Digital divide in UK education during COVID-19 pandemic: Literature review

Research Report

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Abstract

The COVID-19 pandemic has had an unprecedented effect on education worldwide. Countries around the world have had to go into lockdown, leading to widespread school closures which required education to be delivered remotely (UNESCO, 2021). Remote education can take various forms, but in many contexts, it has relied on the use of digital technology. In the UK, COVID-19 led to nationwide school closures in March 2020, with most children receiving remote education until the start of the new school year in September 2020. Increases in COVID-19 cases led to a second period of school closure in January 2021, with students again learning remotely until March/April 2021. There are concerns that the move to remote education has led to inequalities in access to learning. Specifically, there are concerns that there is a digital divide, resulting in digital inequality, with already disadvantaged children being most affected. The digital divide has various dimensions: as well as access to devices and internet, digital skills are important, as are external factors such as parental support, teacher skills and learning environment. This report reviews and summarises research that has examined aspects of the digital divide during COVID-19 related school closure in the UK. Given the recency and ongoing nature of the COVID-19 pandemic, there is limited published academic literature examining aspects of the digital divide in education, and so most of the research considered in this report is 'grey literature'. There is evidence of a digital divide in education in terms of access, as well as parent, teacher and learning environment factors, with differences across different school types and groups of students. Very few studies considered digital skills and so this warrants further investigation.

Introduction

The COVID-19 pandemic has had an unprecedented effect on education worldwide. Many individual children have missed school due to exposure to or catching COVID-19, or because of COVID-19 related bereavement. Around March 2020, when the pandemic was declared, countries all over the world went into lockdown with governments mandating that schools be closed, and that education be delivered remotely (UNESCO, 2021). At peak of school closures, on the 15th of April 2020 there were countrywide school closures in 191 countries, and six local school closures, affecting over 1.5 billion children worldwide (UNESCO, 2020). In the UK, and around the world, there are concerns that the move to remote education has led to inequalities in access to learning, with individuals disadvantaged due to sociodemographic characteristics such as social class (van de Werforst, 2020). Lockdowns have meant that most children have experienced remote education, much of which relies on digital technology. Consequently, digital inequality has been a significant issue in education, as many children have not had access to education, or sufficient quality education during COVID-19-related remote education. The link between poverty and digital exclusion is well-established, and many already disadvantaged children have experienced a cumulative disadvantage due to the need for remote schooling (Holmes & Burgess, 2020).

Ofcom (2020) data on UK households from just before the pandemic (9th January - 7th March 2020) found that approximately 9% of households with children lacked access to a laptop, desktop, or tablet; 2% had no access to the internet and 4% had smartphone only access. Children in lower earning households were more affected by these issues: 21% of households with children where the main earner was in semi-skilled or unskilled work had no home access to a laptop or a desktop or a tablet, with 6% having no access to internet at home, and 9% having smartphone only internet access. Consequently, going into the pandemic, children in households where the main earner was in less skilled and lower paid work were far more likely to be affected by digital exclusion during the switch to remote learning.

Furthermore, many teachers and schools were not well prepared for remote education at the start of the pandemic. On the 3rd of March 2020, Teacher Tapp (2020) received responses from 6,375 teachers about their ability to use various forms of technology for remote teaching if schools were closed suddenly. Asked whether they would be able to broadcast a video lesson, 42% responded positively (10% already had access to a platform they could use and 32% felt they could figure it out). Teachers in privately funded schools were better prepared with 70% reporting that would be able to broadcast a video lesson compared to 40% of state school teachers. Similarly, teachers in the most affluent state schools were better prepared with 47% reporting they could broadcast a video lesson compared to 34% in the least affluent (categorised by eligibility for free school meals).

Similarly, when asked about both their ability to set and to accept work remotely 63% and 64% of teachers responded that they would be able to do this. This was higher in private schools (89% and 88%) compared to state schools (62% and 63%). Almost two thirds of private school teachers reported having access to a platform they could use to set and accept work, compared to approximately a third of teachers at state schools. A larger proportion of teachers in the most affluent fifth of schools (categorised by eligibility for free school meals) reported having a platform they could use to set (45%) and accept (37%) work remotely, compared to those in the least (29% and 23%).

Research Aim

This report aims to investigate the digital divide in UK school education during the COVID-19 pandemic and mitigation approaches. First, this report recaps the periods of school closures in the UK since the onset of the Covid-19 pandemic and considers terminology and definition related to the topic of digital exclusion and remote education. This report then summarises and reviews research findings relating to digital exclusion from several reports which have investigated education in the UK during Covid-19.

It should be noted that this report covers research published in the period March 2020-April 2021. The COVID-19 pandemic is ongoing, and the digital divide remains a challenge, although in the UK most children returned to in-person education in March, after the second period of mass school closures and remote education. Furthermore, the recency of the Covid-19 pandemic means that only limited research has been published so far.

Periods of school closure in the UK

It is helpful to recap on the periods of school closure that have occurred in the UK since the onset of the COVID-19 pandemic, to highlight when digital divide concerns have been most pertinent. There have been two periods of almost total school closures and therefore remote education, first in March-June 2020 and second in January-March 2021. Additionally, there have been localised school closures throughout the pandemic, as well as instances of individual children or classes in schools being required to learn remotely from home due to COVID-19 outbreaks. While there have been some differences in the COVID-19 response across the four home nations in the UK there have been broadly similar milestones in the educational response (Cambridge Assessment, 2020a; 2020b; 2020c; 2020d).

March 2020

The first period of COVID-19 related formal school closure in the United Kingdom occurred in March 2020. Northern Ireland began COVID-related school closures on March 9th, and by the 23rd of March educational institutions across the UK were required to close for in-person schooling (Cameron-Blake et al., 2020). The only exception to this was a small amount of in-person provision available for vulnerable children and the children of keyworkers (Cambridge Assessment, 2020a). National exams were cancelled, and teaching became remote, with much of this relying on digital technology (Cambridge Assessment 2020b; 2020c). Although in England

and Wales they began phased reopening of schools in June, to allow some children to return for the remainder of the summer term, it was not compulsory and most children in the UK did not return to school until the start of the new school year in August or Early September (BBC, 2020a, 2020b; Cameron-Blake et al., 2020).

August 2020-December 2020

In August and September 2020 schools began opening for in-person teaching for the start of the first term of the 2020-21 school year, with a return to in-person schooling being compulsory (BBC, 2020c). To minimise the spread of COVID-19 outbreaks, many schools have adopted 'bubble' systems, so that students and staff mix in smaller distinct groups (Department for Education, 2021a). Despite attempts to minimise Covid-19 spread, local instances of COVID-19 outbreaks and the need for children and teachers who had contact with COVID-19 positive people to isolate, meant that some children, or whole cohorts of children, continued to have periods of remote education throughout this term. For example, in mid-November, TES reported that at least a third of state schools in England had been affected by COVID-19 cases since the start of the new school term, leading to the need for self-isolation and therefore remote education for some children (Gibbons & Roberts, 2020). In the UK, each of the four nations required schools to have contingency plans to support remote education in the event of the need for further school closures, or for individual children to be out of schooling (Cambridge Assessment, 2020d). Consequently, remote learning continued to occur to some extent during the first school term.

January 2020

With a new variant of COVID-19 causing an increase in cases, by the 5th of January each of the four home nations announced national lockdowns with accompanying school closures, except for vulnerable children and the children of critical workers. This has meant that remote education, much of which has relied on digital technology, went on for most of the second term. Schools in Scotland and Wales began staggered reopening (where year groups' return to school was spread out over several weeks) on the 22nd of February, schools in England reopened fully on the 8th of March in England and schools in Northern Ireland began staggered re-opening on the 22nd of March. While as of mid-April 2021, most students in the UK have returned to in-person teaching, localised school closures and instances of COVID-19 outbreaks mean that remote education will continue to be relevant for some time, with issues relating to the digital divide remaining extremely important. Each of the four home nations have required schools to have plans to support remote education for students in the event of COVID-19 exposure and the need for self-isolation.
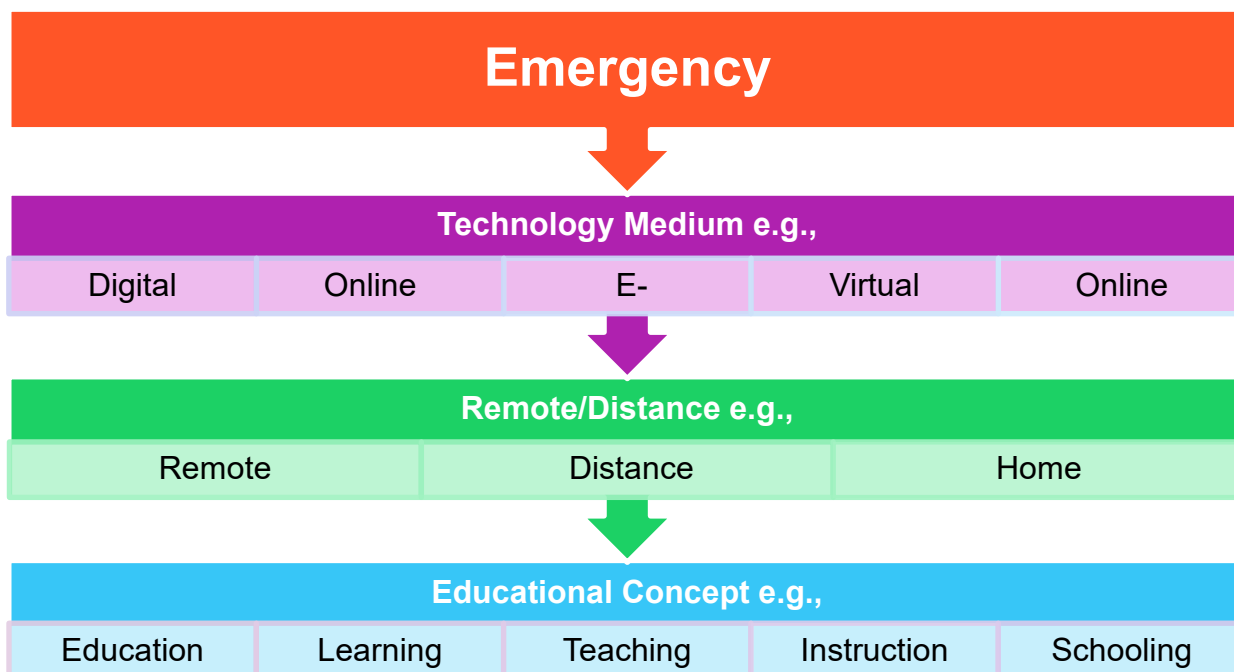
Terminology and Definition

To discuss digital exclusion due to school closures and the subsequent move to remote education, it is necessary to examine the terms used and their definition. There are numerous terms used when talking about the education that is being received outside of a traditional in-person classroom context and which relies on the use of technology. Examples include 'remote education', 'distance learning' and 'online learning'. These various terms are often used interchangeably, and inconsistently defined (Basak et al, 2018; Singh & Thurman, 2019; Anohina, 2005). The problem of terminology has been highlighted during the COVID-19 pandemic and the sudden increase in discussions on remote education, with debate in both public, political, and academic spheres on what terms should be used (Barbour et al., 2020).

