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How many students could continue learning during COVID-19-caused school closures? Introducing a new reachability indicator for measuring equity of remote learning

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ABSTRACT

This paper proposes a new reachability indicator to analyze the effectiveness of remote learning policies adopted by ministries of education in response to school closures caused by the COVID-19 pandemic. The indicator provides the share of students that can potentially be reached by remote learning policies given the availability of necessary household assets such as radios, televisions, computers and internet access. The results of this analysis outline the stark inequities in access to remote learning, suggesting that at a minimum, more than 30% of schoolchildren globally cannot be reached by remote learning policies due to the high variation in access to assets for remote learning that exists within and between the world regions. The analysis finds that wealth and area of residence are key factors affecting the reachability of remote learning policies, suggesting that children who reside in rural areas and/or belong to the poorest households in their country are at the greatest risk of being left behind.

1. Introduction

The COVID-19 pandemic has disrupted national education systems and forced governments around the globe to close schools. The number of students affected by these closures peaked in April 2020 when it exceeded 1.5 billion children and young people from pre-primary to tertiary education in almost 200 countries, representing about 90% of all students worldwide (UNESCO, 2020b). These school closures have magnified existing vulnerabilities and challenged the education sector in its efforts to ensure inclusive and equitable quality education for all, as outlined by Sustainable Development Goal 4 (SDG4). This effect of the COVID-19 on the education systems worldwide is long-lasting. During the period between March 2020 – February 2021 the schools were fully closed on average for 95 days, and partially for 62 days, which indicates that a significant share of in-person classroom instruction was disrupted (UNICEF, 2021). The unprecedented spread of the virus and devastating socioeconomic consequences of the pandemic have created a situation where national education systems were witnessing “an extraordinary twin shock: schools closures needed to fight the pandemic and a widespread global economic recession” (World Bank, 2020). Furthermore, even after one year since the pandemic was announced, some countries still were keeping their schools fully closed (UNICEF, 2021). This situation highlights the need for developing education systems that can rely on remote learning for ensuring equitable education for all, which should be a task for a global community.

In order to mitigate the effects of school closures and keep children learning, national education stakeholders responded swiftly by adopting remote learning policies based on a combination of broadcast media, online platforms and paper-based delivery. Yet globally, many of children and youths, particularly those in poorer or rural households, could face challenges in accessing internet or possessing personal computers, televisions or even a radio at home. These realities amplify existing inequalities in learning, and schoolchildren who lack access to the information and communication technologies (ICT) needed for learning at home have limited means to continue their education during the COVID-19 pandemic. This situation puts them at risk of never returning to school, undoing years of progress made toward equitable and inclusive education for all.

It needs to be emphasized that even before the pandemic, 53% of all children in low- and middle-income countries suffered from learning poverty – defined as being unable to read and understand simple text by age 10 – and progress in promoting reading skills was far too slow to meet the aspirations laid out in SDG4 (The World Bank, 2019). The COVID-19 pandemic not only directly impacts education by reshaping
existing learning modes, it also “threatens to have an even more devastating and long-term impact if it diverts attention away from the most marginalized children” (Save Our Future, 2020). These considerations have triggered attempts to estimate the resulting potential learning loss: “while school closures could lead to falling test scores on average”, in the intermediate scenario of schools being closed for no longer than 5 months “there may be as much as a 25% increase (from 40% to 50%) in the share of lower secondary-aged children who are below the minimum level of proficiency” (World Bank, p. IV, 2020).

Against this pessimistic backdrop, it is important to look at the problem from a more fundamental perspective: we still do not understand how effectively governments are reaching children during the COVID-19 crisis, or how and under which conditions learning takes place, especially among vulnerable schoolchildren. Therefore, it appears essential to examine how many schoolchildren were able to potentially continue learning from home while schools were closed, which will reflect the effectiveness of education policy responses to COVID-19. This study helps fill this knowledge gap with a reachability analysis of remote learning policies that is used to estimate the share and number of schoolchildren on the regional and global scales for whom the continuity of learning can be ensured.

The study aims to address the following research question: how many students can be reached by the remote learning policies implemented during school closures caused by COVID-19? And more importantly, what is the share of students that, despite all the actions taken, was unable to continue learning due to existing inequities? To answer these questions, several supplementary questions need to be addressed:

- At which education level are students more at risk of being left behind in learning?
- How is the reachability of a country’s policy response associated with the country’s economic development?
- Which remote learning channel does provide the most extensive coverage thus ensuring that children can continue learning while schools are closed at the regional and global level?
- What is the profile of schoolchildren who cannot be reached? Can the reachability of remote learning policies be evaluated in terms of sex, socioeconomic status, and area of residence?

