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The likely impact of COVID-19 on education: Reflections based on the existing literature and recent international datasets

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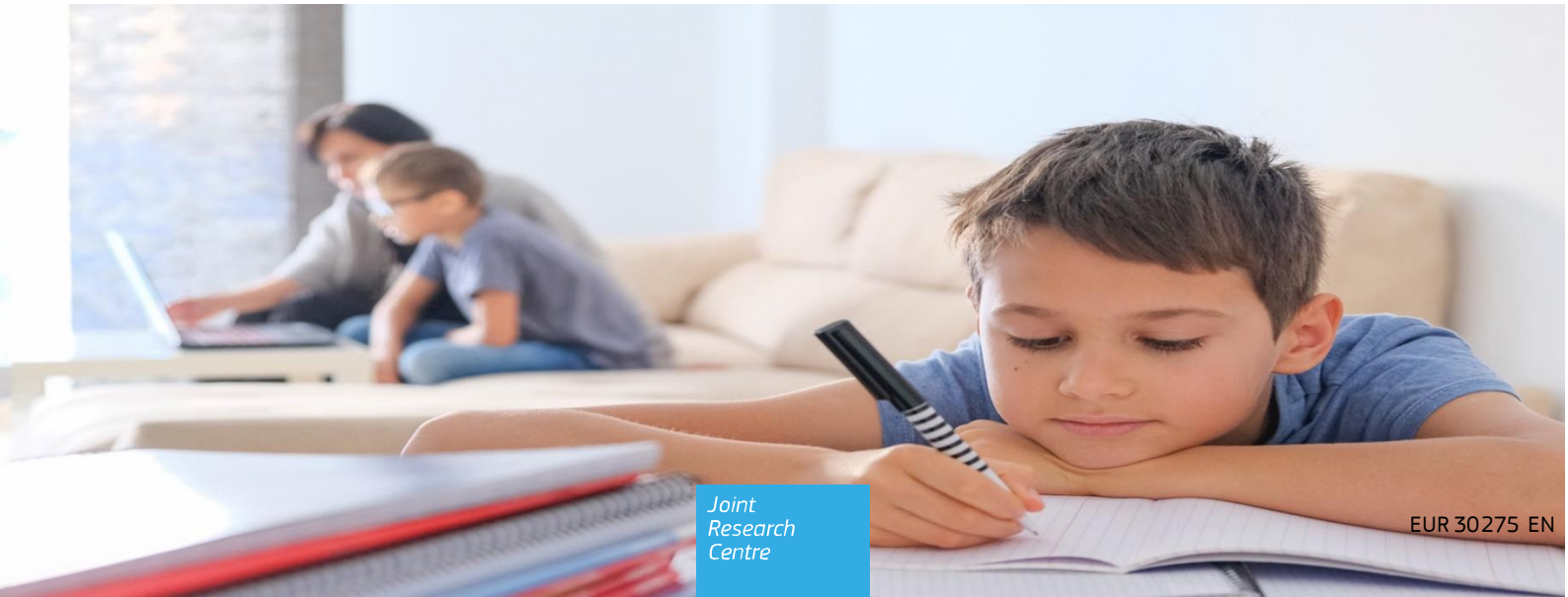

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Abstract

In order to reduce the spread of COVID-19, most countries around the world have decided to temporarily close educational institutions. However, learning has not stopped but is now fully taking place online as schools and universities provide remote schooling. Using existing literature and evidence from recent international data (Eurostat, PISA, ICILS, PIRLS, TALIS), this report attempts to gain a better understanding of how the COVID-19 crisis may affect students' learning. It looks at the different direct and indirect ways through which the virus, and the measures adopted to contain it, may impact children's achievement. 'Conservative' estimates for a few selected EU countries consistently indicate that, on average, students will suffer a learning loss. It is also suggested that COVID-19 will not affect students equally, will influence negatively both cognitive and non-cognitive skills acquisition, and may have important long-term consequences in addition to the short-term ones.

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Authors

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Executive summary

Most educational institutions around the world cancelled in-person instruction and moved to remote learning and teaching in March 2020 in an attempt to contain the spread of COVID-19. Parts of the (or the whole) formal education system will not re-open this academic year in some countries, whereas in others (parts of) the formal education system have progressively re-opened.

While the disruption in learning caused by COVID-19 is unprecedented, important insights about its possible impact can be gained from findings of relevant existing studies and pre-COVID-19 data.

Although the adoption of distance learning is key to ensure the continuity of education following the physical closure of schools, students are, on average, likely to experience a learning loss during the lockdown. Several arguments can be put forward to explain this. First, there is evidence showing that quarantined students tend to spend less time in learning compared to when schools are open. Second, many students confined at home due to COVID-19 may feel stressed and anxious, and this may negatively affect their ability to concentrate on schoolwork. Third, physical school closure and the lack of in-person contact may make students less externally motivated to engage in learning activities. 'Conservative' estimates for France, Italy and Germany suggest that students will suffer a weekly learning loss of between 0.82 and 2.3% of a standard deviation. Such loss reflects the reduction in test score students would be experiencing because of less time spent in learning compared to the amount of time they typically invest when they are in school. For a test which is scaled to have a mean of 500 and a standard deviation of 100, the implied learning loss over the whole period of lockdown would mean a reduction in scores of between 6.5 and 14 points.

The switch from offline to online learning caused by COVID-19 is likely to affect negatively those children, in primary and lower secondary schools, who have higher difficulties in adapting to the new learning environment. The switch is also expected to exacerbate existing educational inequalities. More vulnerable students, such as for instance those from less advantaged backgrounds, are especially likely to fall behind during this emergency period. These students are less likely to have access to relevant learning digital resources (e.g. laptop/computer, broadband internet connection) and less likely to have a suitable home learning environment (e.g. a quiet place to study or their own desk). Additionally, they may not receive as much (direct or indirect) support from their parents as their more advantaged counterparts do. In more affluent families, parents are more likely to be able to work from home and are also more likely to afford private online tuition. Schools may further contribute to this inequality given that students from more advantaged backgrounds may be more likely to attend schools with better ICT-based infrastructure (e.g. Virtual Learning Environment) and where teachers have higher levels of digital skills. Children of single parents or large families as well as students with special needs or disabilities are also likely to suffer from the switch, unless assisted technologies are promptly put in place and adapted to the new learning environment.

Not only are COVID-19 and the move to remote learning and teaching expected to cause greater inequality in cognitive abilities, but they may exert a similar effect as regard students' emotional well-being and motivation. In fact, students' isolation from their friends and teachers may result in an unequal distribution of behavioural and psychological problems. During the lockdown, students from less advantaged backgrounds are more likely to be exposed to a stressful home environment (e.g. they are more likely to share a limited space and a limited number of digital devices with other family members). Furthermore, parents in these households, who may be under pressure because of financial and job security issues due to the COVID-19 crisis, are probably not in the best position to support their children in these circumstances.

The increased disparity in both cognitive and non-cognitive abilities that is likely to emerge during COVID-19 pandemic may have important consequences not only in the short-term, but also in the long-term. Several studies find that children's cognitive and socio-emotional

skill levels are good predictors of later outcomes. Students poorly endowed with these skills tend to have lower educational attainment and poorer labour market prospects, in terms of both employment and pay rates. Therefore, there is the risk that, in the absence of appropriate policy measures, the short-term inequality caused by COVID-19 may persist or even grow over time, leading to more economic disparity in the future.

Finally, it is interesting to put the learning loss suffered by students during the COVID-19 crisis into a broader perspective. Such loss will translate into a reduction of available human capital, with negative effects on productivity growth, innovation and employment, including future lower earnings for the student cohorts directly affected by the lockdown. For example, rough estimates indicate that the aggregate annual earnings loss that French primary school students will experience because of the COVID-19 confinement period amounts to between 700 and 800 million euro. These values are much bigger if earnings losses across all educational levels are summed up. Such consideration and these numbers should be kept in mind by policymakers when deciding about the budget to be invested in an attempt to mitigate the detrimental effects of COVID-19 on education.

The effect of COVID-19 on education poses at least two key challenges for policymakers. First, measures should be taken to ensure that more vulnerable students will be able to make up for the learning loss they experienced during the lockdown. This should be done quickly and effectively, in order to avoid that such crisis results in permanent education and economic inequality. Second, given that there is the possibility that educational institutions may not be able to operate fully in-person during parts of (or the whole) next academic year, alternative methods of delivering teaching and learning should be put in place. Although a blended /rotating learning system (with offline and online elements) is an interesting option, it is important to note that: 1) it requires a change in both the quantity and quality of the teaching capacity, 2) it requires a revision in the curriculum, 3) younger children may have problems in adapting to this model especially for the online learning part, and 4) the structure of many existing school buildings may not be appropriate if one wants to maintain physical distancing.

The following elements should be part of a successful strategy integrating online and offline teaching and learning activities:

- Guarantee access to internet and availability of computers, laptops, or tablets: access to the internet at a decent speed and to proper ICT tools are basic prerequisites for any online teaching and learning strategy.
- Adopt proper Virtual Learning Environments (VLE): VLE can give learners access to educational resources, connect students with teachers and facilitate remote lessons.
- Rethink the role of broadcasting education: educational broadcasting can be a useful complement to online programmes as it delivers teaching to those who do not have access to the internet and equalises teaching methods and material across schools within a country or region.
- Improve availability of learning technology for students with Special Educational Needs and /or Disabilities (SEND): digital technologies can provide useful support to SEND students, especially if they are part of a coherent and overarching process.
- Support teachers: teachers should learn how to adapt their role to a situation in which they can communicate only online and in which even students typically performing well at school may lose motivation when shifting to online learning. It is crucial to improve teachers' digital competences across all ages, as well as to ensure that they are well trained in the pedagogical approaches best suited for online learning and blended models.
- Support parents to help their children: parents are an essential element of the picture, and more so for younger students who cannot be left alone facing the challenges of online learning. Parents should be involved in the design of the strategy and in its implementation as they need to fully understand what is taught

and why. Regular and detailed communication between parents, teachers, and the school is a fundamental element of a successful online learning strategy.

1 Introduction

In an attempt to contain the spread of COVID-19, in the large majority of countries around the world educational institutions have decided to temporarily suspend in-person instruction and move to a remote learning model of delivery. According to UNESCO, at the end of April 2020, educational institutions shut down in 186 countries, affecting approximately 74% of total enrolled learners on the planet[1]. In many countries, schools have been closed since the beginning of March 2020, while in others (e.g. most of China and South Korea) in-person classes had been already cancelled since January 2020[2]. Several countries (e.g. Malta, Portugal, Ireland) have announced that (parts of) the formal education system will not re-open this academic year, whereas in others (e.g. Denmark, Germany, France, Greece, Poland) (parts of) the formal education system have progressively re-opened in April/May to facilitate assessment and certification, depending on medical advice for de-confinement.

What is likely to be the effect of the long school closure caused by COVID-19 on children's learning in the short-term? Will this crisis have any impact also in the long-term? While the current situation is unprecedented and this makes it difficult to predict the effect that it will have on student achievement, in the absence of relevant data, a useful exercise is to look at the economics and sociology literature in an attempt to gain a better understanding of how the virus and physical school closure may impact education and learning. Such analysis is complemented and supplemented by recent relevant statistical information. Data from various sources, including PISA, ICILS, PIRLS, TALIS, are used.

This report does not focus on a specific educational level or students' age group. However, whilst most arguments put forward apply to all educational levels, some of them, as will be indicated in the text, are relevant (or more relevant) for a given level. Additionally, it has been impossible to present evidence related to students from different age groups as only students of a specific grade/age are typically considered in the international datasets mentioned above.

Our reflections may assist policymakers in formulating interventions and strategies to address the consequences of the crisis. Indeed, they may also assist teachers and parents in how to best support students during and after this emergency period.

The remainder of the report is as follows. Section 2 looks at the effect of physical school closure on student learning, highlighting the important role of remote schooling in these circumstances. Section 3 examines the implications of the COVID-19 crisis for educational inequality. Section 4 summaries the main findings of the report. Section 5 outlines some policy options for mitigating the negative effects that COVID-19 is having on education.

[1] Real time data can be found at https://en.unesco.org/covid19/educationresponse

[2] More details about the education responses of various countries to the COVID-19 crisis can be found in Reimers and Schleicher (2020).

2 Physical school closure, remote schooling and learning

Physical school closure and the adoption of distance education may negatively affect students' learning through four main channels: less time spent in learning, stress symptoms, a change in the way students interact, and lack of learning motivation. However, in spite of this, remote schooling is fundamental to ensure the continuity of learning in situations where in-person classes are suspended.

2.1 Less time spent in learning

Most of children's formal learning takes place in schools. The closure of school buildings and the move to a remote learning environment may result in children spending less time in learning. According to the Schul-Barometer (School Barometer) survey, which took place from 25 March until 5 April 2020 and was targeted at Austrian, Swiss and German students aged between 10 and 19 years[3], students' weekly learning time during the COVID-19 lockdown is reduced by between 4 and 8 hours, compared to when schools are open (Huber et al. 2020). Additionally, one in five students says that they study less than 9 hours per week.

Leaving aside the question of effectiveness of in-class teaching vs online teaching (Annex 1 briefly deals with it), many studies consistently show that less time spent in learning can lead to learning loss[4].

Carlsson et al. (2015) analyse a situation in which young Swedish males have a different number of days to prepare for a battery of cognitive tests. They find that an extra 10 days of school instruction increases scores on crystallized intelligence tests (synonyms and technical comprehension tests) by approximately 1% of a standard deviation. Marcotte and Hemelt (2008) show that substantial snowfall (leading to fewer days spent at school) results in lower student performance in Maryland. Lavy (2015) looks at how cross-country differences in instructional time affect student learning and concludes that such differences do matter: an additional hour per week over the school year in the main subjects raises test scores by around 6% of a standard deviation. Some studies demonstrate a negative impact of school absenteeism and truancy on student performance. For instance, Stanca (2006) finds that, after accounting for unobservable student traits (e.g. motivation, effort), attendance shows a statistically significant and quantitatively relevant impact on student learning. Aucejo and Romano (2016) investigates how the length of the school calendar impacts test score performance. Using administrative data from North Carolina public schools, they find that extending the school calendar by 10 days increases mathematics and reading test scores by 1.7% and 0.8% of a standard deviation, respectively. Belot and Webbink (2010) look at the effects of a teacher strike, which took place between May and November 1990 in the Belgian French community, on student achievement. They find that this event reduced educational attainment and increased class repetition. Similar evidence is provided by Baker (2013) who examines the consequences of teachers' industrial actions in the province of Ontario, Canada. He finds that these strikes had a statistically significant adverse effect on student test score growth.

Another strand of research that may help us to understand the likely impact of missed learning time focuses on summer vacation. The summer period approximates a natural experiment that enables us to analyse children's cognitive development when they are in their homes and not at school. The consensus emerging from this literature is that summer vacation causes a loss in student learning. Cooper et al. (1996) conclude that, on average, in the US students' test scores decline over summer break by one month's worth of school-year learning. Shinwell and Defeyter (2017) find that in Scotland and the North East of England primary school children suffer a loss in spelling following a 7-week summer break.

[3] The relevant questionnaire was sent via email to school administrators, with a request to forward it to students. The respondents participated on a voluntary basis. A total of 2,152 students took part in the survey.

[4] One may observe that these studies rely on different sources of (exogenous) variation in learning time— less time spent in learning may come from less days to prepare for an exam, less schooling hours, more school absences, teacher strikes, or even a shorter school calendar.

Similarly, Paechter et al. (2015) provide evidence that in Austria lower secondary education students experience losses in both arithmetic problem-solving and spelling after a 9-week summer vacation.

2.2 Stress symptoms

Students who are confined at home with their parents due to COVID-19 may feel more stressed and anxious. Sprang and Silman (2013) show that children who were isolated or quarantined during pandemic diseases are more likely to suffer from acute stress disorder, adjustment disorder, and grief. Such adverse psychological factors may in turn have a detrimental effect on learning (Kuban and Steele 2011). It may be possible to compare these stress symptoms to those developed in the aftermath of hurricanes or earthquakes. For instance, as regards tertiary education, Di Pietro (2018) uses a standard difference-in-differences approach to examine the effect of the L'Aquila earthquake on the academic performance of the students of the local university. Following this event, many students are likely to have developed post-traumatic stress disorder (PTSD) symptoms that include poor concentration, depression, anxiety, and insomnia. The empirical results indicate that the L'Aquila earthquake reduced students' probability of graduating on-time and slightly increased students' probability of dropping out.