Broadly, there seem to be three components of the terms used in this field, although not necessarily in this order or all are used: a technology medium; a word to highlight that the learner is not in the same location as the teacher; and an educational concept. During COVID-19, many researchers have additionally included the word 'emergency' at the start of their term,

to indicate the emergency nature of the remote education. Figure 1 below shows how these components are put together to form various terms for online remote education.

Figure 1. Components of online remote education terms

Emergency				
Technology Medium e.g.,				
Digital	Online	E-	Virtual	Online
Remote/Distance e.g.,				
Remote		Distance		Home
Educational Concept e.g.,				
Education	Learning	Teaching	Instruction	Schooling

Firstly, a word is used to highlight that a technology is used. There are various words used such as digital, online, electronic (often abbreviated to e-) and virtual (Anohina, 2005; Basak et al., 2018; Singh & Thurman, 2019; Moore et al., 2011). These may be accompanied by a connecting term such as 'based', as in web-based learning (Anohina, 2005). A challenge for research here is that these different terms are often used variability, and there are challenges for comparability between and within the terms. For example, 'online' as in online education may sometimes be used specifically to mean live education, such as the use of live-video conferencing (e.g., Green, 2020), while other times it is used more broadly to include non-live online education such as the use of pre-recorded video lessons for students to watch in their own time (Greener, 2020).

Secondly, the word 'remote' or 'distance' is used to signal that learner is not in the same location as the person teaching. The word 'remote' does not seem to have been widespread in these terms until COVID-19 caused widespread remote education to occur worldwide (Barbour et al., 2020). Indeed, one literature review of definitions of online learning used in research from 1988-2018 did not find the word 'remote' in any of the noted synonymous terms for online learning, while both 'distance education' and 'distance learning' were found (Singh & Thurman, 2019). Additionally, others use both together, such as 'remote distance learning' (Greener, 2020). During the COVID-19 pandemic there has also been some use of 'home' such as in 'online home learning' or 'home schooling' (Bond, 2020).

In terms of these first two components, there is often conflation between the two. Terms such as 'distance education' and 'online learning' are often used synonymously, which may be because much of distance education these days occurs online (Singh & Thurman, 2019).Traditionally, 'distance education' or 'distance learning' has been used in the context of 'open' university courses, which have extended access to tertiary education to those who cannot intend in person through providing, originally through non-digital methods such as paper packets and nowadays largely using digital technology such as online platforms (Daniel, 2020).

Similarly, terms which use 'online' or 'digital' may not specify that it is remote as this geographical distance may be assumed, although it is of course possible to have in-person digital education (Greener, 2020). A challenge here is that there is not always clarity and consistency in how these terms are used together, and whether distance or remote education is assumed to rely on digital methods by default.

The third component of terms is an education concept, most commonly 'education', 'learning' or 'teaching', but also other terms such as 'instruction' and schooling. In some cases, 'learning' is used as an umbrella term when they seem to be discussing education more widely. For example, Singh and Thurman's (2019) literature review of online learning found that some of the definitions appeared to refer to online education more broadly, as they included discussion of aspects related to teaching, and in some cases did not even include reference to the concept of learning within them. The term education may be preferable to learning or teaching, as it allows both to be encompassed and allows space for other aspects of education such as assessment, which in some cases are also occurring remotely.

A new term that has emerged during the COVID-19 pandemic is 'emergency remote teaching' which was proposed by higher education researchers who wished to distinguish it from well-planned online or distance learning and education, (Hodges et al., 2020). They define emergency remote teaching as

a temporary shift of instructional delivery to an alternate delivery mode due to crisis circumstances. It involves the use of fully remote teaching solutions for instruction or education that would otherwise by delivered face-to-face or as blended or hybrid courses and that will return to that format once the crisis or emergency has abated.

(Hodges et al., 2020, p.7).

They consider this to be distinct from well-planned and high-quality online education, which existed prior to the pandemic. That said, the adoption of this term does not seem to be as widespread in the school education literature (Bond, 2020). Furthermore, they have since extended their thinking on this, arguing that by now education institutions should have moved from the emergency remote teaching that occurred in Spring 2020, to remote teaching, as they have had time for planning, which still should be differentiated from high-quality online education. They consider remote teaching as "true contingency planning for remote or distance delivery of instruction based on the realities of the pandemic at a given point in time" (Barbour et al., 2020, p.7).

There has been a great deal of variety in the terminology used to discuss teaching and learning carried out remotely during the COVID-19 pandemic. In September 2020, Bond (2020) conducted a rapid systematic review of literature on teaching and learning during COVID-19 and identified 90 studies. As part of this, she examined the terminology used, and found there were 30 different terms used, with 'distance learning' and 'online learning' being the most common, with each being used in 25.6 per cent of the studies, although not necessarily exclusively. This huge variety of terms poses a challenge for research, particularly given that there is also variability in how these terms are being applied and what they are considered to encompass. When looking at the literature on digital remote education during COVID-19, it is also useful to consider the term used to describe what digital remote education is a comparison to. Terms used include 'traditional' (e.g., Greener, 2020), 'face-to face' (e.g., Ofsted, 2021a), 'in-person' and 'offline', or some combination of these alongside 'learning', 'teaching' and 'education'.

As well as inconsistency in which term is used, there is also inconsistency in definition. For example, Singh and Thurman (2019) conducted a systematic literature review of definitions of online learning from 1988-2018 and found 46 different definitions. This highlights that there is a great deal of variation in the field of online or remote learning and education, and which poses a

challenge for research in this area. Ofsted (2021a) defines remote education as "a broad term encompassing any learning that happens outside of the classroom, with the teacher not present in the same location as the pupils". Building on this, they define digital remote education as "often known as online learning, this is remote learning delivered through digital technologies".

An additional consideration is that remote education may not be live or synchronous, and that there may therefore be variation in the nature of the remote education that is being discussed (Singh & Thurman, 2019). Ofsted (2021a) highlight the distinction between synchronous and asynchronous remote education; "synchronous education: this is live; asynchronous education is when the material is prepared by the teacher and accessed by the pupil at a later date". While synchronous remote education will necessarily rely on digital technology, asynchronous does not have to as it could take the form of paper packs sent home. That said, both can be used as part of digital remote education approaches. Which is used may be determined by practical limitations around technology, and teachers often use a mixture of the two.

An additional challenge is lack of clarity in where the boundaries of digital remote education lie. While 'remote education' is typically used to describe situations where pupils are taught remotely from their homes, and are not in a classroom, in the UK during the COVID-19 pandemic it has included situations where a teacher is working remotely and teaching a class of pupils at a school, such as when they (the teacher) are self-isolating or shielding (NASWUT, n.d.). Another term that must be looked at is 'blended learning', which is also sometimes referred to as 'hybrid learning' (Greener, 2020). Blended learning has also been defined in various ways, but most commonly refers to the of a mixture of online and face-to-face teaching and learning (Cronje, 2020; Bowyer & Chambers, 2017). During the COVID-19 pandemic 'blended learning' has also been used to refer to situations where some children are learning from the classroom and in the same location as the teacher, while others in the class are learning remotely from home (usually relying on digital technology), for example because they need to self-isolate.

Singh & Thurman (2019) highlight that this further blurs the line as to what is considered online learning. Their literature review also found that the term 'flipped classroom' as a type of blended learning began appearing in online learning definitions after 2015. Whilst definitions of the 'flipped classroom' vary, broadly it can be understood as teaching model where "activities traditionally done by students outside class (e.g., practicing problem solving) are moved into the classroom session, whereas what is traditionally done in class (e.g., expository, information transmission teaching) is done outside and prior to the class" (Låg& Sæle, 2019, p.1). The "flipped classroom' does not necessarily rely on the use of digital technologies, however many definitions do specify the use of digital technologies, such as pre-recorded instructional videos (e.g., Cheng et al., 2019).

Ofsted (2021a) define blended learning as "a mix of face-to-face and remote methods. An example would be the 'flipped' classroom, where main input happens remotely (for example through video), whilst practice and tutoring happen in class". Consequently, in this report we will consider blended learning as part of digital remote education, as it relies on digital technology in part.

Digital remote education can take many forms beyond the synchronous/asynchronous and blended learning distinctions already discussed. Several authors break down digital remote education into categories. For example, Stanford (2020), describes a 'bandwidth-immediacy matrix', from low bandwidth and immediacy approaches such as the use of email or discussion boards through to high bandwidth and immediacy options such as the use of videoconferencing. Similarly, UNESCO (2020) outline methods from low to high digital maturity, for various aspects of teaching and learning, from methods such as the use of TV or radio programs or text

messaging through to the use of adaptive software programs[1] and live videoconferencing. They make a distinction between the technology options available and appropriate to use for four aspects of education: communicating new assignments and information; teaching new concepts; student practice; and for formative feedback and coaching. UNESCO (2020) highlight how these have been combined in various ways and illustrate that there has been a wide variety of approaches that have been used within and between different national contexts. Overall, this highlights that 'digital remote education' is a broad concept with many varieties in what it looks like in different contexts.

