (Ibid.). Therefore, it can be challenging to know how digital technology policies affect equity and inclusion for diverse student groups. Furthermore, data on specific dimensions of diversity can be difficult to gather and compare because countries view diversity through varying cultural and contextual lenses. For example in Portugal, where education policies emphasise inclusive education, a non-categorical method is used to collect data and students are not labelled[16] (OECD, 2022[261]). The reason is that categorising student groups can be reductive, overlook needs and underestimate intersectionality (UNESCO, 2020[227]), although the evidence on labelling is inconclusive as to whether it is harmful or helpful (OECD, 2022[261]).

[16] Labelling refers to the categorisation of students according to characteristics such as immigrant background, SEN, gifted etc.

4. Conclusion

Digital technology has the ability to support all students as they move through education, and can help promote equity and inclusion within systems. However, without support for equity and inclusion, technology can also be yet another barrier if factors such as digital inequalities and inclusive design are not addressed. Policy makers can consider whether the policies they develop and implement aim to promote digital equity in education, digital inclusion in education, use digital technologies to promote equity in education or use digital technologies to promote inclusion in education. In some cases, policy goals will specifically target one of these four categories, whereas in other instances policies will aim to target a combination.

Designing technology for inclusive education includes flexibility and personalisation, if based on sound pedagogy. Many research studies show evidence of how the diverse needs of students can be met with inclusive digital technology. The benefits have exciting potential to support academic and well-being outcomes for students, but many challenges must be addressed. Policy and practices address some of these challenges through governance, resourcing, developing capacity, school-level interventions and monitoring and evaluation. However, many policies are fragmented and not comprehensive.

Despite the rapidly emerging literature on these topics, there remain a number of research gaps that need to be addressed moving forward. These include:

Exploring the potential opportunities and risks of digital technologies for diverse student groups. Currently, there is an abundance of literature on how digital tools can support students with SEN for example, while for other diverse student groups the literature base is lacking. Focusing specifically on how digital technologies can support equity and inclusion for students from other backgrounds is essential, as well as how systems can promote digital equity and inclusion for all students.

Looking more deeply into the potential for digital inclusion of students who identify as LGBTQI+, and those who are gender non-binary. Much of the literature on gender differences in terms of digital technology and inclusion focus on the gender binary, solely on girls and boys. In order to be truly inclusive of all students, especially those who identify as non-binary, more research is needed in this area. More research on how specific interventions can target LGBTQI+ students and build their digital resilience is essential as these students are more likely to experience risks such as cyberbullying.

More research is needed to see how digital tools, especially innovative and emerging technologies, can be incorporated into inclusive and effective pedagogical practices. Simply replacing in-person teaching using digital tools is not the best way forward, and exploring how digital tools can be capitalised upon for their inherent flexibility and accessibility features will be essential when conceptualising inclusive in-person or virtual classrooms. The same is true of assessment, and many systems have struggled with how to appropriately implement digital forms of assessment, especially during the COVID-19 pandemic.

Key issues for policy makers include:

Addressing digital inequalities. Investing in digital infrastructure and ensuring adequate access to digital tools and broadband at home and in schools is important to ensure digital equity, and that all students can engage with increasingly digital curricula. This is especially important post COVID-19 as many education systems are incorporating elements of distance learning. In addressing digital inequalities, parents are also key stakeholders. Supporting parents in upskilling their own digital competences will empower them to

support and guide their children effectively in the digital environment and can help minimise inequalities in this sense.

Investing in developing and adopting digital tools designed with inclusive principles, such as UDL. Investing in digital development that is truly inclusive from the start is important. Building inclusion into already developed products is more complicated than if principles such as UDL are incorporated from the beginning. Policy makers can invest in the development of inclusive tools to improve equity among different student groups, which is a step towards more inclusive education systems. These tools and applications that are inclusive by design should also be prioritised when incorporating digital technologies in education systems.

Investing in teacher professional learning for in-service and pre-service teachers. Teachers consistently report a high level of need for professional learning regarding incorporating digital tools into their practice. Incorporating elements of equity and inclusion into professional learning opportunities about digital technologies will be important, and ensuring adequate training in terms of quality and quantity is essential. Teachers who have high self-efficacy and are comfortable with using digital technologies are more likely to incorporate them into their teaching practice.

Addressing digital risks. Students who are most vulnerable offline tend to also be the most vulnerable online. Addressing digital risks should therefore be high on the policy agenda as education systems move towards inclusivity. Support for students from diverse backgrounds, especially those who may not have access to support from digitally skilled adults at home, is important to provide in the school environment. Positioning schools as hubs for addressing digital risks and harm, and teachers as trusted and digitally competent adults can create an environment where students, especially the most vulnerable, can seek support and recourse when facing digital risks. Co-ordinated regulatory responses to child protection are also important.

There is a clear need for stronger monitoring and evaluation. Integrating national data from varying platforms and sources can be difficult (Chang, 2021[262]). Data for inclusive digital technology can be difficult to define, and can be sensitive and politicised for diverse groups. Indicators can be sensitive, intrusive, or put the respondent at risk. The COVID-19 pandemic meant that implementation of ambitious digital agendas came first, and research regarding effectiveness is slowly emerging. As schools move to keep an increased role of digital technology in education, data collection and measuring effectiveness along the way can help inform future evidence-based policy.

Forging strategic partnerships with other public sector actors and private sector actors with the goal of promoting equity and inclusion. Policy making often happens in silos, and it can be a challenge to coordinate services across different ministries and levels of government (i.e., local to national). Effective digital strategies require the coordination of policies and practices across domains and between levels of government. Establishing strategic partnerships with private sector actors is also important not only to equip classrooms with specific tools that can promote equity and inclusion, but also to stay up to date with the newest innovations in educational technology and how these can be incorporated into the teaching and learning process. Regulating partnerships between public and private sector actors to ensure that education systems do not end up with expensive or lengthy agreements to technological tools they neither use nor need is also important. Strong regulatory policies are also important to ensure that the involvement of private sector actors does not undermine efforts to advance equity and inclusion in education.

Paying close attention to implementation. In some cases policy makers do not give enough thought to the implementation process, and it is at this stage that policies can fail. Thinking carefully about implementation, and how specific programmes can benefit diverse students through their conceptualisation and implementation will be important as systems strive for equity and inclusion.

In conclusion, going forward, how can education be future-ready? Digital technology is evolving quickly, and the COVID-19 pandemic has shown that students, schools and systems require adaptability. The

possibilities for digital tools to be used effectively and innovatively to support student outcomes is promising. So too is the growing understanding of the need for equitable and inclusive education so that all students have the ability to reach their full potential.

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