2.3 A change in the way students interact

It is well known that the school environment influences achievement through peer effects. Being in a classroom and hence having the opportunity to interact with classmates may produce important positive externalities. Peer effects may operate through many different channels. Students may teach each other and get improvement together. Classmates' high achievements may motivate the student (through competition or social influence) to work harder. The student can also develop an interest in reading or in mathematics thanks to his/her peers (Sacerdote 2011).

Additionally, classroom activities provide a central role in helping students acquire social skills that have important implications for their future personal and professional growth (Goodman et al. 2015). The interaction with teachers and other students is found to be essential for the development of positive self-esteem, self-confidence, and a sense of identity. It also improves students' ability to work in groups in collaborative and productive ways. There is significant evidence showing that social skills are positively associated with cognitive skills and school achievement (Malecki and Elliot 2002; Cunha and Heckman 2007).

It is, however, important to observe that also online learning platforms offer socialization opportunities. Not only do they incorporate class-based interaction and communication (including one-to-one contacts and group projects), but often provide also extra-curricular activities such as, for instance, online clubs. One advantage of online socialization is that it eliminates, or considerably reduces, social barriers among students (Watson and Gemin 2008). Although some commentators[5] argue that there is no substantial difference between socialization in online learning vs traditional high school, this is probably not the case for lower educational levels. For instance, the US National Education Association argues that elementary school children need the classroom experience as they are significantly more likely to communicate with their peers or teachers through face-to-face contact compared to online[6].

[5] See, for instance, https://www.asuprepdigital.org/socialization-in-online-learning-vs-traditional-high-school/
[6] http://blogs.edweek.org/edweek/DigitalEducation/2009/06/socialization_in_virtual_educa_1.html

2.4 Lack of learning motivation

The governments of several countries (e.g. Spain, Italy) have announced that, due to COVID-19, students will not have to repeat the school year regardless of their performance while studying remotely. France has forbidden to use student assessment results in the formal evaluation of the "Brevet" (lower secondary school exam) and of the "Baccalaureat" (upper secondary school exam). Although this could be a fair decision (Sonnemann 2020), several studies suggest that students may be more externally motivated to learn if they know that their learning will be assessed[7]. For instance, Elikai and Schuhmann (2010) conclude that grades can motivate students to learn. Austin (1978) finds that homework that was assigned and checked turns out to be more effective in improving students' achievement than homework that was assigned, but not checked.

2.5 Remote schooling

Remote schooling does play a key role in helping students continue with their learning following the disruption of educational processes caused by the closure of schools and universities. For example, as regards the latter institutions, Leung and Keing (2003) analyse how the Chinese University of Hong Kong responded to SARS (Severe Acute Respiratory Syndrome) in spring 2003. Despite classes being suspended, many professors were able to deliver teaching online. Although most professors were already familiar with online teaching platforms before the SARS crisis, this situation encouraged them to discover how to use more complex functions (e.g. setting online quizzes). Baytiyeh (2018) highlights the importance of digital technologies in supporting the continuity of education during short-term post-earthquake school closures. She stresses the importance of a reliable internet connection at home to assist in education materials delivery. In her work it is argued that, in addition to teachers' significant contribution, parental involvement is also crucial for the success of online education environment. Parents should ensure that learners are focused on the assigned tasks.

Digital education offers important advantages for independent learners. Older students will be able to personalise their learning (Herold 2017). To some extent, they will have the possibility to take control over their learning, understand what they want to learn, what they like and what kind of support they need. Online educational platforms also enable these students to learn at their own pace and this gives them more flexibility during the day. On the other hand, these advantages are less likely to hold for dependent learners. Younger children may not be well organised, self-motivated and have time management skills that allow them to exploit the benefits of distance education. Furthermore, teachers' preparedness and positive attitude are key elements for the success of online learning platforms. Online instructors should be able to compensate for the lack of physical presence by setting up a virtual environment where all participants feel comfortable and teachers can be easily accessed.

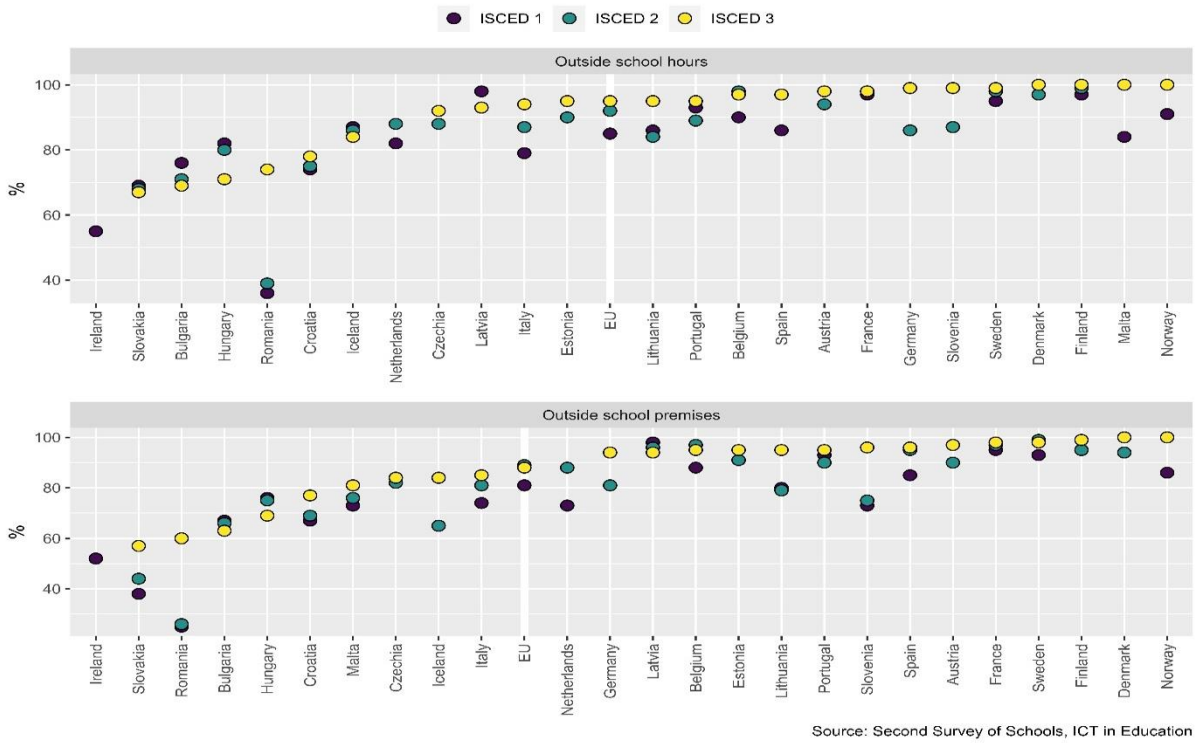
Data from the 2nd Survey of Schools: ICT in Education, which refers to the academic year 2017-18, show that, on average, a large proportion of European students can access a Virtual Learning Environment (VLE) outside school hours and outside school premises. However, there appear to be differences by ISCED levels. As illustrated in Figure 1, in Europe the proportion of students who have the possibility to study remotely tends to be higher at ISCED level 3 (upper secondary education) compared to ISCED levels 2 and 1 (lower secondary education and primary education, respectively). Furthermore, there is significant variability across countries. While Romania, Bulgaria and Slovakia consistently lag behind across all ISCED levels, in Finland, Denmark and Sweden almost all students across all ISCED levels are in schools offering a VLE outside school hours and outside school premises.

Following COVID-19, companies such as Microsoft and Google have opened up the availability of their remote education tools and provide assistance to teachers and students on how to use them. However, schools employing e-learning platforms before this

[7] Students' intrinsic motivation is unlikely to be affected (Cerasoli et al. 2014).

emergency period have an important advantage over the others since their teachers and students were more prepared to make a quick switch to fully online learning.

Figure 1. Students with a VLE at school that can be accessed outside school hours/outside school premises by ISCED level and country, academic year 2017 – 2018



3 Learning and inequality

The aforementioned literature on summer learning loss suggests that, not only does summer break cause a decline in learning, but it also exacerbates educational inequality (Downey et al. 2018). According to the "faucet theory" (Entwisle, et al. 2001), schools provide roughly equal benefits to children of every economic background. However, during the time when there is no school (like summer vacations), while performance among children from higher socio-economic status continues to develop, no similar growth is observed in children from lower socio-economic status[8]. Recent evidence from Germany would seem to be in line with this conclusion. Meyer et al. (2017), using data from German primary schools, find that students attending schools located in high-income communities make more progress in reading over the summer compared to their peers whose schools are situated in low-income areas. It is also suggested that this learning gap may have important long-term consequences. Alexander et al. (2007) argue that summer shortfall over the five years of elementary school partially contributes to explaining differences in high school track placements (college preparatory or not), high school non-completion, and four-year college attendance between students from more advantaged backgrounds and their peers from less advantaged backgrounds.

Similarly, COVID-19 and the closure of schools may not affect students equally. Students from less advantaged backgrounds can experience more significant learning loss during this emergency period than their more advantaged counterparts. This may be due to differences in non-financial parental support, parental financial resources, schools attended and students' digital skills. Significant learning disparities may possibly emerge also between native students and migrant students.

3.1 Non-financial parental support

Parents from different socio-economic backgrounds may have different ability (in terms of both cognitive and non-cognitive skills) and availability to support their children in their learning process at home during the lockdown.

3.1.1 Cognitive skills

Research shows that there is a correlation between parents' and children's cognitive ability. Anger and Heineck (2010) find that individuals' cognitive skills are positively associated with their parents' ability and they conclude that parental education plays an important role in explaining the transmission of cognitive abilities between generations. More educated parents spend more time with their children (Sayer el al. 2004) and tend to be more involved in their learning process. Holmund et al. (2008) argue that more educated parents may be more efficient at assisting their children with schoolwork. Additionally, not all parents possess the digital skills required to help their children deal with the technical challenges of online learning[9]. Some of them, especially among those from less advantaged backgrounds, may not have basic digital skills such as sending emails, writing documents using a word processor or finding information on the internet[10]. Vigdor et al. (2014) report that home computer technology is found to improve students' achievement only in households where parents can serve as more effective instructors in the productive use of online resources.

Different quality of parental involvement, which in turn is driven by family background and wider social environment, has been often used to explain why summer break is found to result in a significant learning loss in mathematics (as opposed to reading) among disadvantaged students (Borman and D'Agostino 1996). Although many parents from less advantaged backgrounds may have factual knowledge about mathematics, they may lack

[8] Ready (2010) argues that missing school can have an adverse effect especially on children from less advantaged backgrounds who tend to benefit from school more than those from more advantaged backgrounds.
[9] Zhang and Livingstone (2019) show that higher educated parents tend to be more digitally advanced, i.e. they use a wider array of digital devices and report more digital skills.
[10] Lack of parental digital literacy has important implications especially for younger children who are unlikely to be able to deal with remote schooling activities on their own.

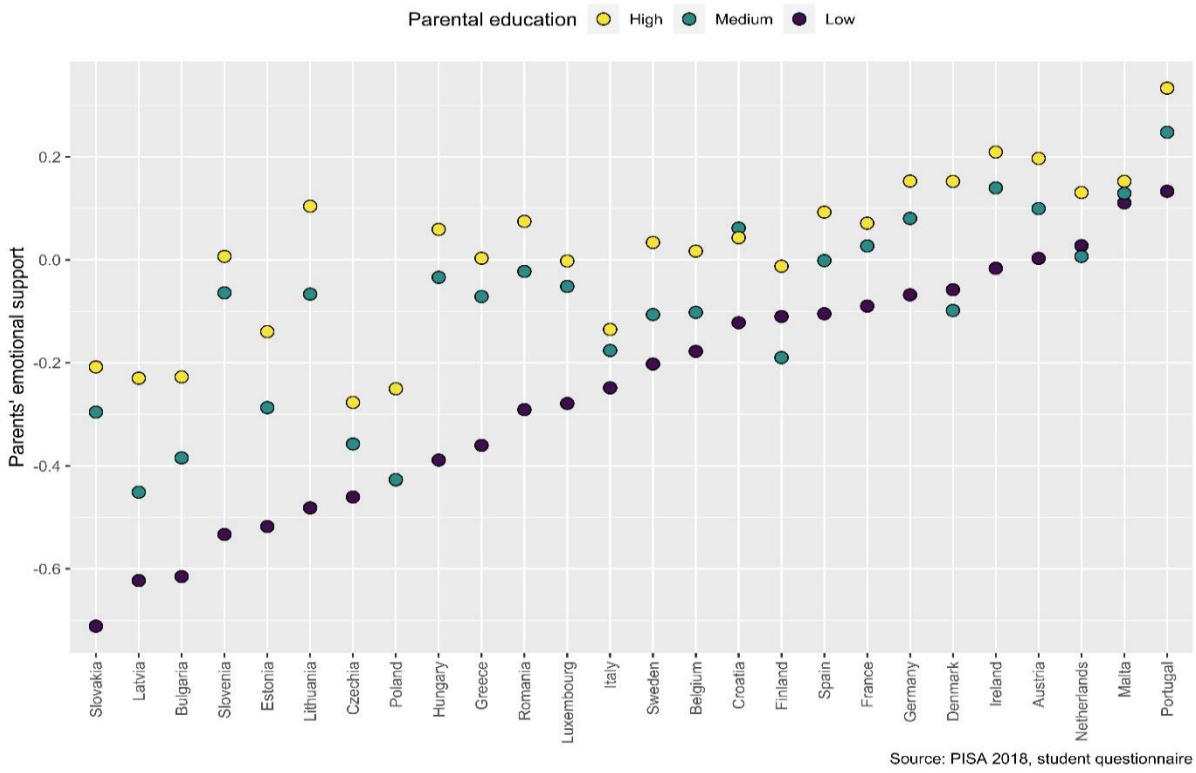
procedural knowledge (e.g. mathematical principles) that is important for teaching purposes (Cooper 2005). They may, as a result, put more effort into enhancing the reading ability of their children and pay less attention to mathematics.

3.1.2 Non-cognitive skills

Another disadvantage suffered by parents from unprivileged families is that they may have lower non-cognitive or socio-emotional abilities. They may, for instance, not value education enough to encourage their children to study while at home (Anderson and Safar 1967; Hatcher 1998; Nash 2003). Attanasio et al. (2020) provide evidence of widening disparity in socio-emotional skills among British children of different socio-economic status. Inequality is found to have increased especially for boys at the bottom of the distribution.

Data from PISA[11] (Programme for International Student Assessment) 2018 can be used to gain further insights on the above issue, given that students were asked about the degree of emotional support they receive from their parents. Figure 2 shows the mean index of parents' emotional support by parental education[12]. Three parental education categories are distinguished: high (at least one parent with a tertiary degree), medium (at least one parent whose highest educational attainment is upper secondary education) and low (both parents with lower secondary education or below). Students who have more educated parents are likely to get more emotional support than those who have less educated parents[13]. The size of the gap between the high and low categories appears to be especially large in several European Eastern countries.

Figure 2. Parents' emotional support by parental education



[11] Students participating in PISA are 15 years old.
[12] Please see OECD (2019) for information on how this index is constructed.
[13] This result can be at least partially attributed to the higher likelihood of parents from less advantaged backgrounds of being under stress because of job insecurity and financial issues. Stress may make them suffer behavioural and emotional problems and adopt inconsistent parenting practices (Coger et al. 2010).

Moroni et al. (2020) argue that COVID-19 is likely to further widen the socio-emotional disparities between children from more and less advantaged backgrounds. Students' isolation from their friends and teachers may have a detrimental effect on their socio-emotional skills and parents from more privileged backgrounds may be better equipped to support their children in these circumstances. Additionally, children from lower socio-economic status are more likely to spend their quarantine time in a more stressful home environment than those from higher socio-economic status. Evidence from an online survey conducted by Romain Delès and Filippo Pirone in France would seem to confirm this argument[14]. Following COVID-19, the proportion of parents from less advantaged backgrounds who report having problems in the relationship with their children is 32% whereas the corresponding figure for parents from more advantaged backgrounds is 24%. Delès and Pirone believe that the former parents are more likely to experience financial problems as well as the stress of sharing a limited space and limited digital devices at home.

3.1.3 Amount of time at home with children

In addition to having lower levels of both cognitive and non-cognitive skills to help their children with distance learning, parents from less advantaged backgrounds may also have less time to dedicate to their children given their inability to work from home. Younger children may especially need the presence of their parents at home as they do not possess the independent learning skills, attention spans or social-emotional maturity to succeed in Virtual Learning Environments for very long. According to a very recent report by the Economic Policy Institute (March 2020), in the US 61.5% of workers in the highest wage quartile can telework whereas the corresponding figure for those in the lowest wage quartile is less than 10%[15]. Similar evidence, also from the US, is provided by Yasenov (2020). He finds that lower-wage workers are up to three times less likely to continue their work from home than higher-wage workers. Those with lower levels of education, younger adults, ethnic minorities, and immigrants are also disproportionately in occupations that are less likely to be performed from home.