Defining Digital Divide and other terminology

There are various terms that have been used when looking at the issue of discrepancy in some people in society lacking or having insufficient or poor-quality access to and use of digital technologies. Terms such as 'digital divide', 'digital exclusion' and 'digital inequality' are often used interchangeably and poorly defined (Sanders, 2020). The digital divide is a concept that is particularly well-established in the field and used as a common term for discussing access, or lack thereof, to digital technologies. Its origin has been traced back to 1995, when it was first used in the US to talk about the 'haves and have nots', in terms of access to digital media (van Dijk, 2020a). While there are numerous definitions, broadly it can be understood as "a division between people who have access and use of digital media and those who do not" (van Dijk, 2020a, p.2). One common misunderstanding is that it represents a binary division between two categories, the digitally included and the digitally excluded. Instead, van Dijk argues that it is best understood as a complex and multifaceted concept, with multiple dimensions and degrees of digital exclusion and inclusion (van Dijk, 2020a). The term 'digital inequality' is also often commonly used, to describe the inequalities in access to and use of digital media, that is the inequalities in the extent to which some individuals are digital excluded or included.

There have been various conceptualisations and frameworks of the digital divide (Talaee & Noroozi, 2019). One of the most used is a four-layered framework proposed by van Dijk (2002) which distinguishes between four kinds of access, and which will be used here. The original model has been expanded on by van Dijk and colleagues, and while the original conceptualisations of the digital divide focused on access, it has been increasingly expanded to look at divides in the use of digital media.

The 'first-level digital divide' is in relation to access. While originally access was conceptualised in terms of physical access to devices and internet, it has since been expanded to a broader concept of 'material access', recognising that there has been an expansion in types of digital technologies and that the quality of access they provide is variable. For example, it is more challenging to access and engage in digital remote education through a mobile phone than a laptop due to the screen size and small keyboard. Similarly, a laptop which is equipped with up-to-date software, a webcam and a microphone provides greater access than one without these features. Furthermore, it considers aspects such as conditional access, such as whether children have to share the device, or have the means to maintain the use of the device (van Deursen & van Dijk, 2018; van Dijk, 2020a) and issues of data poverty, which is where individuals, communities or households "cannot afford sufficient, private and secure mobile or broadband data to meet their essential needs" (Lucas, P., et al., 2020, p.5). There has also been an expansion of the first level digital divide to include 'motivational access', also termed mental or attitudinal access (e.g., van Dijk, 2002). This refers to an individual's motivation or attitude towards using technology and includes factors such as technology anxiety (Ghobadi & Ghobadi, 2013; van Dijk, 2005).
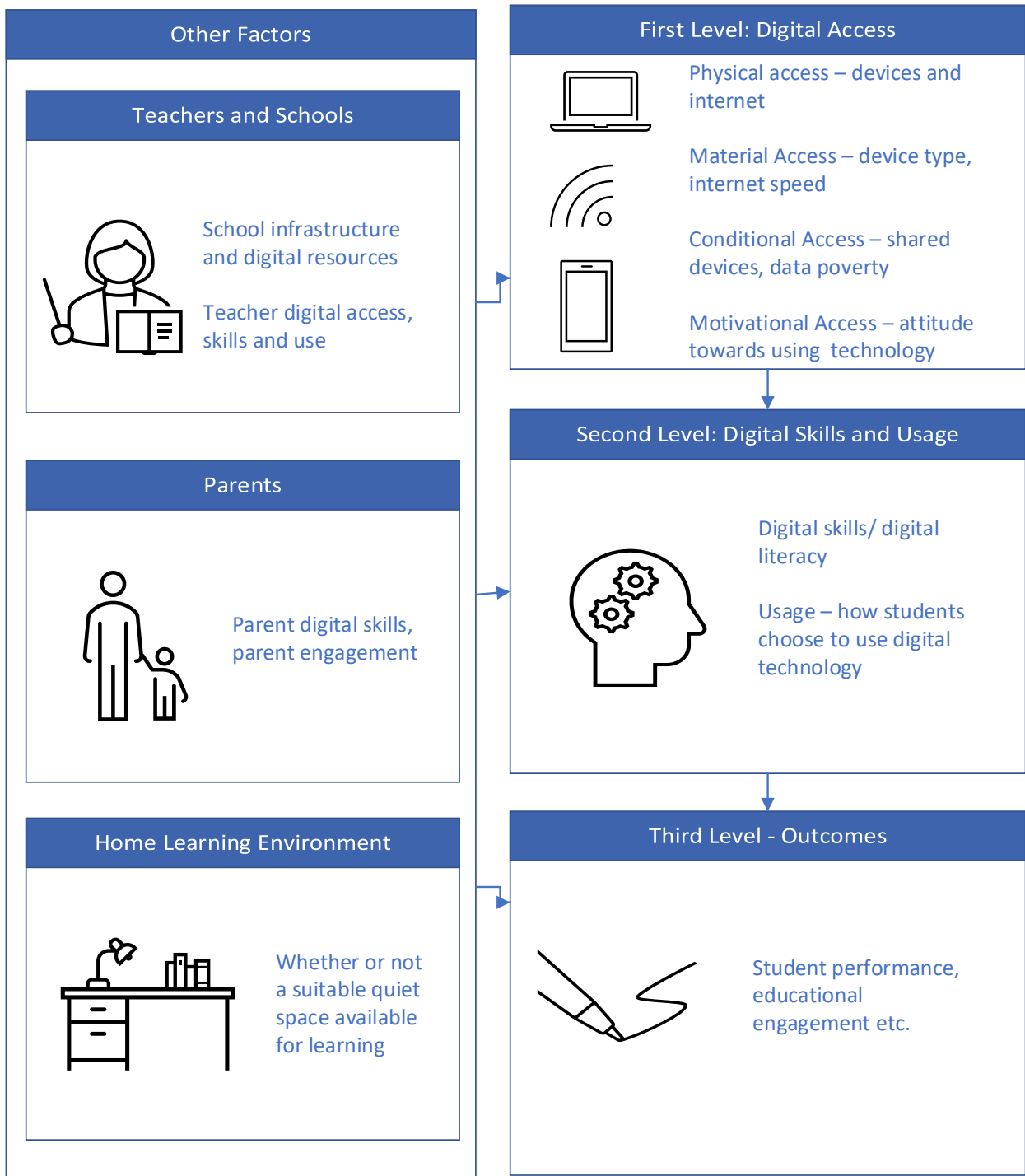
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[1] Examples given include the ViLLE platform developed and used in Finland and several AI based platforms used in China (UNESCO, 2021)

While originally, definitions of the digital divide focused on physical access to digital technology, increasingly definitions emphasise discrepancies around usage. Researchers now recognise a 'second-level digital divide' which concerns digital skills and types of usage of digital media (van Deursen & van Dijk, 2013). van Dijk (2002; 2020a; 2020b) argues that the first-level digital divide is easier to address as this focuses on increasing access to digital technologies. However, many argue that access is not the main driver of digital inequalities, with digital skills/literacy being increasingly important in the extent to which individuals are digitally excluded (van Dijk, 2006; van de Werforst, 2020). While it is often assumed that children are 'digital natives' and have strong digital skills, this is not always actually the case, and so digital skills/literacy remain an important factor in the digital divide in education (ECDL, 2018). In terms of usage there may be gaps both in terms of the frequency of use of digital technologies, and the nature of their use, such as whether for learning or entertainment purposes. For example, even where children have access to computers and to the internet there is evidence of a social group divide in the nature and quality of such computer use (Talaee & Noroozi, 2019). That said, this dimension is less relevant in the context of remote digital education where schools specify the nature of digital technology use; however, difference in digital use more generally will likely interact with the digital skills that individual children possess.

More recently, researchers have discussed the concept of the third-level digital divide, which relates to the outcomes of technology access, skills, and usage (van Dijk, 2020b). The third-level digital divide seeks to understand the impact that digital divide has on offline inequalities, it relates to "gaps in individuals' capacity to translate their internet access and use into favorable offline outcomes" (van Deursen and Helsper, 2015, p.30). For example, in the context of education, it can be understood as the effects of technology access, skills and use on educational performance (van der Werfhorst, 2020).

When discussing the 'Digital Divide' in the context of children's experience of remote online education, during the current COVID-19 pandemic, a variety of other social and environmental factors also impact the extent to which a child is digitally excluded. Some researchers have hypothesised this in terms of a 'fourth level' digital divide, relating to the impact external parties and environments have on the digital divide (van de Werfhorst, 2020). When considering the digital divide in remote education, the surrounding context is an important factor in the extent to which children are digitally excluded (Talaee & Noroozi, 2019). Children whose parents do not have the digital skills and time to support them in digital remote learning are more likely to be digitally excluded. Similarly, the home learning environment will impact upon digital exclusion. For example, children who are learning in the same room as siblings who are also remote learning or parents who are remote working, may be less able to participate in digital remote lessons, as they may be affected by noise or unable to verbally participate in live video conferencing lessons. Factors relating to teachers and school also impact digital exclusion. Children who attend schools which lack appropriate infrastructure to support digital remote learning may be more digitally excluded, as compared to their peers in better equipped schools. Similarly, teachers' access, skills and usage of digital technologies will impact the methods they choose for digital remote education. Consequently, some children will have access to poorer quality digital remote education than others. Figure 2 summarises how the digital divide might apply in the context of Education during COVID-19 related remote learning.

Figure 2. Digital divide in education during remote learning

Other Factors	First Level: Digital Access
Teachers and Schools	Physical access – devices and internet
School infrastructure and digital resources	Material Access – device type, internet speed
Teacher digital access, skills and use	Conditional Access – shared devices, data poverty
	Motivational Access – attitude towards using technology
Parents	**Second Level: Digital Skills and Usage**
Parent digital skills, parent engagement	Digital skills/ digital literacy
	Usage – how students choose to use digital technology
Home Learning Environment	**Third Level - Outcomes**
Whether or not a suitable quiet space available for learning	Student performance, educational engagement etc.

Definitions

In this report we will use the term 'digital remote education' as used by Ofsted, adapting the definition to include blended learning which may include some students being in the same location as their teacher.

Digital remote education can be understood as education that is happening outside the physical classroom, where the teacher is not present in the same physical location as the pupils, and which is delivered through digital technologies. This includes any blended learning that relies on digital technology such as:

- when students receive a mixture of in-person and remote teaching;

- when students are in the classroom, while the teacher is remote;
- when some students are present in the classroom with the teacher, while others join in remotely.

This report considers the digital divide in remote digital education during the COVID-19 pandemic. In this context the digital divide can be understood as the various dimensions and degrees by which children may be digitally excluded in terms of sufficient quality access to and skills to use digital technologies for education. The extent to which an individual child is digitally excluded will also be impacted by factors relating to their parents, learning environment, and their teacher and school.

Methodology

In the first instance, academic databases were searched in order to identify studies on the topic of digital exclusion during COVID-19. From this it became apparent that there is limited academic literature published on the impact of COVID-19 on education yet. This is illustrated by a systematic literature review by Bond (2020). At the end of September 2020 Bond (2020) conducted a systematic literature review of articles that had been published about school-level remote education during COVID. The review found 89 empirical or primary research-based studies, with 12 per cent of the studies being UK based. This illustrates that there is not a great deal of academic literature which has been published yet, which is unsurprising given that the COVID-19 pandemic is recent and ongoing. Additionally, it is more limited when focusing on specific aspects, such as digital exclusion, or on specific national contexts.

Consequently, this review then moved to focusing on reports published by educational organisations within the UK primarily found through their reference in newspaper articles, blogs posts, mailing lists etc. Table 1 summarises the reports and literature found, outlining when the research was conducted and who the sample were. Most of these reports were not focusing on the digital divide or digital remote education, but rather were looking at remote education during the COVID-19 pandemic more generally and included some reference to aspects relevant to the digital divide. In some cases, multiple reports from the same organisation were found often drawing from the same data, or with new data building on previous findings. In these instances, the most up-to-date report published by the organisation was used.

In total 13 reports and articles were found which had research findings relevant to the digital divide. Findings from each report were identified and summarised focusing on three specific dimensions of the digital divide: digital access; digital skills; parent, teacher and learning environment factors. Additionally, findings discussing the divide in student engagement are included, as differences in student engagement in remote learning may in part be explained by the digital divide. Finally, reference to approaches to mitigating digital exclusion were also identified and included in this report. Within these various reports there is variation in the terminology used to describe digital remote education and differences in what is being investigated. The studies have taken different approaches to defining concepts such as disadvantage, deprivation and poor, and are not always consistent within themselves as to which terms they use. When reporting on the findings, each study's original terminology is used to most accurately reflect its particular findings.

Table 1. Literature included in this review.

Citation	Organisation	Country	Data collection date	Description of study method and sample
Cambridge Partnership for Education [CPE] (2021)	Cambridge Partnership for Education	UK, primarily England	April-September 2020	A series of surveys and questions over six months (April-September), gathering responses from 1,766 respondents in the UK. These were educators, educational leaders, policy makers, parents, school governors, students and Ed Tech developers.
				46 semi-structured interviews with educators and educational leaders, 9 from independent schools and 37 from state schools. These were primarily in England, with 2 being in Scotland.
				31 semi-structured interviews with parents of children in England, although one was in Northern Ireland.
				Collaborated with Teacher Tapp and Parent Ping to circulate three questions in September 2020.
Lucas et al. (2020)	National Foundation for Educational Research (NFER)	England	7-14 May 2020	NFER conducted 'Wave 1' data collection in May 2020, sending out a survey to all state funded mainstream primary and secondary schools in England. Gathered responses from 1,233 senior leaders and 1,821 teachers, in 1,462 primary schools, and 691 secondary schools. This represents 9% of primary school and 20% of secondary schools.
Julius & Sims (2020)		England	7-14 May 2020	As part of this research several reports were produced focusing on different aspects, two of which are included here as they contain findings relevant to the digital divide. See Nelson & Sharp (2020) for summary of key findings across the reports.
				This research looked at difference in relation to deprived schools, grouping participants into quintiles based on proportion of students with free school meals eligibility (FSM). Disadvantaged students are also defined in terms of eligibility for FSM. Julius & Sims (2020) looked specifically at vulnerable pupils, defined as

Citation	Organisation	Country	Data collection date	Description of study method and sample
				those with an Education, Health and Care Plan (EHCP), a social worker or identified as vulnerable by the local authority of education provider.
Sharp et al. (2020)		England	8-15 July 2020	NFER conducted 'Wave 2' data collection in July 2020, sending out a survey to all state funded mainstream primary and secondary schools in England. This gathered responses from 1,176 senior leaders and 1,782 teachers in 1,305 primary schools and 898 secondary schools, representing 7.6% of primary and 26.5% of all secondary schools.
Green (2020)	Centre for Learning and Life Chances in Knowledge Economies and Societies (LLakes)	UK	Last two weeks of April 2020	Used data from The UK Household Longitudinal Study (UKHLS). This is a long-standing study which has gathered annual survey data from a panel of households since 2010. This report discusses outcomes from the first month of an online COVID-oriented survey of all panel members which included questions on pupil schoolwork. This report focusses on responses regarding 4,559 children, from their parent or other household member responses.
Cattan et al (2021) Feb	Institute for Fiscal Studies (IFS)	England	Wave 1: 29th April – 20th June (90% responses	Online survey of parents of school-aged children in England, in years groups Reception, 1, 4, 5, 8, 9 or 10 in the 2019-20 school year, gathered by two survey companies. Wave 1: 4,316 respondents. Wave 2: 927 respondents, all of whom were also in Wave 1.

Citation	Organisation	Country	Data collection date	Description of study method and sample
			collected before May 15th[2]) Wave 2: 26th June- 26th July (70% of responses came in the first 6 days)	
Montacute & Cullinane (2021)	The Sutton Trust	England	Public First poll 1-3rd April 2020 Teacher Tapp: March/April 2020[3] Teacher Tapp survey: 7th-15th January 2021 YouGov survey: 13-14th January 2021	This report uses data from a Teacher Tapp survey of 6,475 teachers in schools in England, and of 1,500 senior leaders in schools; and YouGov poll of 877 parents of children aged 5-18. This report uses income quintiles to compare private schools and state schools from most affluent to most deprived.
Parkin et al. (2020)	Edurio	England	June-July 2020	Survey of 45,338 respondents in 277 schools. Included 22,729 parents, 14,432 pupils and 8,177 staff.

[2] Note, although this study states that Wave 1 used the same sample of participants as in Andrews et al (2020b), the number of participants included is not exactly the same. There are two other reports (Andrew et al (2020a), Andrews et al (2020b)) and a journal article (Andrews et al (2020c)) which relate to the first wave of this research. The Cattan et al (2020) report is used here as this discussed both Wave 1 and 2 findings.

[3] These findings were first discussed in Cullinane & Montacute (2020) report on March/April Teacher Tapp survey data and PublicFirst/Sutton Trust poll of 1,508 UK adults with children aged 2-18 from 1-3rd April 2020.

Citation	Organisation	Country	Data collection date	Description of study method and sample
Müller & Goldenberg (2020)	Chartered College of Teaching	England	7th May-5th June 2020	Online survey of 1,797 members of the Chartered College of Teaching. Follow up focus groups with 29 of the participants.
Ofsted (2021b)	Ofsted	England	Summer/autumn 2020	Commissioned YouGov to carry out several strands of work in summer and autumn 2020, in England. These were: 1. Semi-structured interview with four leading experts. 2. Semi-structured interviews with school leaders during interim visits, evidence form 789 visits. 3. Semi-structured interviews with remote education leads in 25 schools. 4. Teacher and parent questionnaires–1,003 teachers, 2,020 parents in England. 5. Structured interviews with 20 teachers from the questionnaires. 6. Focus groups with Ofsted inspectors. 7. Focus groups with 7 digital leaders from Ed tech demonstrator schools.
Children's Commissioner for Wales (2021)	Children's Commissioner for Wales (2021)	Wales	Mid-January 2021	Survey of 167 school and college leaders in Wales. 30 were secondary school teachers, 125 primary and 7 were other.
Walsh et al. (2020)	Centre for Research in Educational Underachievement	Northern Ireland	28th April – 8t h March	2,035 respondents, parents, and guardians/carers of children.
Couper-Kenney & Ridell (2021)	Academic researchers	Scotland	June/July 2020	16 case studies of families including a child with Additional support needs and disabilities (ASND), based on email and on-line interviews. The families included 35 children, 24 who had ASND.

Findings and Discussion—Digital Divide during COVID-19 pandemic

What has remote learning looked like?

To understand the impact and extent of the digital divide in UK education during the COVID-19 pandemic it is important to examine what remote education has looked like at this time, and to what extent digital methods have been relied upon. As outlined in The UK's use of remote digital education is broadly in line with what has been seen globally. A survey of government officials in 118 countries between May and June 2020, and 149 countries between July and October provides useful insight into global approaches. 95% of high-income countries reported using online platforms as the main approach to remote learning, followed by take home materials (89%). This differed from low-income countries which relied on the use of low-maturity digital devices such as radio (93%) and television (92%) (UNESCO, UNICEF & The World Bank, 2020). While the digital divide is a concern everywhere, challenges around digital access are particularly pertinent in low-income countries where most students may have only very limited access to high-maturity digital devices, which therefore greatly limits opportunities for digital remote education.

Table 2, a variety of remote education approaches were being used many of which relied on digital technology. In the first period of remote education, most schools were using some form of digital remote learning. As illustrated in several of the reports, there was variation in the types of digital remote education strategies. Findings by Lucas et al. (2020) highlight a digital divide, with deprived schools less likely to be using digital approaches in the first lockdown. There were also differences across school level, primary schools were less likely to be using digital remote learning approaches than secondary schools (Lucas et al., 2020; Sharp et al., 2020; Ofsted et al., 2021b). Consequently, the digital exclusion for secondary school children is likely much greater than in primary.