3.2 Financial parental resources

Students from less advantaged backgrounds are less likely to have access to digital resources at home, less likely to have a suitable home learning environment, and more likely to have nutritional deficiencies.

3.2.1 Digital resources at home

There are considerable socio-economic inequalities in students' access to digital technologies at home. Students from higher socio-economic status are significantly more likely to have a laptop or a computer at home than those from lower socio-economic status. For instance, data from Teacher Tapp — an app that asks daily questions to more than 6,000 UK teachers — show that at the end of the first week of lockdown following COVID-19, about 10% of students did not have access to either a device or the internet[16]. In the US, according to a 2019 analysis by the Associated Press, the percentage of students who do not have a computer at home and those who lack broadband internet access is 17% and 18%, respectively. A US survey conducted by the Pew Research Centre also in 2019 shows that there are striking differences in access to broadband internet at home between low and high-income families[17]. Eurostat data from 2019 show that also in Europe there is great socio-economic disparity. As depicted in Figure 3, access to broadband internet connection varies significantly by household income across all European countries. Richer

[14] https://www.ouest-france.fr/education/enseignement/ecole-la-maison-des-inegalites-de-pedagogie-selon-les-familles-6830947

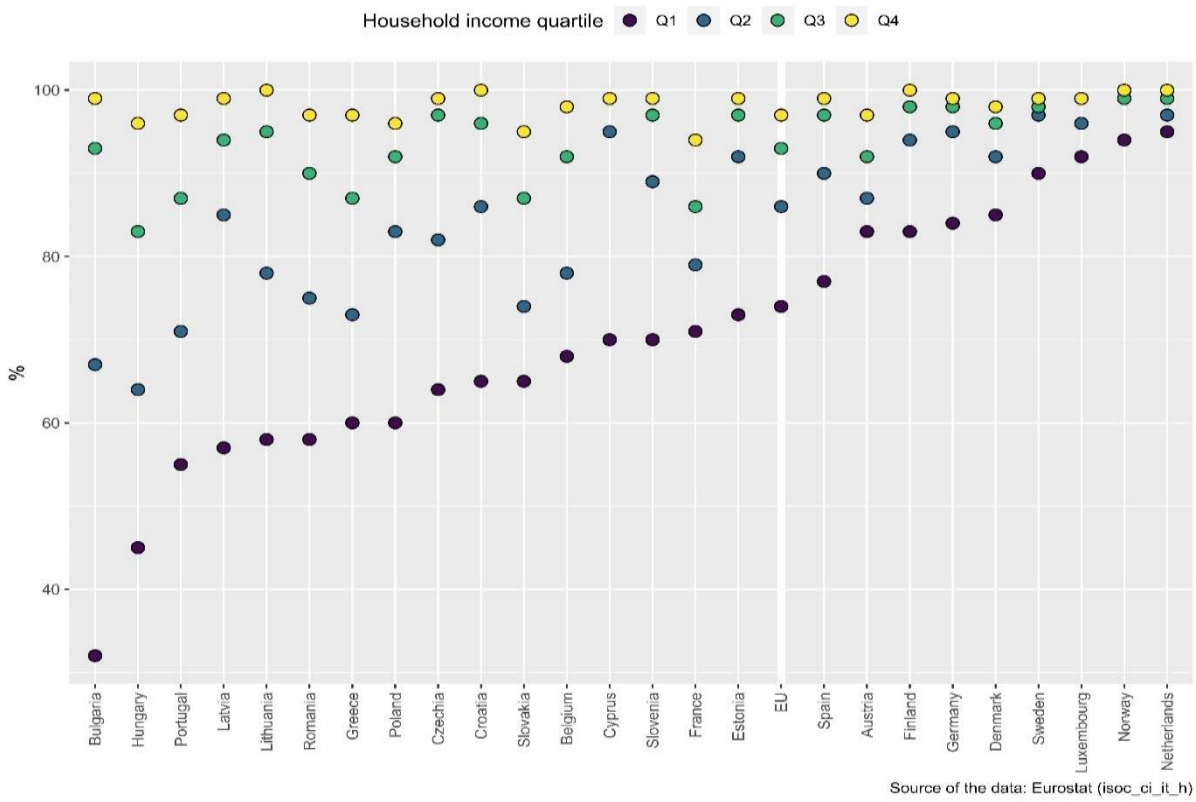
[15] https://www.epi.org/blog/black-and-hispanic-workers-are-much-less-likely-to-be-able-to-work-from-home/.

[16] https://www.aljazeera.com/indepth/opinion/coronavirus-widen-education-gap-uk-200409135841608.html

[17] While 92% of adults from households earning $75,000 or more per year report that they have broadband internet at home, the similar figure for adults from households earning below $30,000 is 56% (https://www.pewresearch.org/internet/2019/06/13/mobile-technology-and-home-broadband-2019/).

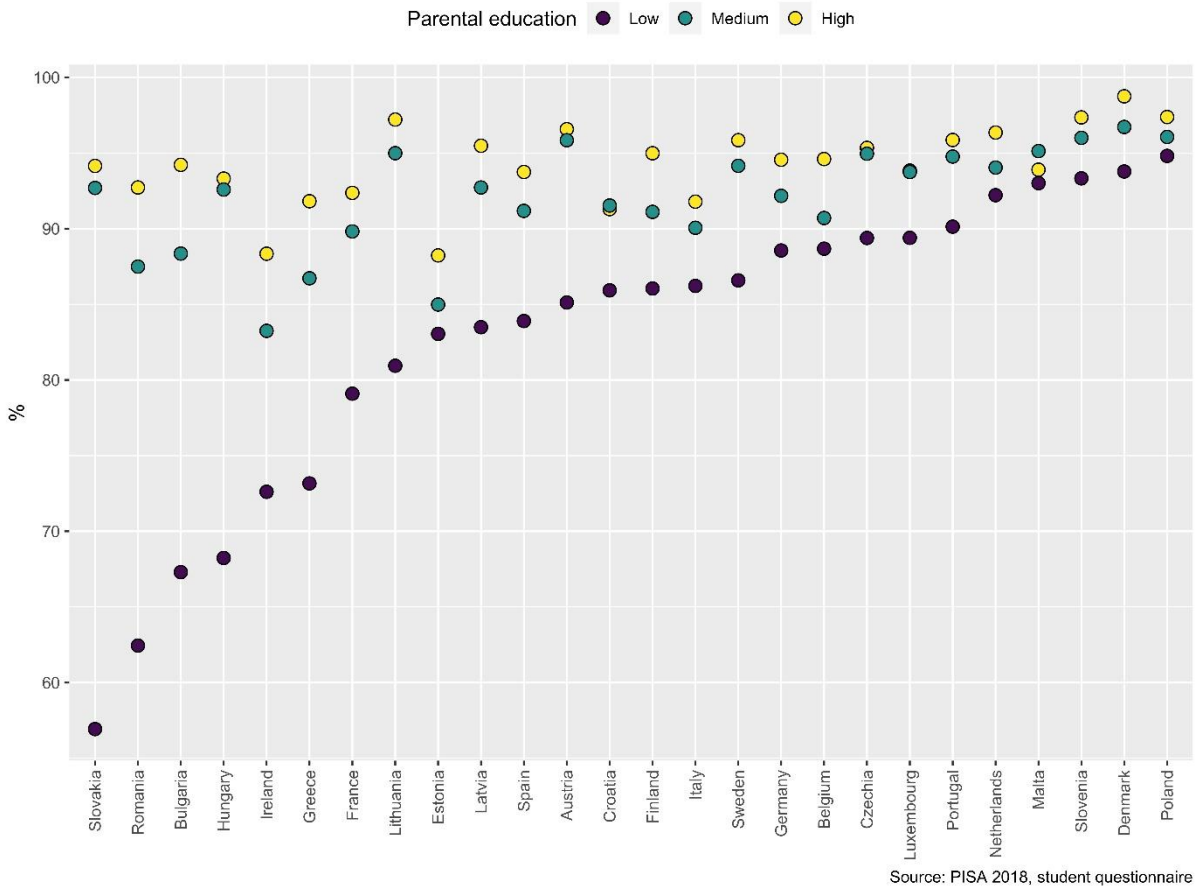
households are consistently more likely to have a broadband internet connection than poorer households. While the average EU proportion of households with a broadband internet connection in the lowest income quartile is approximately 74%, the corresponding figure for those in the highest income quartile is about 97%. Additionally, one may observe that cross-country variability is much larger in the bottom quartile than in the top quartile. The percentage of households with broadband internet connection in the lowest income quartile varies between less than 40% in Bulgaria and more than 90% in the Netherlands.

Figure 3. Broadband internet access by household income in the EU, 2019



Data from the PISA 2018 student questionnaire show that also as regards computer access at home there are relevant socio-economic differences across European countries. Figure 4 presents the proportion of EU students who have access to a computer at home by parental education and country. Parental education is split into the same three categories as in Figure 2. Overall, parental education appears to be positively correlated with children's access to a computer at home. The difference between high and low education groups is quite large in many countries, but especially in Slovakia, Romania, Bulgaria, and Hungary. On the other hand, in Poland and Malta there seem to be practically no differences across the three parental educational categories.

Figure 4. Presence of a computer at home by parental education



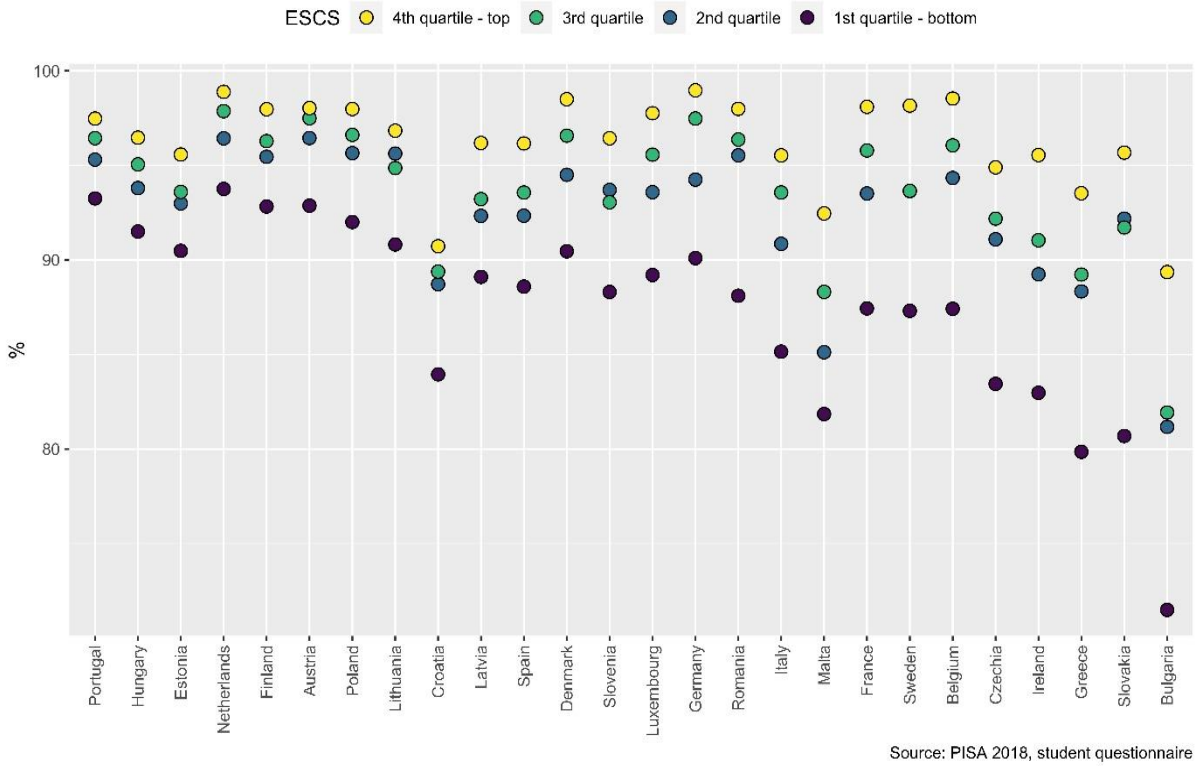
Given the unavailability of computers at home in many low-income households, children are likely to gain access to online classroom learning only through their mobile phones, which makes any completion of work and uploading it onto an e-platform very difficult. Moreover, using data from a sample of school children in Korea, Moon et al. (2016) show that continuous smartphone use is associated with eye discomfort symptoms.

3.2.2 Home learning environment

In addition to having access to appropriate digital resources, students need to be in a home environment that is conducive to learning. However, this might not be the case for a large number of students from less advantaged families, who often have to do their work in a small space shared with other family members. Such consideration is supported by data from the PISA student questionnaire 2018. Figure 5 depicts the proportion of students reporting having a quiet place to study in several countries. In each country, children are split into four quartile groups based on the PISA index of economic, social, and cultural status (ESCS)[18]. Figure 5 shows that socio-economic status matters as students from more advantaged backgrounds (those in the top quartile of the PISA ESCS index) are systematically more likely to have a quiet place to study. One may also observe that in most countries the proportion of children from the bottom quartile of the PISA ESCS index having a quiet place to study is less than 90%.

[18] ESCS is created on the basis of the following variables: the International Socio-Economic Index of Occupational Status (ISEI); the highest level of education of the student's parents, converted into years of schooling; the PISA index of family wealth; the PISA index of home educational resources; and the PISA index of possessions related to "classical" culture in the family home.

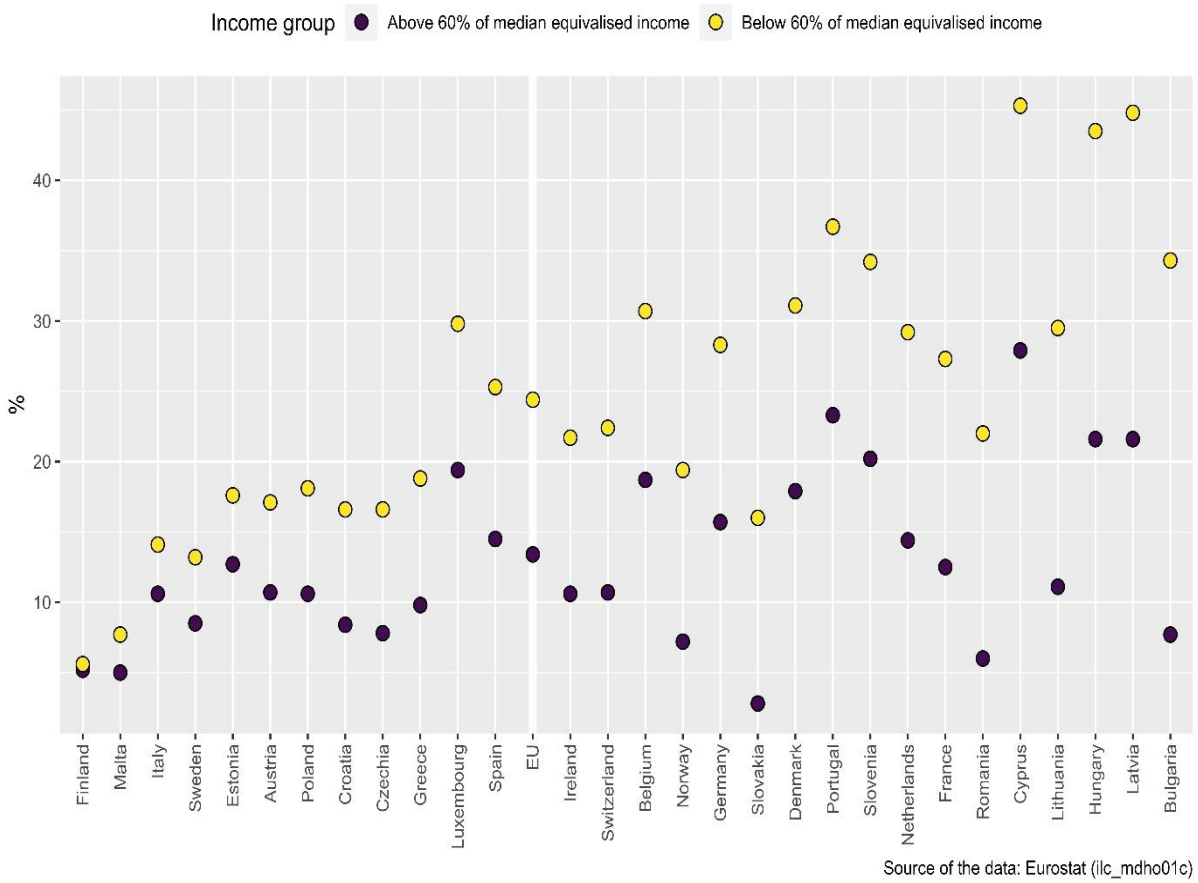
Figure 5. Children having a quiet place for studying by ESCS quartile



In an attempt to provide additional evidence about socio-economic differences in the home learning environment in Europe, it is possible to use data from the EU-SILC survey on the proportion of children (aged 0 to 17) living in a dwelling with a leaking roof, damp walls, floors or foundation, or rot in window frames or floor, by household income[19]. This indicator, which refers to the quality of housing, may also capture important disparities in the indoor environment at home affecting children's achievement. As shown in Figure 6, children living in households that are classified as being below the poverty line (i.e. their equivalised income is below 60% of median income) are consistently found to be more likely to live in a dwelling in need of major repairs. The magnitude of the gap in housing quality between poor and non-poor households varies considerably across countries. For instance, while it is negligible in Finland, it exceeds 20 percentage points in Bulgaria, Hungary, and Latvia.