Findings by Cattan et al. (2021) suggest that type of remote education provision was consistent from March to July 2020 with a variety of digital remote education approaches used, as well as the use of physical resources. However, in the January 2021 lockdown there appeared to be a shift in school provision with an increase in more 'active' digital remote learning strategies such as the use of live lessons using video conferencing software (Montacute & Cullinane, 2021). Additionally, this research highlights that there was a gap in remote provision between private and state schools. Whilst the gap had reduced in some aspects such as in the use of online platforms to set and collect learning activities, it had widened in other aspects, with private schools much more likely to be holding live online lessons. These differences in provision between state and private schools, and between state schools of different levels of deprivation illustrate the digital divide between schools (Montacute, & Cullinane, 2021). In some cases, schools may choose to take physical resources remote education approaches for all or some students due to digital divide challenges (Ofsted, 2021b). For example, Julius & Sims (2020) found that many schools were providing physical resources for their vulnerable students, and that this was higher in the most deprived schools. It seems that where schools were aware of individual students facing digital divide challenges, such as limited access, they sought to provide different education options for them such as delivering physical resource packs to them. However, these children are therefore disadvantaged compared to their peers who may have the opportunity to engage in more interactive digital remote education. Taken together, the difference in types of remote education provision could illustrate both a consequence of the digital divide, and a form of digital divide in itself: children who are more digitally excluded but

are attending schools with high levels of digital remote education provision might be the most disadvantaged of all.

Online safety and privacy concerns were highlighted by the CPE (2021) research as a reason many state schools were not carrying out live lessons. Concerns about online safety and privacy in remote education have been seen worldwide, particularly at the beginning of the pandemic. Instances of 'zoombombing' where strangers joined classrooms to share inappropriate content occurred highlighting potential risks of live lessons (Gibbons, 2020). The DfE has offered guidance on safeguarding procedures during coronavirus, and state that whilst some schools have had concerns around live lessons, they do not have additional safeguarding risks if managed well (2021b). Privacy concerns for both students and teachers have also been an issue. The NASUWT, the Teacher's Union highlights concerns about privacy and data protection issues when live teaching to pupils in their homes. They state members that they should not be forced to teach via livestreaming and give recommendations as to conditions which must be in place if live streamed lessons are carried out (NASUWT, n.d.).The UK's use of remote digital education is broadly in line with what has been seen globally. A survey of government officials in 118 countries between May and June 2020, and 149 countries between July and October provides useful insight into global approaches. 95% of high-income countries reported using online platforms as the main approach to remote learning, followed by take home materials (89%). This differed from low-income countries which relied on the use of low-maturity digital devices such as radio (93%) and television (92%) (UNESCO, UNICEF & The World Bank, 2020). While the digital divide is a concern everywhere, challenges around digital access are particularly pertinent in low-income countries where most students may have only very limited access to high-maturity digital devices, which therefore greatly limits opportunities for digital remote education.

Table 2. Remote education during COVID-19

Study	Date/Location	Research Findings
CPE (2021) 46 interviews with educators 31 interviews with parents 1,766 educational stakeholders	England, April-September 2020	Interview data revealed that many schools had initially responded to the lockdown by providing downloadable resources, links to resources on the school website and/or learning platform and increased their use of already available apps and resources. As lockdown went on there was a move towards increased use of pre-recorded videos and some use of live lessons. All the private school participants reported that their school was providing live lessons, while most in state schools were not providing these, due to challenges around technology and internet access, lack of resources in the school or poor infrastructure, concerns around online safety and privacy and also challenges of covering both remote and in-person lesson for key worker children. Survey data revealed that 47% of educators reported that the school was providing live lessons using video or audio-conferencing systems, 43.93% were marking work submitted digitally, 39.12% were providing downloadable activities on the school learning management system/app, 21.23% reported using subject specific software, 12.95% reported providing technology to help students to talk to and support one another.
Lucas et al. (2020) – NFER	England - May 2020	**Communicating with students/parents about learning activities** A variety of remote learning approaches were being used to inform students about remote learning activities: 86% senior leaders reported that emails/texts were being used; 80% that the school website was used to share resources, 69% that they

Study	Date/Location	Research Findings
1,233 school leaders 1,821 teachers		were having telephone/video calls home, 52% reported use of a virtual learning environment (VLE), 47% reported staff deliveries/visit to pupil homes, 26% were posting resources home. The most deprived schools, as measured by FSM eligibility, were significantly more likely than the least deprived schools to be using the school website as a method of notification (85% vs 73%). They were more likely to be using labour intensive methods such as making phone or video calls to individual students (74% vs 60%); delivering to/visiting pupil homes (55 vs 35%) and using postal services (33% vs 17%). They also looked at differences by phase of schooling and found that secondary leaders were more likely to report using a VLE as a method of communicating learning activities than primary (71% vs 48%). **Delivering remote learning: teaching and learning approaches** Most schools were using materials produced by external providers such as from educational websites or apps (92%) or pre-recorded video lessons (90%). They were less likely to be producing their own pre-recorded lessons (44%), live remote lessons (14%) or holding online conversations (37%). Senior leaders in the most disadvantaged schools were significantly less likely than the least deprived to report that their teachers were: providing live lessons (7% vs 15%); having online conversations with pupils (30 vs 42%) and pre-recording video lessons (3% vs 51%). They were also significantly more likely to be using physical resources such as workbooks, sheets and resources (86% vs 74%). They also noted regional differences in digital remote learning provision, which appeared to link to relative deprivation in these regions, and therefore to the extent of access to digital technology. There were also differences between secondary and primary schools, with secondary more likely to be providing live remote lessons (33% vs 10%); having online conversations (46% vs 35%) and pre-recording lessons (55% vs 42%).
Julius & Sims (2020), NFER 1,233 school leaders 1,821 teachers	England - May 2020	Most schools were using printed resources and worksheets to support those vulnerable pupils who were learning remotely (84%). This was higher in primary (84%) than in secondary schools (77%). This was higher in the most deprived schools (88%) compared to the least (73%).

Study	Date/Location	Research Findings
Sharp et al. (2020), NFER 1,176 school leaders 1,782 teachers	England - July 2020	Secondary teachers were more likely than primary teachers to be accessing online content from other providers (48% vs 65%). They were however more likely than primary teachers to be engaging in interactive and therefore digital remote methods including listening to/watching a live session (36% vs 10%), working collaboratively with teachers (23% vs 10%) and working collaboratively with other pupils (8% vs 4%).
Cattan et al. (2021), IFS Wave 1: 4,316 parents Wave 2: 927 parents	England – W1: April-June 2020 W2: June/July 2020	School provision was largely consistent between waves 1 and 2 of data collection. Access to active provision (online class, video conferences, online chat) did increase slightly overall across waves for both primary (44% up to 51%) and secondary (59% up to 65%), although online classes provision actually fell for primary students (34% to 27%).
Montacute & Cullinane (2021), Sutton Trust 6,475 teachers 1,500 senior leaders 877 parents	England – March/April 2020 and January 2021	19% of parents reported that their child was attending school in person for some, or all of the time, so most children were remote learning. School provision for remote learning has changed. There was no longer any difference between private and state schools in use of online learning platforms to set and collect work, 71% of state schools and 70% of private schools in January 2021 compared to 63% of state schools and 77% private schools in March. 54% of teachers reported using online live lessons compared to just 4% in March 2020. 86% of private schools using live online lessons compared to 50% in state schools, with the gap having widened since the first lockdown when they were 28% of private schools and 2% of state schools. Use of offline methods had changed, just 15% reported using physical workbooks in January 2021 compared to 34% in March 2020.
Parkin et al. (2020) 22,729 parents 14,432 pupils 8,177 school staff	England, June-July 2020	Staff were asked about how teaching had been delivered with 67% of primary and 81% of secondary teachers using tasks set in digital platforms, 50% primary and 53% secondary were sharing video materials, 32% primary and 51% secondary were holding online lessons, and 25% primary and 36% secondary were recording video lessons. Physical delivery of written exercises was reported by 37% primary and 25% secondary staff. The teachers were also asked about the types of activities they had used digital technology for. 81% of teachers were using it to communicate with pupils, 77% were using it to provide access to learning materials, 61% were preparing explanations or demonstrations, 5% were receiving pupil work and providing feedback, 44% were providing work.

Study	Date/Location	Research Findings
		40% of teachers reported that technical issues had sometimes disrupted their work, and 21% said they were disrupted quite or very often.
Ofsted (2021b) 1,003 teachers 2,020 parents Various interviews and focus groups	England, Summer-Autumn 2020	Teachers were asked what approaches their school was offering for remote learning. Most common for secondary school was live video lessons (74%), blended learning approach (67%) and links to external websites/resources (69%). For primary schools it was a blended learning approach (67%), links to external websites and resources (69%) and video assemblies (62%). 63% of primary schools were using physical remote learning resources and 49% of secondary schools. Some school leaders reported that their school used primarily digital asynchronous learning such as pre-recorded lesson as a deliberate choice to reduce pressure on parents, as this is easier where multiple siblings sharing a device etc. A small number of schools offered primarily non-digital asynchronous remote lessons; teachers delivered paper-based work packs. Just 46% of schools said they offered additional remote learning arrangements for pupils with SEND (Special Educational Needs and Disability). During interviews with school leaders, some explained they were not providing digital remote education, and were instead more paper-based for a number of reasons including due to concerns about overload for children with SEND; concerns about suitability of digital remote education for early years children; and in schools who had difficulties in getting adequate digital access for their pupils. Leaders from 2 special schools reported they were focusing on making learning tangible rather than digital. Arranged to do things like recording voice messages, so they could hear their voices,

Extent of digital exclusion

Digital access

As shown in Table 3, during the first period of remote schooling, most schools had challenges around digital access with at least some pupils having limited or no access or devices, or had challenges around access to quality internet coverage (Lucas et al., 2020; Green, 2020; Cattan et al., 2021; Müller & Goldenberg, 2020; Ofsted, 2021b; Couper-Kenney & Ridell, 2021; Walsh et al., 2020). This was seen throughout the first period of remote schooling from March through to July. Cattan et al. (2021) found that most students had the same access to resources across their two waves of data collection in 2020, although the proportion of secondary students with access to a computer or tablet showed a small increase.

A digital divide in access was apparent both across and within schools. The most deprived state schools reported more students with limited access to IT (Lucas et al., 2020; Sharp et al, 2020)

and students in state schools had more challenges around device and internet access than private schools (Montacute & Cullinane, 2021). Similarly, a larger proportion of wealthier students had access to devices compared to less well-off students (Cattan et al., 2021). Inadequate access to devices remained a challenge in January 2021 and was reported to have an increased impact due to an increase in the amount of live video-conferencing lessons being held (Montacute & Cullinane, 2021; Children's Commissioner for Wales, 2021). There remained a digital divide between students in private schools and state schools, and while access to devices improved amongst private school students it did not amongst state school students, thus widening the gap between them (Montacute & Cullinane, 2021).

Montacute & Cullinane (2021) specifically looked at the teacher's perceptions of the extent to which students' lack of engagement in remote learning could be explained by lack of access to devices. While over half of teachers in the most deprived secondary state schools felt this was a problem, just 10 per cent of those in private schools did. This highlights a school level digital divide and illustrates that those children in private schools were having fewer challenges around digital access, and subsequent impact on their engagement in learning.

While access to internet and devices such as computers or tablets was examined in many studies, research by Parkin et al. (2020) highlights that for some students, lack of access to a printer was an additional technology access challenge. This highlights that even where students are learning online, there may still be some reliance on turning these into physical resources, with those students without a printer being disadvantaged.

Table 3. Digital access

Study	Date/Location	Research Findings
Lucas et al. (2020), NFER 1,233 school leaders 1,821 teachers	England, May 2020	Senior leaders and teachers were asked what proportion of students had little to no IT access at home, with senior leaders reporting an average of 23% and teachers 27%. There were double the number of students with little to no IT access in the most deprived schools compared to the least (39% vs 19%).
		86% of senior leaders and 76% of teachers reported that their school had at least some students with lack of limited home access to IT, showing that IT access was a concern in most schools. This was higher in the most deprived schools compared to the least (93% vs 73%).
Sharp et al. (2020), NFER 1,176 school leaders 1,782 teachers	England, July 2020	Senior leaders reported that 28% of their students had little to no access at home. This was higher in the most deprived schools compared to the least (43% vs 18%).
Green (2020), LLakes Parents of 4,559 children	UK, April 2020	97% of private school students had access to a computer at home. 20% of students on free school meals had no access to a computer at home, compared to 7% of other children.

Study	Date/Location	Research Findings
Cattan et al., (2021), IFS Wave 1: 4,316 parents Wave 2: 927 parents	England, Two waves April/May and June/July	Less than two thirds of students had access to a computer or tablet whenever they needed it for schoolwork in Wave 1. 72% of the richest fifth of students had access to a device at the start of the pandemic, compared to 62% of the poorest. They compared Wave 1 and Wave 2. They found that most children had the same access to resources in June/July as they had had in April/May, although the proportion of secondary students with access to a computer/tablet whenever they needed it rose by 10% points.
Montacute & Cullinane (2021), Sutton Trust 6,475 teachers 1,500 senior leaders 877 parents	England, March April 2020 and January 2021	5% of state school teachers reported that all students had access to an appropriate device or remote learning compared to 54% private schools. This has widened since March/April 2020 (4% in state school's vs 42% in private). The proportion of teachers reporting that more than a fifth of students lacked sufficient access to devices had risen from 13% to 18% which may relate to changes in demand for devices, due to an increase in use of live and more interactive forms of digital remote education. 5% of state school teachers reported that all of their students had access to the internet compared to 51% of private school teachers. 19% parents reported that children did not have a sufficient number of suitable devices (35% lowest incomes, 11% of those in highest) Lack of access to suitable technology was given as a reason for poor student engagement in remote learning was reported by 42% of teachers. This varied across school types, 55% of teachers in the most deprived secondaries reported this compared to 37% in the most affluent and 10% in private schools.
Parkin et al. (2020), Edurio 22,729 parents 14,432 pupils 8,177 school staff	England, June-July 2020	92% of primary and 93% of secondary pupils reported having a computer/laptop or tablet for schoolwork at home. 43% of primary and 72% of secondary pupils had access to a smartphone or webcam (enabling live video conferencing). 64% of primary and 74% of secondary pupils had an internet connection and 47% primary and 53% secondary pupils had a printer. When asked about what they did not have access to at home that would help them learn better, the most common response across primary and secondary was printed materials (23% primary and 27% secondary). This was followed by printers (21% primary and 19% secondary). Lack of access to a computer/laptop was a challenge reported by a minority of pupils (15% primary and 8% secondary) as was lack of a stable internet connection (4% primary and 2% secondary).

Study	Date/Location	Research Findings
		Parents were asked about the main challenges for learning and 40% of primary school parents and 32% of secondary school parents reported that the main challenge was around the need to share devices across family members. Another common challenge was the lack of printing equipment, reported as a main challenge by 36% of primary and 26% of secondary school parents; and lack of stable internet connection was a challenge reported by 17% of primary and 28% of secondary parents.
Müller & Goldenberg (2020), Chartered College of Teaching 1,797 respondents	England, May-June 2020	88% of teachers reported that some of their students do not have access to adequate internet/devices. 20% felt that only half of their students had adequate access to adequate devices/internet. In the focus groups teachers expressed concern that they needed more training to adjust remote teaching to be inclusive and had concerns about those who did not have internet access or only had internet access through mobile phone contracts; those whose parents needed to use the computer for their own work and families where a shared phone was the only access.
Ofsted (2021b) 1,003 teachers 2,020 parents	England, Summer-Autumn 2020	Asked parents about the main challenges for remote learning, 11% lack of access to adequate devices, 11% reported technology compatibility issues, 10% poor internet connection and 2% no internet connection. Asked about devices for remote schooling the most commonly reported was a device provide by the parents themselves (77% of primary parents, 63% of parents of 11-15-year-olds and 53% of parents of 16-18-year-olds). School provided devices were reported by 3% of primary parents and 5% of parents of 11-15-years-old.
Children's Commissioner for Wales (2021) 167 school leaders	Wales, January 2021	26% of school leaders reported that all of their students had access to a device, and 60% reported than less than 10% of their students did not have access to a device. 12% of schools reported than more than 20% of their students did not have access to a device. 64% of school leaders reported that less than half of their students were sharing a device, while 36% reported that more than half were sharing a device. 52% of school leaders reported that some of their students did not have internet access, and 46% reported that some of their students had insufficient data. Qualitative responses indicated that school leaders felt that the January 2021 lockdown had increased access demands for devices, as there had been an increase in live online lessons.

Study	Date/Location	Research Findings
Couper-Kenney & Ridell (2021) Parents from 16 families	Scotland, June/July 2020	Parents reported challenges around access, some of them reported having to purchase or borrow more devices. Those in rural areas reported challenges due to poor internet coverage.
Walsh et al. (2020), CfREA 2,035 parents	Northern Ireland, April-May	98.48% parents reported that they had access to broadband, 1.13% had mobile data only and 0.05% had no access to internet at home. 27.62%parents reported their internet connection was excellent, 43.54% reported that the quality of the internet connection was good, 21.52% rated it as fair and 7.13% rated it as poor. 53.56% of parents reported that their children always used their own personal device to access online learning, 49.34% sometimes or often had to share devices or wait to access online materials, and 1.28% rarely have access. 76.76% had a printer at home.

Digital skills

Most of the studies did not include specific reference to digital skills. Müller & Goldenberg (2020) found that only 44% of teachers reported that all of their students had learnt how to use new technology needed for their remote learning. Edurio research (Parkin et al., 2020) found that parents felt reasonably confident in their child's ability to work with the technology their school was using, with 64% of primary and 62% of secondary parents reporting they had found it easy, although 16% of primary and 17% of secondary parents reported their child had found it difficult. These studies suggest that lack of adequate digital skills might be impeding the ability to engage in remote learning for at least some students. Their focus groups provided further insight into this with teachers having specific concerns about the lack of digital skills for independent online learning amongst those students who were disadvantaged, had SEND or lacked parental support to help them navigate new technologies for learning. While children and young people are often considered to be 'digital natives' and assumed to have strong digital skills research suggests that young people themselves may overestimate their own digital skills and do not necessarily have adequate digital skills to use technology to its best potential (ECDL, 2018).

Consequently, differences in digital skills may be one aspect of the digital divide that is impacting the extent to which children are able to engage in and benefit from online education. Di Pietro et al (2020) investigated the likely impact of COVID-19 on education around the world pulling from academic literature and international data such as PISA. Research suggests that children from poorer socio-economic background tend to have less exposure to digital technologies both at home and at school, and consequently may have less well-developed digital skills. Data from the International Computer and Information Literacy study shows that children from less advantaged economic background perform worse on measures of computer and information literacy and computational thinking than their peers from more disadvantaged backgrounds. Therefore, inadequate digital skills are likely another dimension of the digital divide which is likely to affected children from more socio-economically disadvantaged backgrounds and their ability to engage with online remote education.

Other factors influencing the digital divide.

As shown in Table 4, several of the studies examined teacher, parents and learning environment factors, which may interact with digital divide challenges. Most teachers felt able to support their students in remote learning and were confident in their digital skills (Lucas et al., 2020; Müller & Goldenberg, 2020), however a third lacked confidence in their ability to carry out remote teaching (Lucas et al., 2020; Ofsted, 2021b). While not specific to digital remote education, this suggests that training for teachers would have been beneficial, considering both technical and pedagogical aspects of digital remote education. As highlighted by the Edurio study (Parkin et al., 2020), approximately half of teachers felt they had received all the support they needed from senior leadership however, some teachers suggested they would benefit from various training related to digital remote learning suggesting that there were some gaps. Another teacher factor highlighted by the Edurio study was teachers' own access to digital technology, as although most school staff had access to a device, only 80% reportedly had access to an internet connection for remote working[4], and so may have been relying on smartphone data.