[19] Note that the data refer to 2018. 2019 data are only available for few countries.

Figure 6. Children living in a dwelling with a leaking roof, damp walls, floors, or foundation or rot in window frames or floor by household income in the EU, 2018



3.2.3 Nutrition

In the absence of schools, many children from unprivileged backgrounds are at risk of eating only unhealthy food, or even at risk of hunger[20]. In fact, schools play a key role in the nutrition of students from poor families. In the UK, 1.3 million children are entitled to free school meals[21]. In the US, the National School Lunch Program supplies free or low-cost lunches to 29.7 million children[22]. Many studies show that there is a relationship between nutrition and academic performance. For instance, Florence et al. (2008) argue that in Nova Scotia (Canada) grade 5 students with less nutritious diets performed worse on a standardized literary assessment. Belot and James (2011) use a difference-in-differences technique to estimate the causal effect of healthy school meals on educational performance. They find evidence that healthy school meals improve educational outcomes. Research also indicates that diets high in trans and saturated fats can have an adverse effect on the brain, affecting learning and memory (Gómez-Pinilla 2008).

Data shown in Figure 7 can be used to have a rough estimate of the number of children with dietary deficiencies in Europe in 2018. It is reasonable to assume that school meals

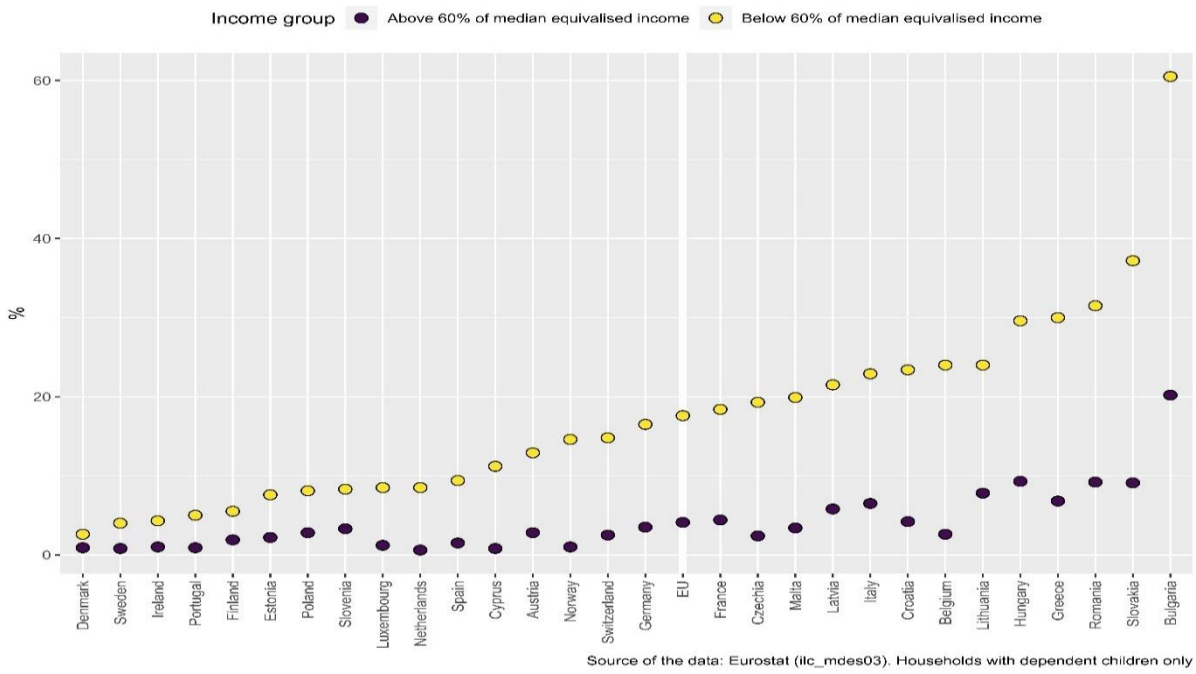
[20] This situation is likely to be exacerbated by the increase in unemployment observed during COVID-19 disease. Fana et al. (2020) show that the COVID-19 crisis is likely to have a negative effect especially on the most vulnerable segments of the working population such as workers with lower wages and worse employment conditions.

[21] https://www.nurseryworld.co.uk/news/article/coronavirus-families-on-free-school-meals-will-be-sent-vouchers-during-school-closures

[22] https://www.vox.com/2020/3/28/21197965/coronavirus-school-shutdown-free-meals

are especially important for these children. As depicted in Figure 7, the proportion of households with children that cannot afford a meal with meat, chicken, fish (or vegetarian equivalent) every second day is in many countries above 20%. In line with expectations, households below the poverty line are consistently found to have a greater risk of malnutrition, especially in Eastern European countries, Belgium, and Greece.

Figure 7: Inability to afford a meal with meat, chicken, fish (or vegetarian equivalent) every second day by household income in the EU, 2018



3.2.4 Affordability of extra-school activities

During the lockdown, children from more advantaged backgrounds tend to be more engaged in extra-school learning activities than those from less advantaged backgrounds. Such activities may considerably improve student achievement as they may complement and supplement the e-learning resources provided by schools. Using information from an online survey completed by over 4,000 UK parents between 29 April and 12 May 2020, Andrew et at. (2020) report that students from richer families are significantly more likely to have access to a private tutor than their peers from poorer families. A similar situation seems to be occurring in France according to Pirone[23].

3.3 Schools

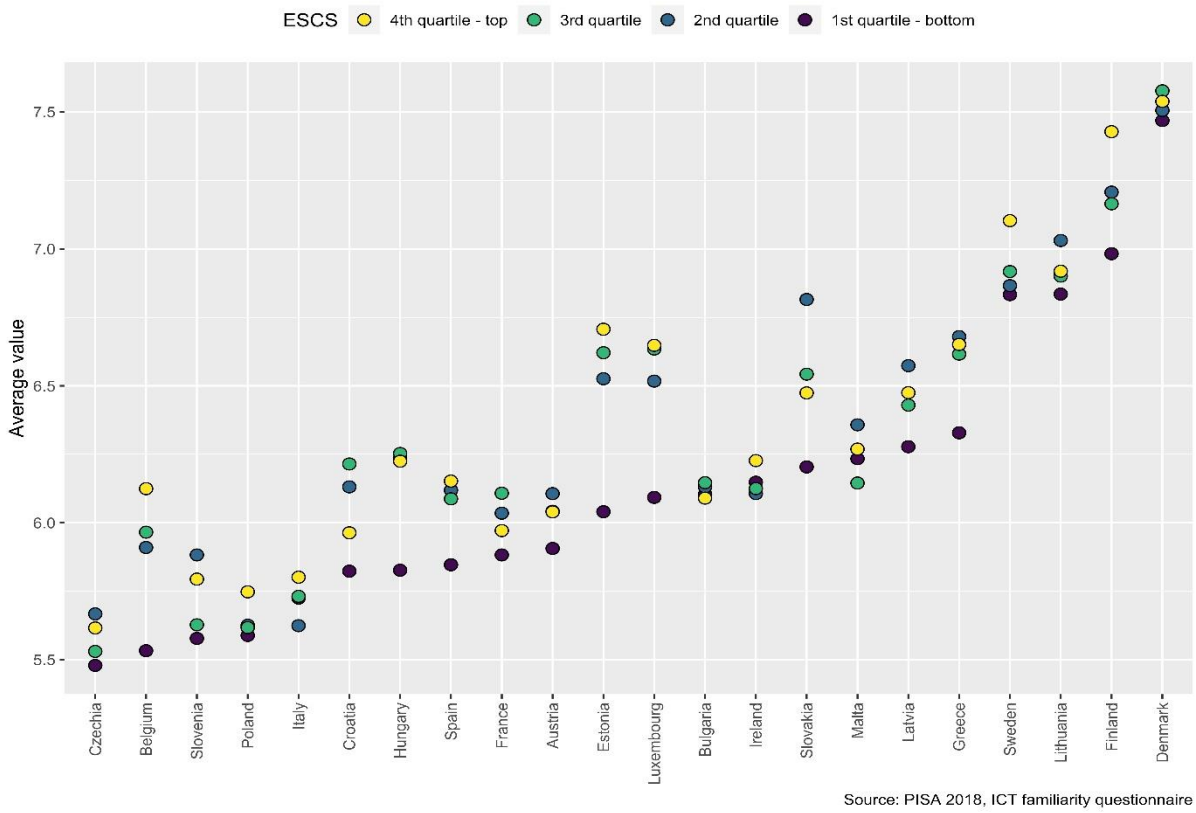
Another way through which the COVID-19 crisis may reinforce social inequality in education is represented by schools. Students from more advantaged backgrounds may be more likely to attend schools with better digital infrastructure and where teachers have higher levels of digital skills.

[23] https://www.repubblica.it/scuola/2020/05/18/news/scuola_didattica_a_distanza-256975788/

3.3.1 Digital infrastructure

Children from more advantaged backgrounds are more likely to study at schools that are well equipped in terms of digital technology resources. Evidence from the 2018 PISA survey would seem to confirm this. Figure 8 reports the mean index of ICT availability for the students to use at school[24] by student socio-economic status for several countries. PISA ESCS index is again used as a proxy for family background and students have been divided into four quartile groups. Disadvantaged students (those in the bottom quartile of the PISA ESCS index) are found to be more likely to attend schools with lower ICT resources. The magnitude of the socio-economic gap appears to be larger in Belgium, Luxembourg, Estonia, Hungary, Finland, and Greece.

Figure 8. ICT availability for the students to use at school by ESCS quartile



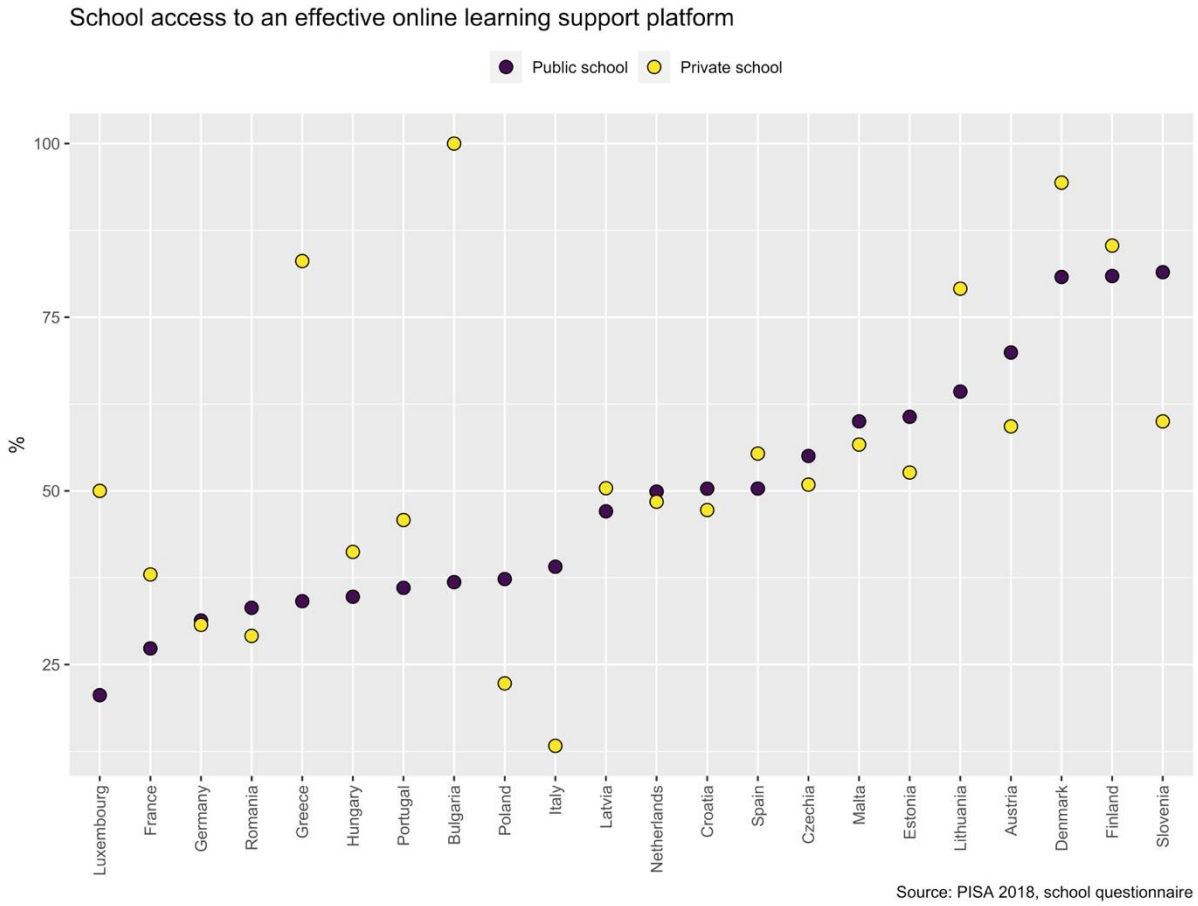
In light of the above, one may assume that schools attended by more advantaged children could have found it easier to adapt to online learning following COVID-19. The results of a survey give us an indication of the digital divide among primary schools in Ireland: about 20% of primary schools had no arrangements in place to keep contact with their students following the closure of schools on 12 March 2020[25]. Schools in disadvantaged, rural or deprived areas are especially likely to lack the appropriate digital capacity and infrastructure required to deliver teaching remotely. Significant differences in the provision of online teaching and learning resources may also exist between private and public schools. For instance, in the UK a survey by Teacher Tapp carried out during the first week after the school closure following the COVID-19 emergency finds that while 66% of

[24] The index for ICT availability for the students to use at school is calculated as the sum of the following 10 items: Desktop computer, Portable laptop or notebook, Tablet computer (e.g. iPad, BlackBerry, Playbook), Internet connected school computers, Internet connection via wireless network, Storage space for school-related data, e.g. a folder for own documents, USB (memory) stick, e-book reader (e.g. Amazon Kindle), Data projector (e.g. for slide presentations) and interactive Whiteboard (e.g. Smartboard).

[25] https://www.irishtimes.com/news/education/coronavirus-primary-school-measures-are-reinforcing-inequality-report-says-1.4221574

teachers in private schools had set work via an online learning platform already on Monday, the corresponding figure for public primaries was 52%[26]. More insights on this issue can be obtained by looking at data from the 2018 PISA school questionnaire. Figure 9 reports the proportion of school leaders who "agree" or "strongly agree" that their school has access to an effective online environment for teaching/learning across several countries, by type of school. It appears that in the majority of countries private schools are more likely to have an effective VLE than public ones (however, this is not true in European countries such as Slovenia, Austria, Italy, Czechia, Poland, Romania, Estonia, Malta and Croatia). The difference between private and public schools is especially relevant in Bulgaria, Greece, and Luxembourg. In Slovenia there is also a quite large gap, but it is in favour of public schools.

Figure 9. Percent of school leaders who "agree" or "strongly agree" with the statement: An effective online learning platform is available



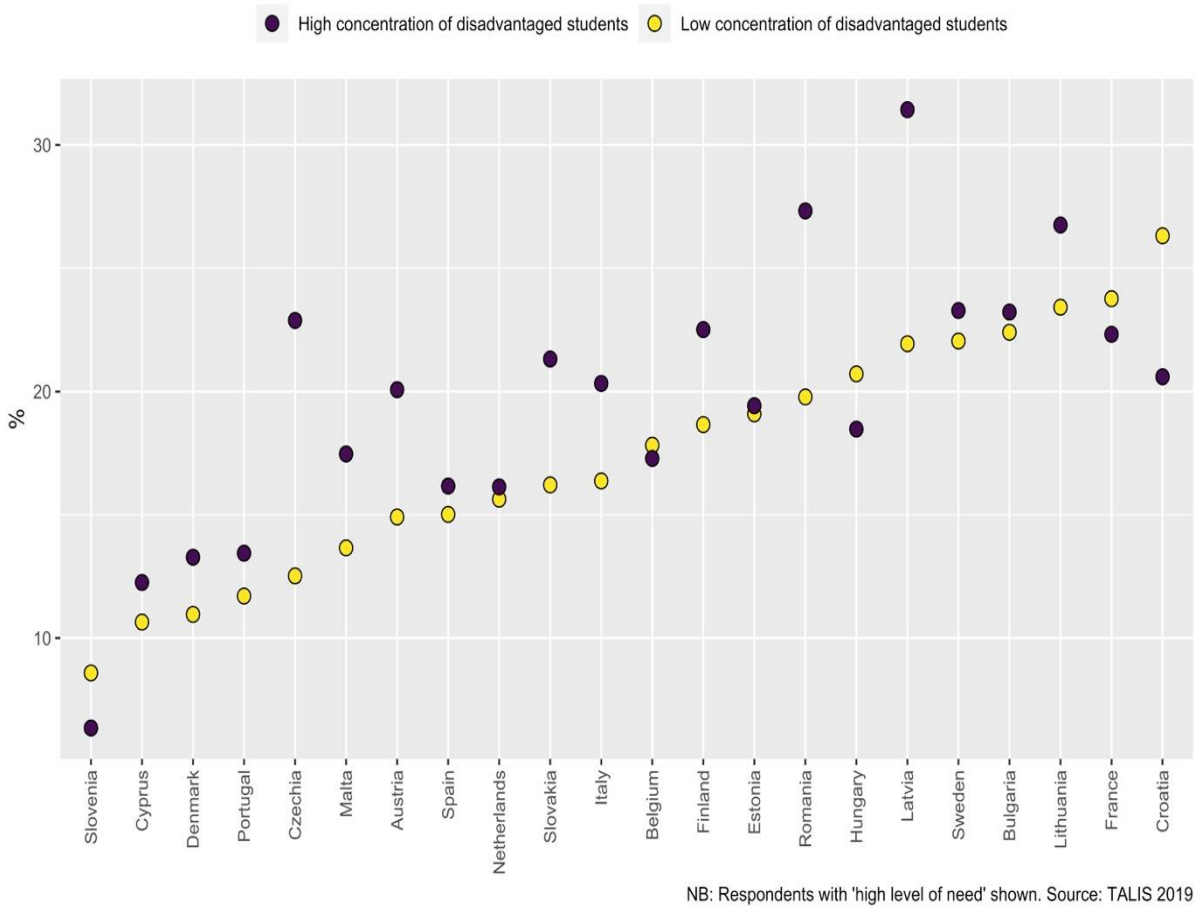
3.3.2 Teachers' digital skills

An additional channel that may contribute to increased inequality in learning outcomes following the switch from offline to online environments lies in teachers' preparedness in digital technologies. This would occur if students from lower socio-economic status are more likely to attend schools where teachers are less able to fully take advantage of e-learning technologies given their lack of or limited ICT skills. However, evidence from TALIS (Teaching and Learning International Survey) 2018[27], a survey gathering information about teachers' working conditions and learning environments at their schools, is not clear in this

[26] https://schoolsweek.co.uk/coronavirus-fears-lockdown-will-lead-to-a-widening-inequality-gap/
[27] Data on lower secondary education (ISCED 2) are considered.

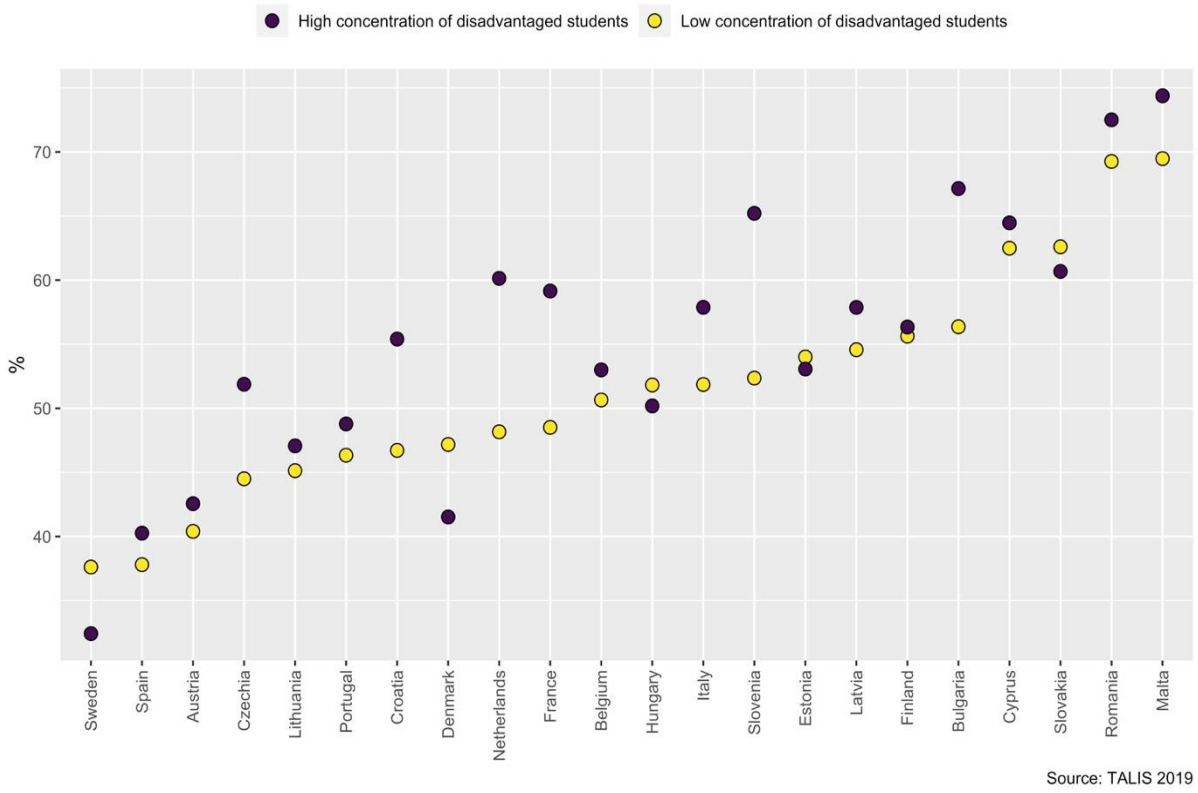
respect. On the one hand, as shown in Figure 10, in most EU countries (apart from Slovenia, France, Croatia, Hungary, and Belgium) teachers who have classes with high concentrations[28] of students from socio-economically disadvantaged backgrounds are more likely to report that they need professional development in the area of ICT skills for teaching. On the other hand, as depicted in Figure 11, teachers who have been educated and/or trained in the use of ICT as a teaching resource are more likely to work in schools with higher proportions of socio-economically disadvantaged students in their classes (with the exception of Sweden, Hungary, Estonia, and Slovakia). Teachers' age may help to reconcile this apparently contradictory evidence. Younger teachers, who are more likely to have been exposed to digital technologies in their education and/or training, begin their career in schools with high concentrations of less advantaged students (Ingersoll 2004). Additionally, they may also be more aware of the importance of technologies and their fast-paced evolution and, hence, more eager to undertake continuous ICT professional development.

Figure 10. Need for professional development in the area of ICT skills for teaching



[28] This refers to classes in which at least 30% of students are socio-economically disadvantaged.

Figure 11. Inclusion of ICT use for teaching in teachers' education and training



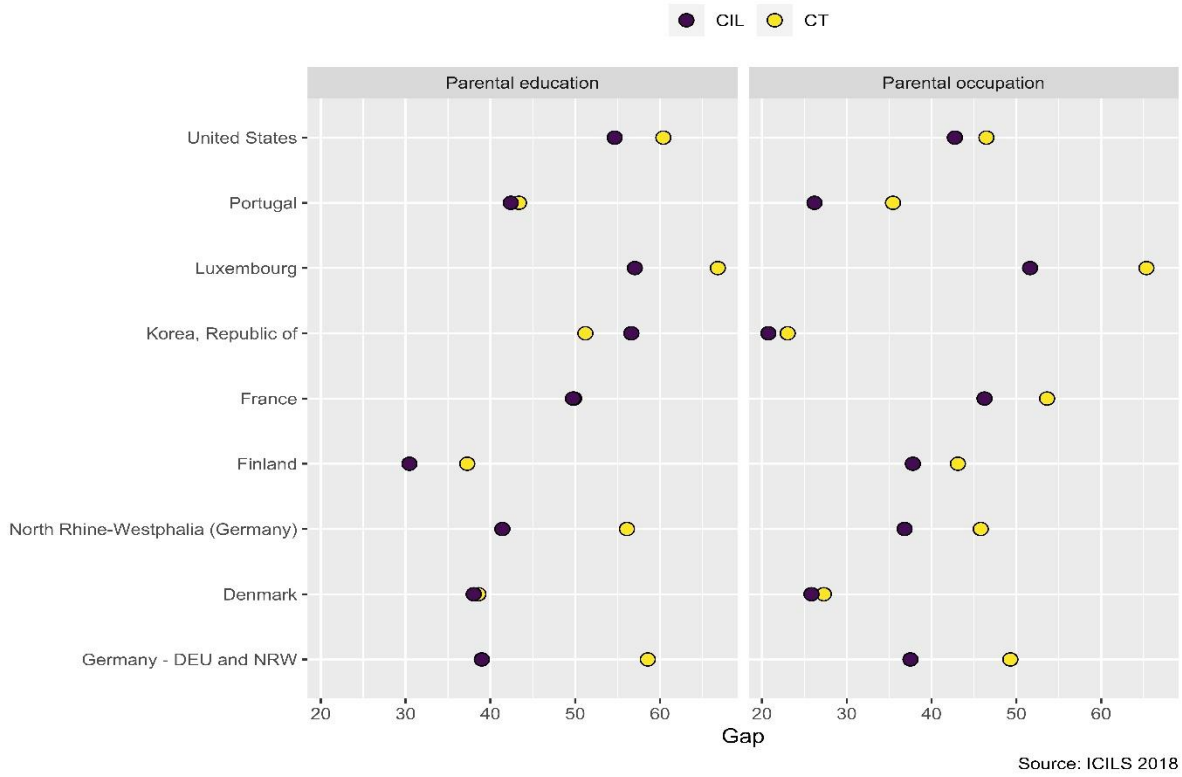
3.4 Students' digital skills

Within disadvantaged households not only may parents not possess basic digital skills, but this may also hold for their children. Such situation puts these students at risk of not being able to fully benefit from remote schooling activities[29]. Umar and Jalil (2012) argue that, as observed earlier, children from less advantaged backgrounds tend to be less exposed to digital technologies and applications (either at school or at home). Data from the 2018 wave of ICILS (International Computer and Information Literacy Study) can be used to look at the association between family background and digital competences. ICILS tests 8-grade students (or 9-grade in some countries) in two areas: computer and information literacy (CIL) and computational thinking (CT). Figure 12 reports socio-economic gaps in the CIL and CT test scores for several countries[30]. High socio-economic status is measured employing two different proxies: a) whether at least one of the parents has a tertiary degree; b) whether at least one of the parents is employed in a professional or specialist occupation (i.e. one-digit ISCO08 1, 2 and 3 occupations). Figure 12 shows that, regardless of the proxy for socio-economic status employed, the gaps are positive, indicating that students from higher status families perform better in both CIL and CT tests than their peers from lower status families.

[29] For instance, a study from Australia shows that 45% of students can be described as rudimentary digital technology users (Kennedy et al. 2010).

[30] CIL is defined as "an individual's ability to use computers to investigate, create, and communicate in order to participate effectively at home, at school, in the workplace, and in society" (Fraillon et al. 2019). CT is defined as "an individual's ability to recognize aspects of real-world problems which are appropriate for computational formulation and to evaluate and develop algorithmic solutions to those problems so that the solutions could be operationalized with a computer" (Fraillon et al. 2019).

Figure 12. Socio-economic gaps in CIL and CT test scores



3.5 Natives vs Immigrants

While until now we have focused on family background to identify more disadvantaged children, one should note that other indicators can also be used. For instance, many studies indicate that there exists a learning gap between native students and migrant students. Several reasons can be offered to explain such difference (Dustmann et al. 2012). Students with a migrant status tend to have parents with lower educational attainment or working in less prestigious occupations, compared to natives' parents[31]. To the extent that there is a strong positive correlation between the educational achievements of different generations, this influences negatively the educational achievements of the students with a migrant status (see Entorf 2015). The process used to allocate students to schools might also be a relevant factor driving the migrant-native learning gap. Migrant students may systematically attend schools with lower resources and less qualified/trained teachers. Finally, the proficiency level of the native language is an important determinant of learning outcomes.

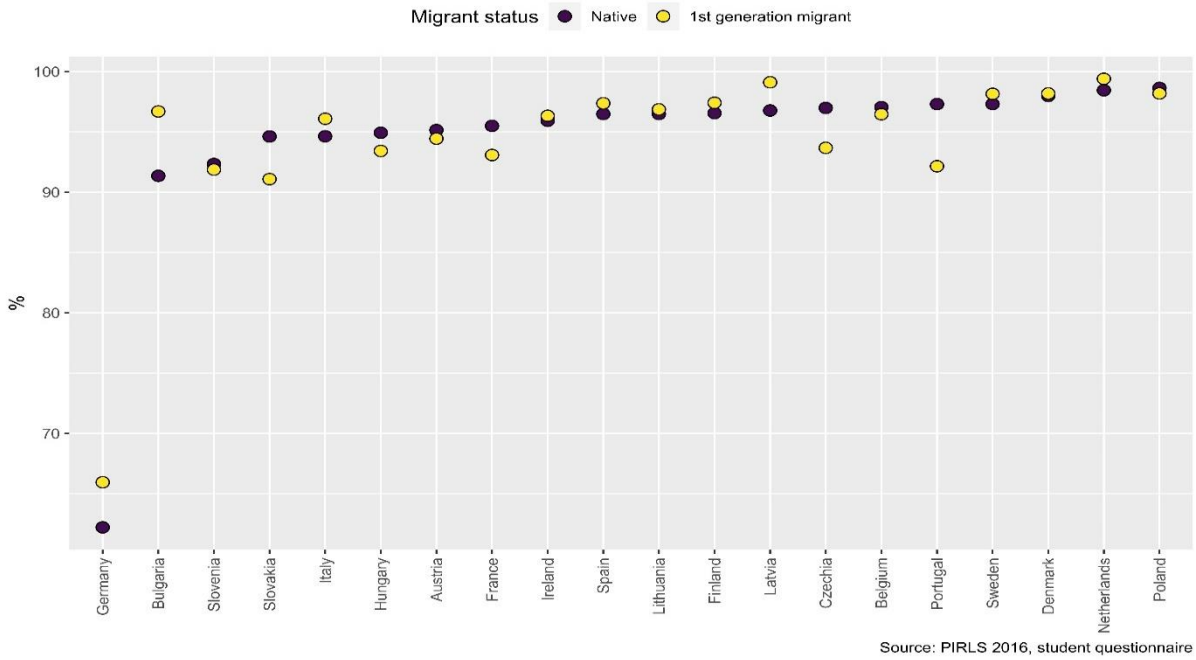
Given the pre-existing learning gap between migrant students and native students across the EU, one may reflect on whether the outbreak of the COVID-19 pandemic is expected to increase it or not. Some interesting evidence is provided by PISA 2018 and PIRLS[32] (Progress in International Reading Literacy Study) 2016. However, while in PIRLS only first-generation migrants can be identified[33], in PISA it is possible to distinguish between first- and second-generation migrants[34]. In both datasets, two of the previously reported

[31] The extent to which this is true very much depends upon the immigration flows of the different countries and hence on their immigration policies. Countries like Australia or Canada have higher shares of immigrants with high educational attainments.
[32] Students participating in PIRLS are in the fourth year of formal schooling or fourth grade, with an average student age of 9.5 years
[33] PIRLS defines migrant students those who were born outside the country in which the test took place.
[34] In PISA, first-generation migrant students are foreign-born students whose parents are also both foreign-born. Second-generation migrant students are instead students born in the country/economy where they sat the PISA test and whose parents are both foreign-born.

indicators are considered: availability of a computer at home and own room at home (as a proxy for having a quiet place for studying at home)[35].

Figures 13 and 14 depict the proportion of children who have a computer at home by migrant status across several countries using PIRLS and PISA, respectively. While in Figure 13 there is no clear pattern in the difference between migrants and natives[36], this is not the case in Figure 14 where most countries display a relatively large disparity. However, both Figures coincide that native students appear to be more likely than migrant students to have access to a computer at home in Portugal, Czechia, Slovakia, and France.