There were concerns around parental engagement in home learning, this was reported to be more of a challenge in state schools, particularly in the most deprived, compared to private schools (Lucas et al., 2020; Julius & Sims, 2020, Montacute & Cullinane, 2021). While this did not specifically consider engagement in digital remote learning, parental engagement may be particularly important in mitigating the digital divide. For example, where children do not have adequate digital skills or access, parental engagement is important in helping them to navigate these digital divide challenges.

Parents themselves were aware of these issues with 41% reporting that they did not have time to help support their child's learning (Montacute & Cullinane, 2021), and with parents giving themselves fairly low confidence ratings in their ability to manage their child's learning (Walsh et al., 2021). Findings in January 2021 showed that while 39% of parents were finding supporting remote learning easier in the second school closure, 24% were finding it harder, highlighting the diversity of experience during COVID-19 remote education (Montacute & Cullinane, 2021). Research with parents of children with SEND highlighted specific concerns. Children with SEND are likely to need more support in their engagement with digital remote education, but parents discussed challenges in navigating the online systems and felt unsupported by schools (Couper-Kenney & Ridell, 2021).

Lack of a suitable learning space was a challenge for some students, particularly those who were the most deprived (Cattan et al., 2021; Ofsted, 2021b). Access to a suitable learning environment may be particularly important to some digital remote education approaches. For example, without a quiet learning space students may not be able to engage verbally in live remote lessons. Schools were very aware of these challenges, and qualitative research highlighted additional concerns around electricity costs (Children's Commissioner for Wales, 2021). While lack of an adequate learning environment was only a challenge for a minority of students it is likely to have a substantial impact on individual children's ability to engage in digital remote education. Another learning environment challenge faced by some students was having to attend to other responsibilities while trying to study (Brink et al., 2020).

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[4] 20% of school staff not having access to an internet connection for remote working seems surprisingly high. This may relate to how the question was phrased or interpreted. Additionally, this included both teaching and non-teaching staff, and so it is not clear what proportion of those without access to an internet connection were the teachers.

Table 4 Teacher, parent and learning environment factors

Study	Date/Location	Research Findings
CPE (2021) Partnership for Education 1,766 survey respondents	England, April-September 2020	Educational stakeholders were asked about their main concerns about remote learning, and some challenges relating to digital technology were raised. 11.65% of educational stakeholders reported concerns around lack of technical know-how or poor infrastructure and 12.38% reported concerns around lack of online teaching expertise.
Lucas et al. (2020), NFER 1,233 school leaders 1,821 teachers	England, May 2020	Approximately 2/3s of teachers felt good/very good in supporting students to learn remotely, in terms of their own confidence and skills in using IT. On average, teachers reported that 55% of their pupils' parents are engaged with their children's home learning. This was lower in the most deprived schools compared to the least (41% vs 62%).
Julius & Sims (2020) 1,233 school leaders 1,821 teachers	England, May 2020	Lack of parent/carer support for learning was reported as one of the main challenges in supporting vulnerable children by 57% of senior leaders and 75% of teachers. Both senior leaders and teachers reported that students in the most deprived schools were less likely to be engaged (69%/85%) compared to those in the least (44%/64).
Cattan et al. (2021), IFS Wave 1: 4,316 parents Wave 2: 927 parents	England, Two waves April/May 2020 and June/July 2020	Approximately 20% of primary students and 10% of secondary students did not have their own/ or a quiet shared place to study in April/May 2020 and this stayed largely consistent in June/July 2020. 90% of the richest fifth of students had access to their own/quiet shared space compared to 86% of the poorest.
Montacute & Cullinane (2021), Sutton Trust 6,475 teachers 1,500 senior leaders 877 parents	England, March April 2020 and January 2021	41% of parents with children learning at home reported having no time/not much time to help their children with online learning. This was higher amongst secondary school parents (61%) than primary (23%). 39% of parents reported home learning was easier in this lockdown compared to March while 24% were finding it more difficult. The most common reason given by teachers for pupils not engaging in online learning was limited/no parental support (60%). State schoolteachers were more likely to report this (65%) than private school teachers (25%). Teachers in the most deprived state schools were more likely to say this (57%) than those in the most affluent (47%).

Study	Date/Location	Research Findings
Parkin et al. (2020), Edurio 22,729 parents 14,432 pupils 8,177 school staff	England, June-July 2020	School staff were asked about the main challenges they had faced during the summer term. Only 13% reported lack of IT skills or experience and 8% reported lack of technical provision as the main challenge. However, 59% reported that time spent on a computer/by the screen was a challenge for them. Asked about support during this time, 49% of teachers felt that they had received all the support they needed from school leadership. When asked about types of training they would like more of, 11% wanted more provision of technology solutions, 18% wanted more training in using technology, 17% wanted more training in organising pupil collaboration digitally, 15% wanted more training in delivering remote lessons, and 9% wanted more training in digital assessment and feedback. School staff were also asked about their own technology provision. 96% did have access to a computer, laptop or tablet at home, and 72% had access to a smartphone or webcam (and therefore to a camera). 80% had an internet connection and 35% had a printer.
Müller & Goldenberg (2020), Chartered College of Teaching 1,797 respondents	England, May-June 2020	58% felt confident in planning and delivering distance online learning and 52% felt confident in providing effective feedback online. 54% felt they had the necessary support to plan and deliver distance online learning, while 20% felt they were not adequately supported. 63% of teachers reported that they had been able to easily contact all of most of their students' parents, however 37% had found communication with at least half of parents to be difficult.
Ofsted (2021b) 1,003 teachers 2,020 parents	England, Summer-Autumn 2020	One third of teachers lacked confidence in teaching through remote solutions. Parent factors and learning environment - 12% parents reported that some of the main challenges for their children's parents was having a suitable space to learn, 18% reported that balancing learning with siblings was a challenge, 22% reported parental learning support, and 31% reported supervision when learning remotely.
Children's Commissioner for Wales (2021) 167 school leaders	Wales, January 2021	Qualitative responses indicated that school leaders in deprived areas were very aware of the challenges around home environment and parental support, citing concerns around overcrowding at home, electricity costs, poor parental literacy/numeracy and ICT skills, poor parental engagement as barriers for remote learning.

Study	Date/Location	Research Findings
Couper-Kenney & Ridell (2021)\n\nParents from 16 families	Scotland, June/July 2020\n\nChildren with SEND	Parents reported challenges navigating online systems that had been set up by school, and in secondary school there were challenges that teachers in different subjects were sometimes using the platforms differently. Parents reported having to convert resources into physical resources for their children. Half of them had been creating their own educational opportunities for their children. Some parents felt unsupported by schools, and that the work provided to their children was inappropriate to their needs and ability.
Walsh et al. (2020),CfREA\n\n2,035 parents	Northern Ireland, April-May	Most parents rated themselves as a 3 out of 5 (34.20%) in terms of their confidence in managing their child's learning during home schooling.

Student engagement in remote learning

Most of the studies looked at student engagement and outcomes in relation to remote education, but not specifically regarding digital remote education and so there is limited information about the extent to which a digital divide may be affecting student engagement and learning outcomes. Lucas et al. (2020) did look at this aspect in their May 2020 survey. They looked at student engagement measured by the proportion of pupils who returned their last piece of set work as reported by their teachers. They found engagement level was linked to type of remote learning. Specifically, they found that delivering learning through online conversations with pupils, and the use of VLEs (Virtual Learning Environment) to communicate learning activities, were significantly associated with higher engagement for all students, while the use of the school website was associated with lower pupil engagement. They found that schools using VLEs had an 8-percentage point higher engagement than those without, and a 13-percentage point higher engagement than their disadvantaged pupils. Similarly, schools relying on their website to communicate learning activities had a 5-percentage point lower level of pupil engagement and an 8-percentage point decrease in disadvantaged students' engagement compared to schools that did not use their website for this. Given that their study found that the most deprived schools were more likely to be using the school website than the least, this suggests that some types of digital remote education led to better quality education than others, and so those children and schools who are unable to access these more engaging forms of digital remote education are further disadvantaged.

Approaches to mitigating digital exclusion.

Several of the studies included reference to strategies for addressing the digital divide, primarily around device provision (see Table 5). Montacute & Cullinane (2021) reported that teachers felt rollout of laptops had been the most useful provision for disadvantaged students, showing that lack of access to devices had been a significant concern. As noted by Julius & Sims (2020) and Commissioner for Wales (2021) many schools were providing laptops or computer equipment to the children, however not all schools were able to do so particularly those that were more deprived overall. Consequently, disadvantaged children in deprived schools are most likely to be impacted by the digital divide as they are least likely to have adequate access to devices and least likely to be in schools that can provide them with devices. Even where devices are available, such as through schools or accessed through government provision, barriers remain in terms of the practicalities of distributing these devices (Children's Commissioner for Wales, 2021).

There were also attempts to provide training and learning resources to teachers, parents, and students in how to use remote education tools (Sharp et al., 2020; Ofsted, 2021b). Ofsted (2021b) found that most teachers reported that their school had offered training and resources to teachers and students, while less than half reported that training and support had been offered to parents. Parent digital skills may be one area where the digital divide could have been further addressed, although this may relate to challenges with parental engagement.

At a government level, each of the four home nations in the UK has announced various schemes to support access to remote learning, largely focusing on provision of devices and internet connections (Cambridge Assessment, 2020c, Baker et a al., 2020). In England in 2020, this focused on giving devices and laptops to digitally excluded students, focusing on those in Year 10. Following the return to remote education in January 2021, in England the DfE announced further support for providing devices and other technological support. As of 14th February, 1,055,700 devices had been delivered or dispatched, and 68,600 routers (Roberts & Danechi, 2021). Similarly, in Scotland £30 million was made available to provide laptops to disadvantaged young people and children, the Welsh government provided £3million to address digital exclusion and Northern Ireland had a laptop scheme for students in key year groups and vulnerable categories (such as having special educational needs, and eligibility for free school meals). Additionally, some local councils have begun their own initiatives to address digital exclusion in education in their local areas, usually focusing on providing access to devices and internet for those children who have insufficient access. For example, the City of Westminster began a drive for donations of laptops and funds to support purchase of digital devices for students in disadvantaged backgrounds without access to devices (City of Westminster, 2021).

However, there is less discussion of efforts to address parental factors such as their engagement and digital skills, or to improve pupil digital skills. Even if devices and internet access are provided to all students, divides in digital skills and other external factors are likely to continue to cause some degree of digital exclusion. Additionally, challenges around learning environment are not easy for schools to address and attempts to mitigate these may instead be seen in the decisions around approaches to remote learning. For example, decisions not to use live online videoconferencing may be driven by knowledge around both student access to devices, but also their ability to engage in live lessons due to their learning environment.

Parents themselves were taking steps to mitigate digital divide challenges for their children. Montacute & Cullinane (2021) found that a quarter of parents had spent over £100 on resources and equipment to support their child's learning, with substantial differences in this by socio-economic background. While this did not specifically focus on technology, it is likely that some of this was towards provision of equipment to support digital remote education.

Table 5. Mitigation approaches

Study	Date/Location	Research Findings
Julius & Sims (2020), NFER 1,233 school leaders 1,821 teachers	England May 2020	74% of senior leaders in secondary schools and 33% in primary schools reported that their school was providing laptops and/or computer equipment to vulnerable children. Senior leaders in the most deprived schools were significantly less likely to be providing laptops/computer equipment for their vulnerable pupils.
Sharp et al. (2020), NFER	England, July 2020	34% of teachers reported that their school had not given any training on how to deliver remote learning (38% of primary,

1,176 school leaders 1,782 teachers		and 17% of secondary). 39% of teachers reported having been given help on using specific software/websites (34% primary, 62% secondary), 16% had received training on producing their own video content (11% primary, 37% secondary). 21% of teachers had no access to audio-visual equipment (and 41% were self-providing it).
Montacute & Cullinane (2021), Sutton Trust 6,475 teachers 1,500 senior leaders 877 parents	England, January 2021	52% of teachers reported that faster rollout of laptops had been the most helpful intervention for disadvantaged pupils. 66% of senior leaders in state schools reported needing to source IT equipment for disadvantaged pupils themselves while waiting for government support (and 72% in secondary schools specifically) 47% of state school senior leaders reported they had only been able to provide half or fewer of their pupils with the laptops they needed. Teachers were asked what the most important intervention in the short term was to help prevent the most disadvantaged or vulnerable pupils from falling behind. 52% suggested more laptops/tablets and 24% wanted measures relating to internet access. 26% of parents reported spending over £100 on resources and equipment to support their child's learning since September 2020. There were socio-economic differences in this, with 31% of those with the lowest incomes having spent nothing, while 29% of those with the highest incomes had spent more than £100 and 19% more than £200. While not specifically about technology, likely that some of this spending has been towards access to technology.
Ofsted (2021b) 1,003 teachers 2,020 parents	England, Summer-Autumn 2020	81% of teachers had been offered training or learning resources on how to use remote education tools. 68% of them reported their pupils had been given training, and 40% reported that parents had been.
Children's Commissioner for Wales (2021) 167 school leaders	Wales, January 2021	Asked about barriers to ensuring students had access to devices, 49% reported that lack of contact with families to enable them to arrange provision was a barrier while 42% of school leaders reported that the schools did not have devices to provide to students. Qualitative responses showed that some schools had been able to meet the device needs of all students, others noted that there were challenges and delays with obtaining further devices, using government funding.

Education digital divide post COVID-19

As COVID-19 remains ongoing it is likely that digital remote education will continue in some form for a while; this could be instances where individual students or classes need to self-isolate, or because of broader COVID-19 surges as some experts warn may happen (Hinde, 2021). There is concern that pandemics may become more likely in the future (Tollefson, 2020), and so we need to be prepared for the possibility that other periods of remote education may be necessary in the future.

Furthermore, aside from enforced remote education due to a pandemic or other crisis, there are suggestions that digital education practices may become commonplace and represent a new future for education post-COVID (Fleming, 2021; Lockee, 2021). Indeed, Microsoft have published a report 'Education Re: imagined' which postulates a paradigm shift in education, in which we develop new hybrid learning models pulling together what we have learnt from remote learning with traditional approaches (Fullan et al., 2020). The Edurio research (Perkin et al., 2020) found that 96% of teachers were using some digital learning tools, with 75% reporting that they were very or quite likely to continue using digital learning tools in the longer term. Similarly, Teacher Tapp surveys have found that many teachers report that they will change how they use technology in their practice in the longer term (CPE, 2021). These potential longer-term changes seem to relate to homework and communication tasks, for example 60% of teachers suggest that they would make changes in their use of technology to set or collect homework and 53% suggest technology will influence the types of homework tasks they set in the longer term. Fewer teachers reported that it would change their in-class practice, for example 22% said it would change how they gave explanations or demonstrations in class in the longer term.

Exam boards in the UK are exploring possibilities to develop online examinations for GCSEs and A Levels, again suggesting that a shift to digital education practices may occur (Lough, 2021). There are concerns that a shift to more digital education practices will increase the impact of the 'digital divide' and mean that inequalities in quality of education and educational outcomes will widen, with disadvantaged pupils most likely to be digitally excluded (Fleming, 2021). Consequently, while COVID-19 has highlighted the impact of the digital divide in education, and more widely, concerns around digital exclusion remain even as we move out of COVID-19 enforced remote education.

Conclusion

This research found that there was little research which specifically looked at the digital divide, however many wider research studies did investigate aspects of the digital divide as part of research seeking to understand remote learning in the UK during the period of COVID-19 related school closures. While closures happened in both March 2020 and January 2021, so far limited research has been published and has primarily focused on the first period of school related closures. The digital divide has generally not been the focus of research, but aspects relating to it, such as access to devices and investigating parent support and access to adequate learning spaces, have been included. Additionally, most of the research found was focused on England rather than the UK more widely.

These reports provide evidence of a digital divide in terms of access to devices. While inadequate access to devices was less of a concern in private schools, in state schools most schools reported challenges for some pupils, particularly in the most deprived schools. The increased use of digital remote education practices in January 2021, particularly live methods such as videoconferencing, may have led to increased digital exclusion due to an increased demand for device access and quality internet. Internet access was examined by fewer of the studies; while most students seemed to have access there was evidence of poor-quality internet, or lack of adequate data for some students. Overall, it appears that there remained a digital

divide in terms of access in January 2021, despite efforts to supply devices and increase internet provision. If digital education practices become more widespread in the future as some predict (CPE, 2021) schools and government will need to ensure that all students have access to adequate devices and internet so as to mitigate digital exclusion.

Very few of these studies examined digital skills and so there is limited evidence around digital exclusion in relation to this. Young people are often assumed to be digital natives and to have strong digital skills, but this is not necessarily the case (ECDL, 2018). Digital divide factors interact with one another: those children who are digitally excluded in terms of access to devices are more likely to have more limited digital skills and so their digital exclusion may be compounded. Consequently, the issue of adequate digital skills needs to be examined in future work, especially if we move towards greater use of digital education practices.

There was evidence of the impact of parental and teacher factors, such as parent engagement and both teacher and parent skills. Should digital education practices become more commonplace efforts will be needed to ensure both teachers and parents gain adequate digital skills, and parental engagement may remain a challenge in some circumstances. Unfortunately, home learning environment is not something easily addressed, and so we need to remain cognisant of the different home learning environments that learners are in and the impact that this has on their ability to engage in remote digital education.

One limitation of this report is that most of the studies looked at aspects of the digital divide in different ways, limiting comparison/aggregation across findings. Most of the studies attempted to understand access to comparable devices more broadly than simply whether the family had a computer, such as asking about 'adequate' access to devices or asking whether students had access to a device whenever they needed it. These differences in how access to devices and internet was examined mean that these findings are not directly comparable. Questions around 'adequate' access are highly subjective. Given the diversity of approaches to digital remote education, the device access that is 'adequate' could vary from one context to another. In schools where live video-remote conferencing is being relied upon, adequate access may be whether students have access to their own personal device throughout lessons, while in schools which have pre-recorded lessons and work that can be completed according to a student's own schedule it may be adequate to share a device with a sibling. Similarly, many of the studies relied on self-report and teacher judgements, and it may be that teachers do not have a full picture of the home circumstances of their students.

While the reports reviewed here provided some insight into the digital divide it is important to note that they almost exclusively relied upon using online surveys for participant recruitment and data collection. This is particularly relevant with regards to those studies relying on parent samples. Parents of the most digitally excluded children are likely to themselves be digitally excluded due to lack of access to devices, internet, and digital skills. Consequently, the extent of the digital divide may be underestimated in the research relying on parental studies, as the parents of the most digitally excluded children are unlikely to be well represented in the research findings due to their own access challenges. The studies which used teacher and school leader samples may provide broader insight although again, teachers in the most deprived areas where learners are more likely to be digitally excluded, may themselves be more likely to be digitally excluded and therefore poorly represented in these research studies, as their schools may be less able to provide devices to both teachers and students.

Overall, these findings highlight evidence of a digital divide particularly in terms of access and the influence of external factors such as parent engagement, teacher skills and learning environment. The digital divide in skills was not examined by most studies, but any divide in digital skills may explain some of the division in student engagement in digital remote learning and so it would be valuable for this to have been considered. COVID-19 may continue to impact

education for some time, and digital education practices are predicted to become more widespread. Consequently, even though most students in the UK have now returned to in-person schooling the digital divide will remain a challenge for education and must be examined and addressed so as to ensure that disadvantaged students do not fall further behind.

Recommendations

1) More research on the digital divide in education is needed, particularly given that online remote education is ongoing, and with expectations of increased use of EdTech in education more generally.
2) When social distancing permits, it may be valuable to undertake research with the most digitally excluded to understand the extreme end of the digital divide in access to remote education.
3) There needs to be greater consideration of digital skills when investigating the COVID-19 related digital divide, by policy makers and researchers alike.
4) If there is a move towards increasing use of digital technology in education, such as in assessment, we will need to be mindful of the digital divide, both in terms of taking steps to reduce digital exclusion and ensuring that non-digital alternatives remain available.

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