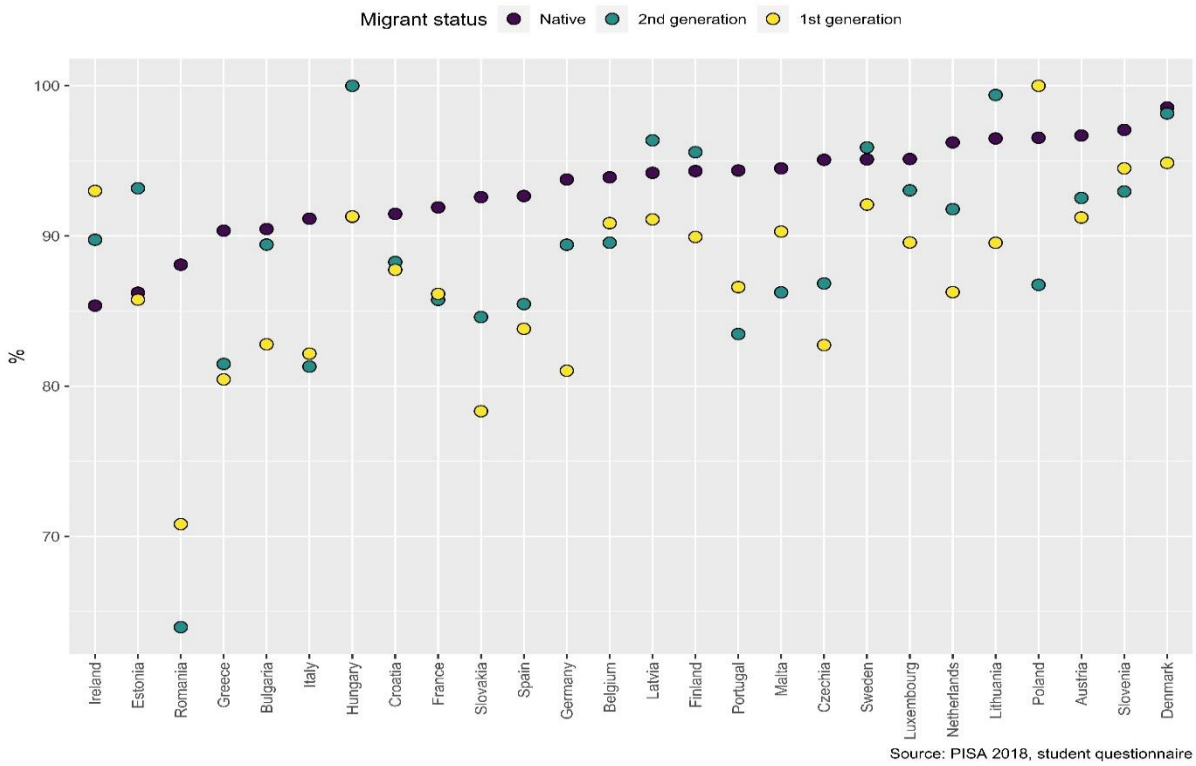
Figure 13: Presence of a computer at home by migrant status (PIRLS)



[35] One should note that data from PIRLS and PIRLS are not fully comparable for two reasons. First, participating children have different ages, i.e. they are younger in PIRLS (9.5 years old on average) relative to PISA (15 years old). Second, while PISA keeps track of second-generation migrants, they are included in the "native" category in PIRLS. Given that second-generation migrants typically fare worse than natives, one would expect the size of the native/first-generation migrant gap to be larger in PISA than in PIRLS.

[36] Data from PIRLS (not shown here but available upon request) show that also as regards internet access there are no significant differences between migrants and natives.

Figure 14. Presence of a computer at home by migrant status (PISA)



Figures 15 and 16 show the proportion of students who have their own room by migrant status across several countries using PIRLS and PISA, respectively. In both Figures natives are generally found to be more likely to have their own room than migrants, though this occurs to a greater extent in PISA. Migrants seem to be at disadvantage especially in France, Belgium, Germany, Austria, Finland, Sweden, Denmark, Spain, and the Netherlands.

Figure 15. Own room at home by migrant status (PIRLS)

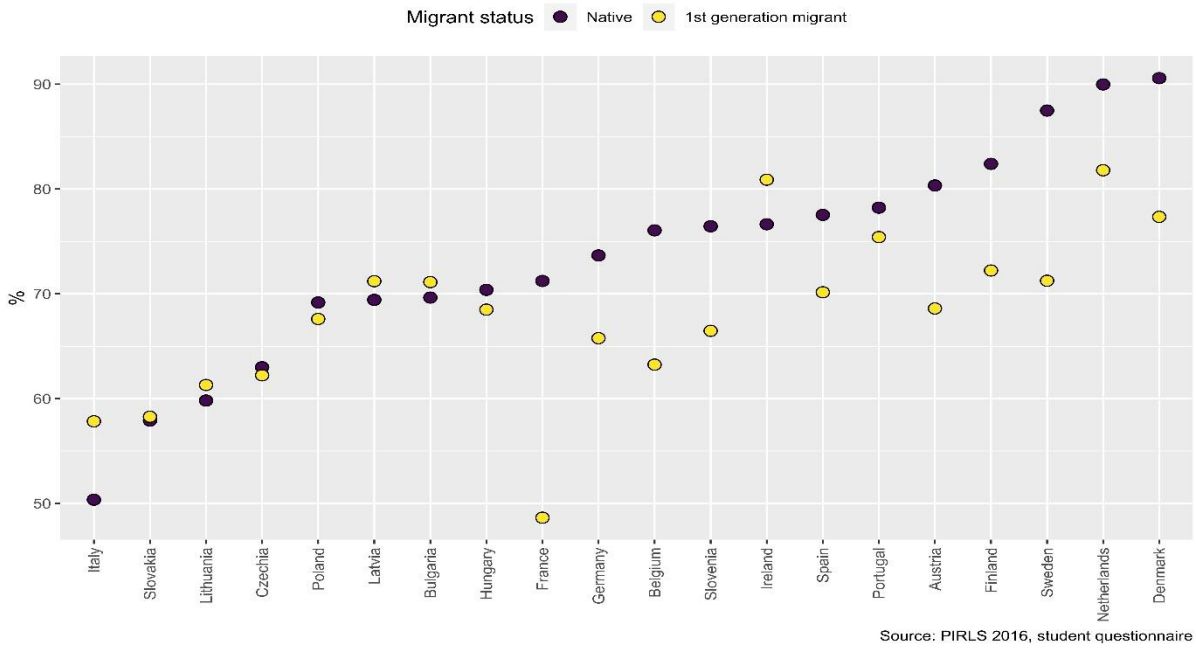
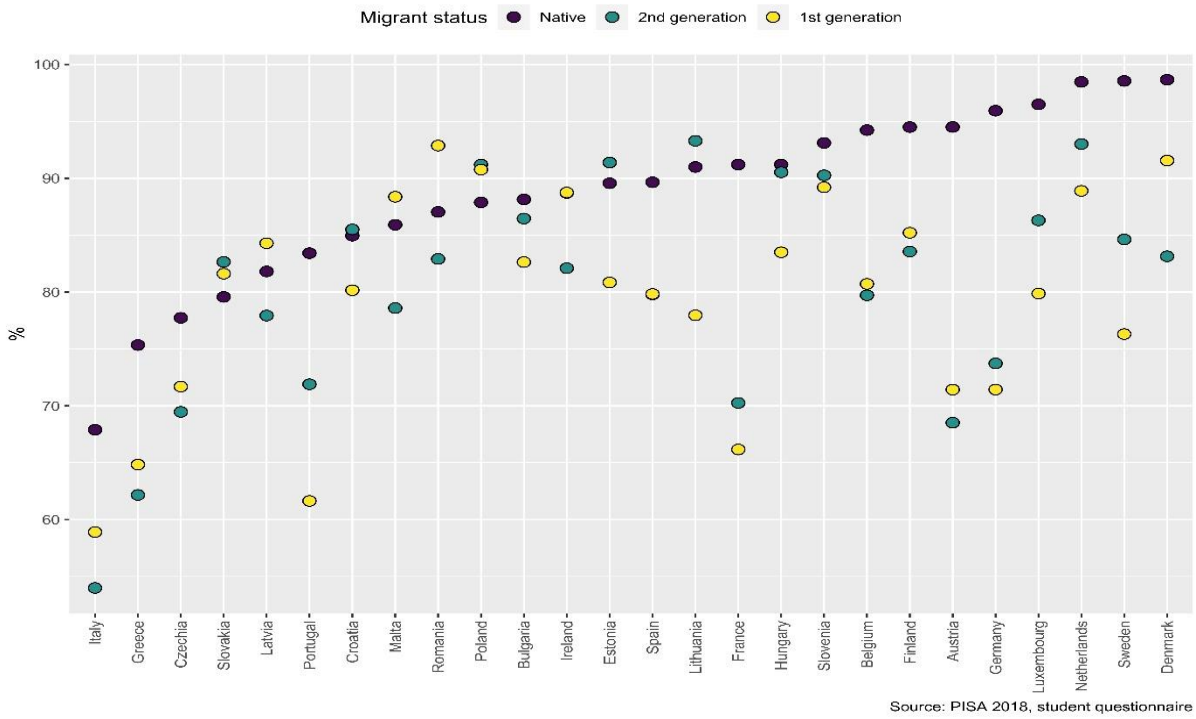


Figure 16. Own room at home by migrant status (PISA)



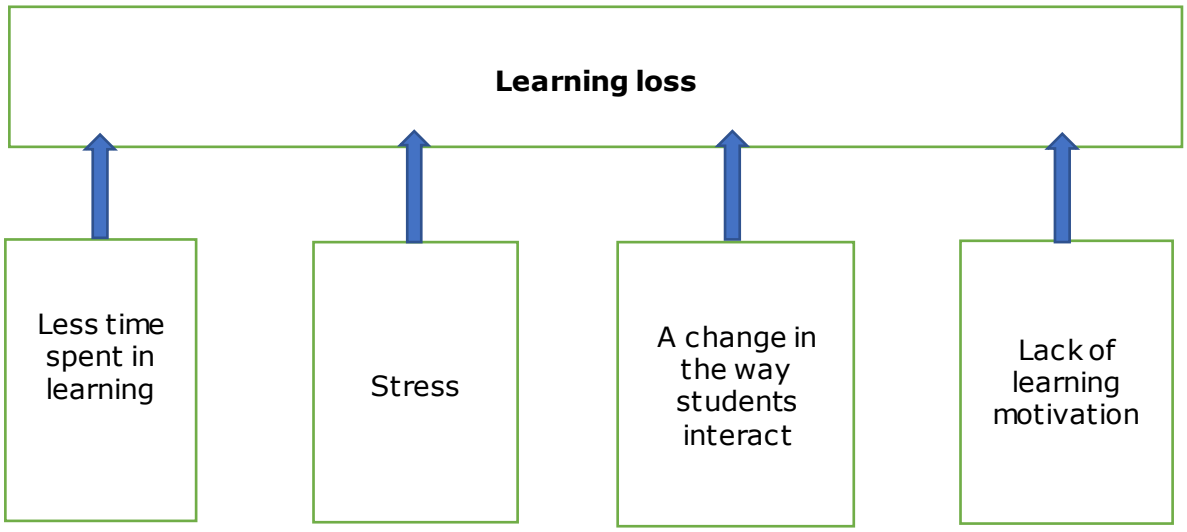
Another aspect to consider, when reflecting on the migrant/native differential impact of the COVID-19 crisis, is that many migrant students' parents might be: 1) less able to provide learning support to their off-springs due to their relatively low familiarity with the content of online learning activities, or to a limited command of the home-country language; and 2) more likely to be employed in occupations that are less likely to be performed from home. As a consequence, migrant students might be more likely to experience low parental support while learning at home. At this stage we have no information to substantiate this hypothesis, but it should be kept in mind when relevant data will become available.

4 Conclusions

To sum up, based on the existing literature and recent available datasets, four main conclusions seem to emerge on the possible impact of COVID-19 on education.

First, student learning is expected, on average, to suffer a setback. Despite the widespread move to online teaching, student progress will not simply be the same as if schools were open. Although online learning has a lot of potential[37], it is more effective when students and teachers have had the time to prepare and get used to it and schools have had the time to test its implementation. Unfortunately, in many cases this did not happen as COVID-19 forced all educational institutions to make a sudden switch to online learning. The results of a School Education Gateway survey[38], which was conducted between 9 April and 10 May 2020 and attracted 4,859 respondents from more than 40 countries (of whom 86% were teachers or school heads), show that, following COVID-19, the majority of teachers (66.9%) had to teach online for the first time. Additionally, many teachers had problems in accessing technology (computers, software, reliable internet connection, etc.).

As illustrated below, one would expect physical school closure and the adoption of distance education to have a detrimental effect on students' learning through four main channels.



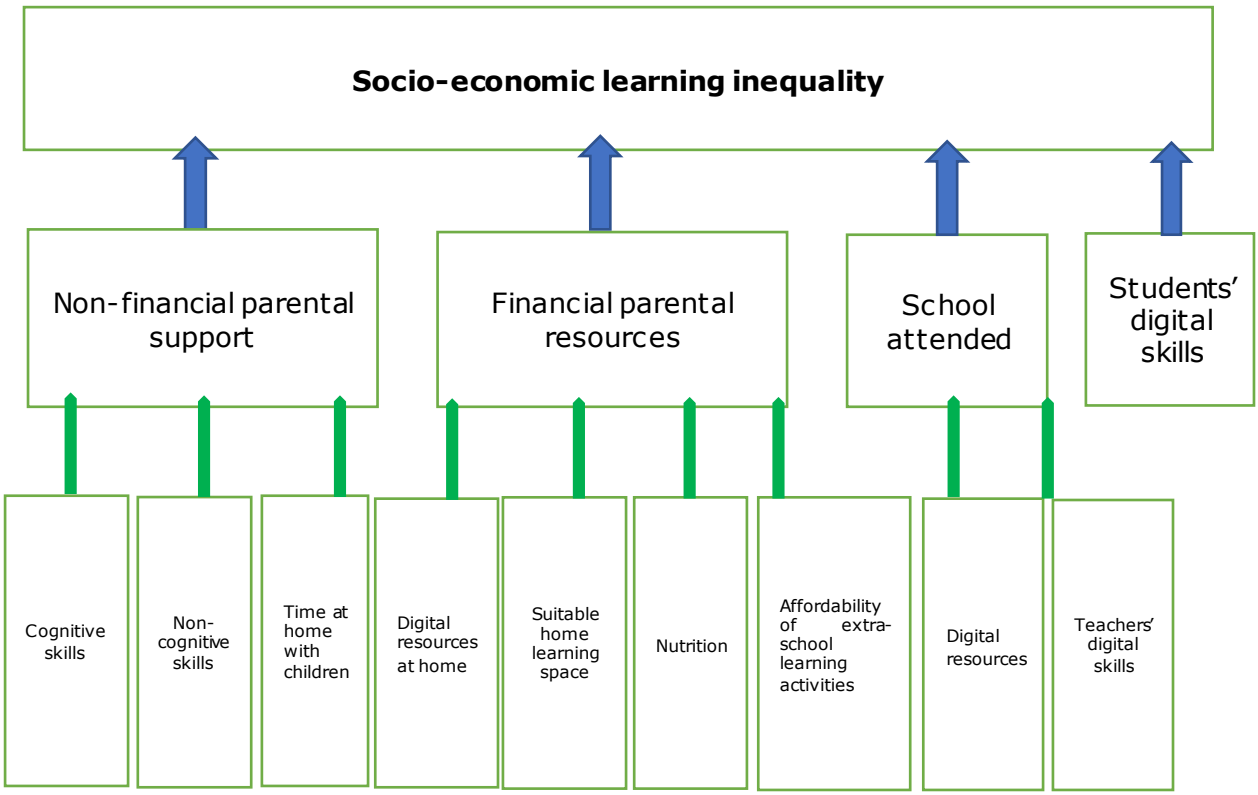
In Annex 1, 'conservative' estimates of the average effect of COVID-19 on student learning are computed for France, Italy, and Germany. Despite the fact that only missed learning time due to the switch from physical to online education is accounted for, these estimates clearly show that physical school closure will cause, on average, a learning loss. Although the size of our estimates indicates a weekly learning loss of between 0.82 and 2.3% of a standard deviation[39], the true magnitude is possibly larger given that other factors, as shown above, are also likely to contribute to the negative effect exerted by COVID-19 on student achievement. Moreover, our estimates would seem to support the hypothesis that the learning loss is greater among younger students compared to older students[40].

Second, the effect of COVID-19 on students' achievement is likely to vary according to socio-economic status. Students from less advantaged backgrounds are likely to experience a larger decline in learning compared to their more advantaged counterparts.

[37] There is evidence showing that the effects of digital education are stronger when technology complements face-to-face teaching rather than when it completely replaces it.
[38] https://www.schooleducationgateway.eu/en/pub/viewpoints/surveys/survey-on-online-teaching.htm
[39] This estimate reflects the average decrease in test score students would be experiencing because of less time spent in learning compared to the amount of time they normally invest when they are in school.
[40] In essence, the ordering of our estimated weekly learning loss is: France (primary education) > Germany (lower and upper secondary education) > Italy (upper secondary education)

This means that one would expect COVID-19 to lead to a wider socio-economic gap in student performance.

As shown below, inequality is likely to be driven by differences in several dimensions and sub-dimensions.



This crisis may also lead to a larger achievement gap between native students and migrant students. It is quite possible that more disadvantaged students will experience a significant learning loss especially in mathematics. School closure and the move to online learning may have a particularly detrimental effect on the learning of younger children who need to start building their softer skills (e.g. communication skills, teamwork) and may have troubles sustaining attention to a computer screen for long. Students with disabilities are at risk of significantly falling behind. Most children with learning difficulties cannot work independently in front of a computer and their supervision is especially challenging. Additionally, losing the daily routine that school offers may have a detrimental effect on students with disabilities who are particularly sensitive to changes in the learning environment.

Third, during this emergency period inequality in socio-emotional skills may also increase. Children from lower socio-economic status are more likely to be exposed to a stressful home environment than their peers from higher socio-economic status. Additionally, parents from more advantaged backgrounds may be better equipped in terms of socio-emotional skills to handle problems emerging during a long confinement period.

Fourth, the widening social gap in both cognitive and socio-emotional skills caused by COVID-19 may have implications not only in the short-term, but also in the long-term. This increased inequality may persist or even grow over time, having consequences on later educational outcomes as well as future labour market performance. Jaume and Willén (2019) examine the long-term consequences of primary school teacher strikes in Argentina. They argue that between 1983 and 2014 students lost, on average, 88 school days. Their analysis shows that being exposed to the average incidence of strikes reduces labour earnings between 2 and 3%. Following this approach, Annex 2 calculates rough estimates of the aggregate annual earnings loss that current French primary students are

likely to experience in the future due to COVID-19. Our computations show that such loss will amount to between 700 and 800 million euro.

In a recent book, Doepke and Zilibotti (2019) show how differing parenting styles are responsible for the increased economic disparity observed in many countries around the world. They emphasize how parents from richer families are increasingly aware of the importance of investing in their children's education. COVID-19 may further exacerbate the parenting gap between families from different socio-economic backgrounds, leading to increased inequality in the future.

Of course, when data on post-COVID-19 will become available, it would be important to investigate if and to what extent our predictions based on the literature and pre-virus available data are valid. Surveys targeted at students, parents, teachers, and school leaders will be an important tool for understanding how the virus has affected different aspects of education. In this context, an important role can be played by SELFIE (Self-reflection on Effective Learning by Fostering the use of Innovative Educational Technologies). SELFIE gathers – anonymously – the views of relevant education stakeholders on how technology is used in primary, secondary, and vocational schools. Overall, it would be beneficial to set up an EU platform to collect all COVID-19 research data so as to enable further rapid analysis by all the academic community[41].

[41] In the same spirit, the European Economic Association (EEA) has created an online registry of research projects that are in progress and involve gathering and analysing data during the COVID-19 crisis (https://www.eeassoc.org/index.php?site=JEEA&page=298&trsz=299).

5 Policy options

Since the beginning of the pandemic public authorities have been taking measures to address the many consequences in the education sector. For instance, Member States have provided support to enhancing the digital skills of teachers and students, suitable access devices and paths to alternative connection means (broadcasting education, digital platforms) as well as content for teaching and learning. What measures can be taken in an attempt to mitigate some of the possible negative effects on education caused by COVID-19?

Students, especially those from less advantaged backgrounds, those with disabilities, those who were struggling academically even before the COVID-19 crisis, and those who lost motivation during the lockdown, will have to make up for the learning loss they experienced. This could start over the summer and continue when the next school year starts. In any case, it would be essential to identify those students who have been hardly hit by the lockdown and put in place catch-up plans for them. Standardized diagnostic testing could be an important tool in assessing students' knowledge level in the relevant areas, and hence their need for meaningful and efficient remedial instruction. Inequalities in students' achievement resulting from physical school closure and the adoption of remote schooling need to be addressed as early as possible given that they may persist and even grow over time, thereby having relevant long-term consequences. One should be especially concerned about widening learning gap among younger pupils.

Small group tuition may be a sensible approach to help weaker and lower socio-economic background students make academic progress more quickly. In a recent article, Burgess (2020) suggests that in the UK small group tutoring can be an effective, rapid and relatively inexpensive method to repair some of the educational damage caused by COVID-19. This type of support could be organized when students come back to school (or even during the summer break in case the appropriate conditions exist). However, given the uncertainty surrounding next school year and the possibility of a second wave of COVID-19 epidemic, it is advisable to put in place both online and offline plans to support students. While working with a small number of students (typically between 2 and 5), teachers are better able to identify and address individual learning needs. Extra support in mathematics may be especially needed. There is evidence from both the US and the UK showing that small group tuition is effective in improving the engagement and attainment of low-attaining pupils[42].

While small group tuition would be beneficial, it is unlikely that a single catch-up approach will be sufficient to make up for the missed learning opportunities more disadvantaged students are likely to have experienced due to the switch from offline to online learning. Governments, teachers, and school leaders will have to adopt additional measures to tackle this issue.

When schools re-open, special attention should be devoted to those children who are transitioning from primary to secondary education. These children are likely to miss out on the transition support that usually takes place in the last year of primary school. The move from primary to secondary education is a critical moment in a child's life as it implies significant changes such as, for instance, having one class teacher vs having a different teacher for each subject and a more challenging curriculum with new approaches to teaching and learning[43].

Although it is not yet clear what are the changes that schools will be implementing to keep children and their staff safe and healthy, one proposal is to operate a rotation with different year groups or classes in school at different days, with the purpose of reducing physical interactions. Students will continue to study online at home during the days they are not

[42] https://educationendowmentfoundation.org.uk/evidence-summaries/teaching-learning-toolkit/small-group-tuition/

[43] https://www.thersa.org/discover/publications-and-articles/rsa-blogs/2020/05/starting-secondary-school

at school. This blended/rotating learning system (with online and offline elements) presents, however, some challenges.

First, dividing pupils into smaller groups at school and continuing to provide distance education requires a revision of the curriculum and a clear identification of the types of teaching and learning activities that need to be performed at school and those that can be done at home (unless the rotating method simply implies that students that are at home follow the lessons that are offered at school, through a video conference facility). This requires a change in both the quantity and quality of the teaching capacity, implying significant investments in terms of qualified teachers and appropriate teaching/learning material. Experienced teachers could collaborate with their digitally skilled colleagues to define concrete teaching and learning programs that capture the best that both online and offline worlds have to offer. In fact, some countries have already put forward plans to recruit additional teachers. In the US, experts have indicated that the federal government could hire recent graduates to provide extra tuition to students[44]. An additional advantage of doing this is that it would help them to get a (provisional) job given the unfavourable labour market conditions caused by COVID-19. In the UK, the Education Policy Institute proposes the setting up a one-year national "Teacher Volunteer Scheme", targeted at retired and inactive teachers, who are willing to give their time to assist schools during this emergency period[45].

Second, younger children are more likely to face difficulties adapting to a blended/rotation model, especially for the online learning part, unless they are closely followed by their parents. Besides, when they are at school, younger children may struggle to understand physical distancing or follow hygiene protocols.

Third, the return to school may also imply different types of problems for older students. Secondary students are typically taught by different teachers and they often need to move from one part to the other of the school. The structure of existing school buildings may be inappropriate if one wants to maintain physical distancing across secondary schools.

Finally, support should be given to working parents if their children are expected to be at home on a regular basis. One possibility would be to have a public fund devoted to financing (part of) parental leaves of working parents that need to support their children when it is their turn to stay at home. This will be essential to preserve employment for those who do not have the option of teleworking and who would face the concrete risk of having to leave their job to assist their children. A public fund, coupled with the prohibition to dismiss those who stay at home to support their children learning activities, would guarantee that the financial burden does not entirely fall on firms.

At the same time, it is important to provide students with emotional support. As argued earlier in the report, many students are likely to suffer from stress following COVID-19. They may have had little opportunities to play outside, and some of them might have seen their family members becoming ill. This crisis might have had a negative effect especially on the socio-emotional skills of students from less advantaged households. In light of this, it would be advisable to increase the number of school mental health specialists and counsellors that will be able to offer relevant support in these circumstances.

There is also the risk that COVID-19 may increase the number of early school leavers. Especially students from unprivileged backgrounds may find it hard to go back to school after a long absence from it. This would be unfortunate given the EU's declining trend in the proportion of early leavers from education and training[46]. Policies designed to reduce early school leaving need, therefore, to be strengthened and monitored. For instance, since some students from disadvantaged families may be tempted to drop out of school if one

[44] http://blogs.edweek.org/edweek/rick_hess_straight_up/2015/08/what_if_every_struggling_student_had_a_tutor.html

[45] https://schoolsweek.co.uk/epi-suspend-ofsted-inspections-until-2021-and-launch-retired-teacher-volunteer-scheme/

[46] In the EU, the proportion of 18-24 year olds who had completed at most a lower secondary education and were not in further education decreased from 11.9 in 2013 to 10.6 in 2018 (https://ec.europa.eu/eurostat/statistics-explained/index.php/Early_leavers_from_education_and_training).

or both their parents lose their job because of the COVID-19 crisis, financial incentives – such as scholarships, cash payments, vouchers – could be offered to these families in an attempt to avoid this. These types of interventions (often referred to as means-tested conditional cash transfers) have been implemented in several developed countries (e.g. the "Helping Outstanding Pupils Educationally" (HOPE) program in Georgia, US). In Europe, the Earnings Maintenance Allowance (EMA) program was piloted in England in 1999 before national implementation. Dearden et al. (2009) find that EMA worked very well in reducing the proportion of school dropouts.

Once the COVID-19 emergency period ends and schools re-open, governments and schools should continue investing in e-learning. They will have to carefully consider all the lessons learnt from this crisis that required a sudden and unexpected switch to online teaching. They will have to analyse what worked, did not work, and why. In fact, this critical approach has already started[47] and will become more articulated when data on the response of schools, teachers, parents, and students to the COVID-19 challenge will become available.

One point that certainly deserves further attention is the role that online learning can play in primary and lower secondary education. Studies of the relative efficacy of online vs offline learning mostly concentrated on upper secondary and tertiary education, and the evidence is mixed and context specific, which makes it very difficult to draw any general conclusions[48].

However, it seems safe to argue that online learning is not likely to be very effective for primary school students, unless it is carefully designed to meet the needs and the characteristics of young children. Many lower secondary school students might also find online learning challenging, especially at the beginning of the cycle, when they face new topics, new teachers, and new classmates.

At this moment in time the expectation is that schools will re-open in September 2020 across Europe (unless a massive second COVID-19 wave materializes). But even in this case there is the concrete possibility that students will be required to continue learning from home, at least for some time, either confined during the next lockdown or simply because they experience a rotating/blended model. To reduce potential learning losses, which have long-lasting effects, education systems should put in place appropriate programs and plans for delivering online at least part of teaching and learning activities. This is an essential element of a strategy increasing the resilience of human capital accumulation to external shocks.

While the path from emergency remote schooling to more efficient education pedagogies is being developed, we think that the following elements should be part of a successful strategy integrating online and offline teaching and learning activities.

- Guarantee access to internet and availability of computers, laptops, or tablets:

Access to the internet at a decent speed and to proper ICT tools are basic prerequisites for any online teaching and learning strategy. Evidence shows that disadvantaged students are less likely to have access to them. Governments could reduce internet access costs for disadvantaged households and guarantee free provision of computers, laptops, or tablets for disadvantaged students[49]. The precise definition of "disadvantaged" would need to be agreed upon, but most likely it will be based on income/wealth elements, labour market participation, risk of social exclusion, and presence of specific family circumstances that can increase the risk of low educational attainment or higher drop-out rates (in fact, these

[47] For an early attempt see: https://edtechhub.org/wp-content/uploads/2020/05/whats-working-whats-not.pdf.
[48] For an historical analysis of the effectiveness of distance learning vs in class learning see Russell (1999). The findings come from more than 350 media comparison studies which consistently show that distance learning doesn't necessarily offer an obvious benefit to learners, but it also doesn't put them at a disadvantage or risk relative to those who participate in in-class instruction. The studies discussed by Russell refer primarily to distance learning courses provided by universities
[49] https://edtechhub.org/overview-of-emerging-country-level-response-to-providing-continuity-under-covid-19-what-steps-are-being-taken-to-reach-the-most-disadvantaged-students-during-the-period-of-covid-19-school-closure/

could be covered -at least in part- by the Child Guarantee, currently under preparation by the EU Commission).

- Adopt proper Virtual Learning Environments[50] (VLE):

VLE can give learners access to educational resources, connect students with teachers and facilitate remote lessons. The selection and the overall impact of VLE crucially depend on teachers' pedagogical and technological readiness and on students' and parents' digital competences (accessibility of the internet and availability of appropriate ICT tools are preconditions). The choice of the appropriate VLE will also depend on the degree of uniformity that governments intend to guarantee across different geographical areas. Various types of VLE exist, from basic content repositories, to scaffolded curriculum-aligned repositories, to synchronous and asynchronous platforms offering a wide range of tools and services. Different models should be tested in different contexts and the selection should be based on an accurate analysis of the relative pros and cons of each VLE.

- The role of broadcasting education:

Educational broadcasting, i.e. the dissemination of education programmes by public television or radio[51], can be a useful complement to online programmes as it delivers teaching to those who do not have access to the internet, and equalises teaching methods and material across schools within a country or region[52]. However, there are also concerns related to the efficiency of educational broadcasting as a means of transferring knowledge to students. Relevant studies are scarce and they were published back in the 1980s or 1990s (for a more recent study, see Ha 2017), as the rise of private television corporations and, most importantly, the internet, changed the landscape in later decades. Educational broadcasting has strong traditions in a number of countries, such as the UK (Sumner 1991), Sweden (Runcis and Sandin 2010), the US (Kentnor 2015), Australia (Oliver, et al. 1994), South Africa (Barnett 2002; Nwanko 1973), or Uganda (Kiwanuka-Tondo 1990), to give just a few examples. During the COVID-19 pandemic, educational broadcasting has been used to support remote learning in a number of countries (e.g. Croatia, Czechia, North Macedonia, Serbia, Spain, or Poland[53])[54].

- Improve availability of learning technology for students with Special Educational Needs and /or Disabilities (SEND):

Students with Special Educational Needs and /or Disabilities (SEND) are among those who are more likely to suffer from physical school closure. Even if they are supported by online personalized tutoring, the fact that this is mediated by technology tends to reduce its effectiveness. On the other hand, digital technologies can provide useful support to SEND students, especially if they are part of a coherent and overarching process. Assistive technologies, which can improve communication, allow mobility, and increase participation, are an important tool to enhance learning for individuals with specific disabilities. In order to successfully implement learning strategies for SEND students, it is essential to: i) identify who they are and their special needs or disabilities; ii) identify the assistive technologies that can best support SEND students (depending on the type and degree of disability), iii) involve SEND students and their families in the process, in order to get their

[50] https://docs.edtechhub.org/lib/53YEZE6A/download/SSRAEANF/HDR07.%20The%20use%20of%20virtual%20learning%20environments%20and%20learning%20management%20systems%20during%20the%20COVID-19%20pandemic%20%28v2%29%20%28DOI_%2010.5281_zenodo.3805843%29%20%281%29.pdf

[51] Educational broadcasting gained popularity in the early 20th century, with the advent of public radio and, later, television, but its origin can be traced even further back, to 19th century, when universities began to offer distance courses, to provide educational opportunities to those who would otherwise be excluded from tertiary education.

[52] https://blogs.unicef.org/evidence-for-action/can-broadcast-media-foster-equitable-learning-amid-the-covid-19-pandemic/

[53] https://krytykapolityczna.pl/kraj/szkola-z-tvp-czyli-jak-sie-konczy-oszczedzanie-na-dzialaniach-edukacyjnych/

[54] See https://www.worldbank.org/en/topic/edutech/brief/how-countries-are-using-edtech-to-support-remote-learning-during-the-covid-19-pandemic and https://www.unhcr.org/5ea7eb134.pdf for a comprehensive overview of how countries responded to educational challenges related to the COVID-19 pandemic.

support and commitment; iv) monitor progress and act accordingly (eventually modifying the initial strategy).

- Support teachers:

Teachers are possibly the most important element in the whole process, and especially so in relationship with disadvantaged students, for whom the family can often offer only limited support (in fact, in many cases teachers have a mediating role between students and their family). Teachers should learn how to adapt their role to a situation in which they can communicate only online and in which even students typically performing well at school may tend to lose motivation when shifting to online learning. It is essential to improve teachers' digital competences across all ages, and this could be done with workshops and training courses (Redecker 2017)[55], which should become part of their continuous professional development. Supporting collaborative types of professional development between teachers (e.g. teacher networks) would also be important, as it would allow them to learn from their peers. Curriculum materials designed specifically for online use should be developed. Additionally, relevant stakeholders (policymakers, school leaders, teachers, parents) need to adopt a coordinated approach. In particular, the overall strategy for online education, together with teaching and learning materials, should be developed through a coordinated process, in order to avoid that each teacher or school chooses its own approach, which would simply increase duplications without delivering higher efficacy. This does not imply that different models could not coexist, but even in this case this should be well organized and managed.

- Support parents to help their children:

Parents are also an essential element of the picture, and more so for younger students who cannot be left alone facing the challenges of online learning. Parents should be involved in the design of the strategy and in its implementation as they need to fully understand what is taught and why. Parents should also be informed of the emotional challenges that online learning entails, which are likely to be greater for young children, but which could also affect adolescent students. Parents need to learn how to support their children emotionally and in their daily school tasks. Constant and detailed communication between parents, teachers, and the school is a fundamental element of a successful online learning strategy.

Finally, in order to gain a better understanding of what worked, did not work, and why during the COVID-19 crisis, it is important to collect accurate, valid and reliable data. High-quality data (especially in the area of assessment) can provide valuable information about how to best support students in times of disruption and uncertainty.

[55] Countries can apply for EU funding in order to provide training to teachers on the use of digital technologies.

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Annexes

Annex 1. Computation of 'conservatives' estimates of the average effect of COVID-19 on student learning in a few selected EU countries

In this Annex, we attempt to derive rough estimates of the average impact of COVID-19 on students' learning in a few EU countries. However, only the loss of learning time due to the switch from physical to online education is considered. This means that our estimates are 'conservative' and hence likely to underestimate the true learning loss. For instance, as argued earlier, other factors (i.e. stress, a change in the way students interact, and lack of learning motivation) are also expected to contribute to the negative effect that COVID-19 may exert on student achievement[56].

France

In France, schools were shut down on 16 March 2020 and started to progressively re-open after 11 May 2020. Younger children, including pre-schoolers, have been the first ones to go back to school (although on a voluntary basis). The period 16 March – 11 May is therefore considered in this analysis. However, one should bear in mind that during this period schools would have been closed for 2 weeks due to the Easter school break regardless of COVID-19. Hence, there are 6 missed school weeks in total.

According to the aforementioned survey carried out by Delès and Pirone, French parents report that during the lockdown, on average, they engage with their children in home learning activities for about 3.2 hours per day. Although the survey is targeted at students of different educational levels, we focus on primary school students as they are less likely to conduct their learning independently[57]. In France, when schools are open, primary students spend, on average, about 5 daily hours in 'net teaching' at school (OECD 2019). Additionally, there is some evidence that it takes to these students about one hour per day to do their homework[58]. This means that, in normal circumstances, they spend approximately 6 daily hours in learning.

Many studies have attempted to compare online learning vs traditional learning. Results are mixed[59] and a large number of them conclude that there is no statistically significant difference between these two teaching delivery modes in terms of student achievement (see, for instance, Birkeland et al. 2015; Wrenn 2015). Then, our approach would be to consider hours spent in online learning to be equivalent to those spent in traditional learning sessions[60].

In light of the above considerations, it emerges that, in the absence of COVID-19 and physical school closure, French primary students would be spending 2.8 (6 – 3.2) more hours per day in learning, or 14 (2.8*5) more hours per week. Given that, as stated earlier, 6 school weeks were missed, the total number of learning hours that French students have

[56] Assumptions outlined in footnotes 60 and 62 also point towards an underestimation of our estimates for the learning loss caused by COVID-19 even considering only missed learning time.

[57] 3.2 hours is an average value across all educational levels, and therefore it is not specific to primary students. In addition to primary students, the survey is also addressed to pre-primary and secondary school students. If, on the one hand, parents are likely to spend less time helping secondary students with their home learning relative to primary students (leading to an overestimation of the figure used in our analysis), on the other this could be partially compensated by the fact that parents are likely to spend more time with pre-primary students than primary students.

[58] https://www.theschoolrun.com/primary-school-in-france

[59] Ahn and Mceachin (2017) find that in-person courses are more effective than online courses, though it is important to keep in mind that their study focuses on a very specific type of schools, i.e., K–12 schools that deliver most, if not all, education online, lack a brick-and-mortar presence, and enroll students full-time. By contrast, the results of a meta-analysis carried out by Means et al. (2010) indicate that students in online learning conditions performed better than their peers receiving face-to-face instruction.

[60] It is here assumed that online and traditional learning methods have the same effect on student achievement throughout the whole lockdown period. However, this may not be necessarily true. During the initial days or weeks of the lockdown, students (and their parents) needed to adapt to the new situation, so probably they weren't able to study very effectively. Over time, they are likely to have developed routines to learn more effectively.

lost is 84 (6*14). This represents 9.33%[61] of the total number of net teaching hours in French public primary schools during an entire academic year. In order to have an approximate estimate of the impact of this situation on student achievement, one can rely on the findings of the analysis carried out by Lavy (2015). As argued earlier, using PISA 2006 data, he finds that one additional weekly hour of instruction over the school year in the main subjects increases test scores by about 6% of a standard deviation. In our case[62], given that the number of instruction weeks in the school year for French primary students is 36, 84 missed learning hours correspond to a loss of 2.33 (84/36) hours per week. This would imply a learning loss of about 14% (6%*2.33) of a standard deviation[63]. In PISA, students' scores are scaled to have a mean of 500 points and a standard deviation of 100 points. Thus, 14% of standard deviation corresponds to a difference of 14 points on this test — and any other test which has the same characteristics. In addition, one could use the results of the Trends in International Mathematics and Science Study (TIMSS) to provide further insights into the meaning of the difference. Standardised tests in TIMSS have the same measurement properties as those in PISA. Additionally, TIMSS is administered to both 8th-graders and 4th-graders. The latter provide a useful point of reference, as our focus here is on primary school students. In TIMSS 2015, the best country in the mathematics test at 4th grade, Singapore, had an average score of 618 points. At the same time, Kuwait, the worst performing nation, had an average score of 353 in the same test. Thus, the learning loss of 14 points would correspond to 5% of the difference between the best and the worst performer in TIMSS 2015.

Italy

In Italy, schools were shut down on 9 March 2020 and they did not reopen in the 2019-2020 academic year. This means that schools have been closed for 86 days[64], which correspond to 12.29 weeks.

According to a survey[65] conducted by Skuola.net, the number of average daily hours spent in home learning activities by Italian students during the lockdown is about 3.84. Since this survey was targeted at students aged between 14 and 20 years, one would expect that most of the surveyed students attend upper secondary schools. In Italy, when schools are open, upper secondary students spend around 15.82 (617/39) weekly hours in 'net teaching' at school or 3.164 hours per day (OECD 2019). One may also consider that these students are likely to spend, on average, 1.74 hours per day doing homework[66]. The total number of daily learning hours is then 4.904.

Again, assuming that hours spent in online learning are equivalent to those spent in traditional learning sessions, COVID-19 and school closure could have led to a decline in learning hours of 1.064 (4.904 – 3.84) hours per day or 5.32 (1.064*5) hours per week. This translates into a loss of learning hours of 65.38 over 12.29 weeks. This accounts for about 10.60% of the total number of net teaching hours in Italian public upper secondary schools during an entire academic year. Additionally, since the number of instruction weeks in the school year for Italian upper secondary students is 39, 65.38 hours correspond to a

[61] A similar estimate is obtained by considering the simple assumption made by Favero, Ichino and Rustichini (https://www.ilfoglio.it/scuola/2020/05/08/news/si-puo-tornare-a-scuola-dividendo-gli-insegnanti-non-gli-alunni-317160/). They hypothesize that online learning is half as effective as traditional learning. Following this approach, French students would be missing 12.5 learning hours per week (half of the 25 weekly net teaching hours at school), which over 6 weeks correspond to 8.33% of the total number of net teaching hours in French public primary schools during the whole academic year.

[62] It is here assumed that the effect of missed learning time is linear, i.e. the learning loss caused by missed learning time is constant over learning hours. However, there are reasons to believe that such effect might be non-linear. Due to the cumulative nature of the learning process, there could be increasing returns associated with more learning hours.

[63] Given that some French primary schools may re-open later than 11 May 2020, it is interesting to note that for every additional week of school closure the learning loss is estimated to be around 2.3% of a standard deviation.

[64] In Italy the academic year ends in the first half of June, but the date varies across regions. We consider the date of 9 June (i.e. the average across all June dates). Additionally, we subtracted 7 days from the computation of the total number of missed school days (3 days for Easter and 4 days for other public holidays).

[65] https://www.skuola.net/news/inchiesta/coronavirus-quarantena-adolescenti-generazioni-connesse.html

[66] Results from PISA 2012 show that 15 years old Italian students spend, on average, 8.7 hours doing homework (OECD 2014).

loss of around 1.68 (65.38/39) hours per week. Following the conclusions of Lavy (2015), such a decline in instruction time may yield a learning loss of 10.08% (6%*1.68) of a standard deviation[67]. This would correspond to a difference of about 10 points on a standardised test with the same measurement characteristics as PISA or TIMSS.

Germany

In Germany, schools were shut down on 16 March 2020 and started to progressively re-open after 4 May 2020[68]. In contrast to France, older children, who are taking exams at the end of the school year, have been the first ones to go back to school. The period 16 March – 4 May is therefore considered in this analysis. Schools were closed for 47 days, though one should note that this period comprises 12 Easter school break days. The total number of missed school days is hence 35, which correspond to 5 weeks.

According to the aforementioned Schul-Barometer (School Barometer) survey targeted at German, Austrian and Swiss students, students' weekly learning time during the COVID-19 lockdown is reduced by between 4 and 8 hours, compared to when schools are open. Given that respondents' age is between 10 and 19 years, one would expect that the majority of the surveyed students study at lower and upper secondary schools. Assuming that the missed learning time reported by the survey only refers to teaching at school, one should also consider that lower and upper secondary students may spend, on average, 0.94 hours per day doing homework[69]. The total number of missed learning is then between 8.7 and 12.7 hours per week, which is equivalent to between 43.5 and 63.5 over 5 weeks. This represents between 5.97 and 8.72% of the total number of net teaching hours in German public lower and upper secondary schools during an entire academic year (OECD 2019). Furthermore, given that the number of instruction weeks in the school year for German lower and upper secondary students is 40, between 43.5 and 63.5 missed learning hours correspond to a loss of between 1.09 (43.5/40) and 1.59 (63.5/40) hours per week. In line with the findings of Lavy (2015), this reduction in instruction time may bring about a learning loss of between 6.54% (6%*1.09) and 9.54% (6%*1.59) of a standard deviation[70]. Using the same type of standardised tests as before to interpret this result, the implied learning loss corresponds to a difference of between 6.5 and 9.5 points on a test with the same scale as PISA or TIMMS (i.e., mean of 500 and standard deviation of 100).

[67] In other words, each week of school closure leads to a learning loss of about 0.82% of a standard deviation.

[68] One should, however, note that there are differences across German states as regards school re-opening.

[69] Results from PISA 2012 show that 15 years old German students spend, on average, 4.7 hours doing homework (OECD 2014).

[70] Given that some German lower and upper secondary schools may re-open later than 4 May 2020, it is interesting to note that for every additional week of school closure the learning loss is estimated to be between 1.31% and 1.91% of a standard deviation.

Annex 2. Computation of rough estimates of the long-term macro consequences of the likely effect exerted by COVID-19 on education in France

In this Annex, we look at the long-term macro implications of the likely effect exerted by COVID-19 on education. In particular, we attempt to derive rough estimates of the aggregate annual earnings loss resulting from the loss of learning time due to the switch from offline to online learning, as calculated in Annex 1. Our attention is focused only on France because, in order to compute these estimates, one would need to use a figure for average annual/monthly earnings, which can be more easily worked out if the relevant educational level is compulsory[71]. France is the only country among those considered in Annex 1 where a mandatory educational level (i.e. primary school) is examined. The remainder of this Annex outlines a method that can be employed to get the above-mentioned estimates.

In Section 4 we presented evidence from Jaume and Willén (2019) that 88 days of teacher strikes in primary school in Argentina reduced labour earnings between 1.9 and 3.2% (the average is 2.55%). As stated in Annex 1, the total number of learning hours that French students have lost due to COVID-19 is 84, which is equivalent to 16.8 missed school days (French primary school children spend 5 'net learning hours' per day at school, i.e. 84/5=16.8). Following[72] the findings of Jaume and Willén (2019), 16.8 missed school days are expected to decrease labour earnings by 0.49%.

The next step is the estimation of the reference earnings over which the loss can be computed. Since earnings around age 40 are considered to be a good predictor of life-cycle earnings (Böhlmark and Lindquist 2006), we take as reference the gross monthly full-time equivalent (FTE) earnings of those whose age was between 39 and 41 in 2018 (euro 2,455; source EU-SILC). The cohorts affected by physical school closure in 2020 here considered are those in primary education, hence in the age interval 6-11[73]. Assuming an annual growth rate of 1% for real earnings from 2018 to 2054, it is possible to estimate the real gross monthly FTE earnings of individuals between the ages of 6 and 11 in 2020 when they will turn 40 (which will happen between 2049 and 2054). The relevant values are shown in column 2 of Table A2.1 (upper panel). We then need to multiply the expected earnings for each age-cohort by the corresponding size as of 1/1/2020[74] (see column 3 in Table A2.1). The sum of the resulting products gives us the overall monthly earnings at age 40 (euro 17,017,147.65). Additionally, given that one would not expect all current primary school students to be working around the age of 40, this is then multiplied by the employment rate of individuals in the age interval 39-41 in 2018 (83.8%; source EU-SILC), and then by the aforementioned estimate of the monetary loss in earnings as a result of 16.8 missed school days (0.49%). Finally, this needs to be multiplied by the survival rate of individuals aged between 5 and 39 (1-0.027=97.3%)[75]. The result is euro 67,989,162.83, which represents expected monthly real earning loss for all primary students affected by physical school closure in 2020 due to COVID-19, corresponding to an annual loss of euro 815,869,953.9.

[71] In this case, we can take average earnings as a reference. If instead the educational level is beyond compulsory education, the relevant earnings figure is higher than average earnings but it is difficult to calculate its amount (for instance, some upper secondary school students will not go to university, others will attend university but not complete their studies, etc.).
[72] The implicit assumption is that the effect of missed school days on earnings is linear. An alternative hypothesis would be that such effect is convex (it increases as the number of lost school days increases). If this is case, then our computations would be overestimating the expected earnings loss.
[73] Students repeating a year are not considered.
[74] https://www.insee.fr/en/statistiques/2382597?sommaire=2382613#consulter-sommaire
[75] https://www.ined.fr/en/everything_about_population/data/france/deaths-causes-mortality/mortality-rates-sex-age/

Table A2.1 Expected earnings at the age of 40 and cohort sizes for French primary school students

H1: Annual growth rate for real earnings: 1%		
Age	Expected earnings at 40 (in euro)	Cohort Size
(1)	(2)	(3)
6	3 512,54	801 336
7	3 477,76	818 973
8	3 443,33	824 266
9	3 409,23	844 412
10	3 375,48	836 610
11	3 342,06	841 774

H2: Annual growth rate for real earnings: 0.5%		
Age	Expected earnings at 40 (in euro)	Cohort Size
(1)	(2)	(3)
6	2 937,85	801 336
7	2 923,23	818 973
8	2 908,69	824 266
9	2 894,22	844 412
10	2 879,82	836 610
11	2 865,49	841 774

In case of a 0.5% yearly growth rate of real earnings (see Table A2.1, lower panel), the overall monthly earning loss would amount to euro 57,577,096.2, corresponding to euro 690,925,154.4 per year.

Our estimates point to very significant monetary losses, which should be taken into consideration when designing policies directed at mitigating the potential future impacts of COVID-19.

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