This study extends the analysis of the UNICEF policy brief published in August 2020 on the reachability of remote learning policies, also providing a detailed description of the methodology behind the estimates presented in the brief (UNICEF, 2020b). The analysis uses two main data sources: remote learning policies deployed at the national level, and the prevalence of information and communication technology assets in households with children attending pre-primary, primary, lower or upper secondary school. By combining these two data sources, the potential reach or coverage of the remote learning policies deployed in 2020 is estimated, with a focus on marginalized populations. We propose that these calculations be summarized in a new reachability indicator that quantifies the share of students at different education levels who could potentially be reached by remote learning policies in a country accounting for both presence of necessary technological assets at home and remote learning policies adopted by the governments to reach them. In other words, the indicator provides the idea of the remote learning equity, also measuring a share of students who cannot continue their education under school closures. Evidence generated by this study will inform policymakers and help them make choices to ensure the equitable continuity of education for more children during the COVID-19 pandemic and beyond. The data and the context analyzed in the given research refer to the figures available at September 2020.

2. Literature review

Although COVID-19 spread rapidly, there is a body of recent policy literature that considers the effects of the pandemic on learning through the lens of inequality and access, thus outlining the resulting challenges to equitable learning for all. As has been correctly noted, access to information and communication technology tools, “including television, radio, internet, cell phones and electricity, have become significantly more crucial learning tools, but also drivers of further inequity” (Save Our Future, 2020).

Given this, some studies have sought to estimate the potential reach of remote learning policies by analyzing household assets, such as the availability of radios, televisions, and internet connections at home. Evidence indicates that access to information and communication technologies for remote learning is highly unequal, both between and within countries. The existing studies emphasize that in many lower income countries, more than half of the population does not have access to the internet (Dreesen et al., 2020; Hereward et al., 2020).

The availability of internet access tends to be a function of household wealth, and among students household wealth is the strongest determinant of home internet access (Hereward et al., 2020). Existing evidence highlights wide disparities in the availability of home internet connections between schoolchildren from the poorest and richest families and underscores the fact that in some countries of the world, internet access among the poorest schoolchildren is almost non-existent. Area of residence is another important factor that could potentially influence the reachability of remote learning policies and put children from rural areas at increased risk (Carvalho and Hares, 2020; Dreesen et al., 2020). In many countries rates of television ownership among urban households are more than twice that of rural households, with the largest disparities found in sub-Saharan Africa countries; for instance, while more than three-quarters of urban households in Mauritania and Guinea have TV, less than 10 % of the rural households do (Dreesen et al., 2020).

The situation appears to be even worse when it comes to the populations that live in emergency contexts or in need of humanitarian action. A 2020 UNHCR report found that “adapting to the limitations imposed by COVID-19 has been especially tough for the 85 % of the world’s refugees who live in developing or least developed countries” due to the fact that “mobile phones, tablets, laptops, good connectivity, cheap data, even radio sets are often not readily available to displaced communities” (UNHCR, 2020).

Household wealth, however, is not the only driver of unequal access to remote learning technology – approaching the issue of education inequities imposed by COVID-19 from a gender perspective also does not give strong grounds for optimism. In sub-Saharan Africa, the digital divide among adolescents worsens when looked at through a gender lens: the data indicate that girls face disadvantages relative to boys in acquiring ICT skills, whether in school or at home (Amaro et al., 2020). This, in turn, puts them at greater risk of missing out on remote learning opportunities that require use of information and communication technology.

Policymakers sought to address these challenges by deploying remote learning through different channels to support the continuity of learning during the pandemic. In this study we aim to evaluate the effectiveness of various remote learning channels, although it should be noted that in many cases decisions regarding the deployment of remote learning channels were influenced by country income. This was particularly true when it came to online learning platforms, which were used by 93 % of upper-middle-income countries and 73 % of lower-middle-income countries, but only about 55 % of low-income countries (UNESCO, 2020a). This shows that access to the digital world is highly unequal, which will undoubtedly contribute to widening the learning gap between advantaged and disadvantaged children (Marshall and Moore, 2020). Consequently, “online solutions in education are not working well for everyone and are causing great concerns for equality and equitable education systems” (UNESCO, 2020a).

Therefore, the use of less expensive broadcast media such as radio and television should be considered as an alternative option – radio has particular potential as a deployed policy solution. For instance, in...
Madagascar, a non-profit association of 30 radio stations offered educational programs to reach children in rural areas where there is no internet access (Verneau, 2020). Previous experience with the Ebola outbreak had demonstrated that although radio programs in core academic subjects across age groups cannot fully compensate for the loss of access to schools and teachers, they helped to sustain a connection to education (Powers and Azzi-Huck, 2016).

The conversation about the effectiveness of broadcast media in delivering remote learning should account for several key limitations outlined in policy discussions (UNESCO, 2020c). First, educational content in audio-visual formats is in short supply, and it is difficult to produce quality learning materials quickly and in quantity. Second, there is a lack of the expertise in the monitoring and evaluation of learning through broadcast media. Third, the absence of pre-existing partnerships to design and broadcast learning materials might substantially affect the effectiveness of related policies. This, in turn, creates a need for cooperation between specialists in education and the audio-visual sector to produce educational programs.

Nonetheless, the importance of radio and television in ensuring continuity of learning during the COVID-19 pandemic should not be underestimated. The added value of learning via broadcast media “goes beyond the needs of students alone,” as in some countries, particularly African countries that have been the most active in leveraging these tools, broadcast channels “provide intergenerational learning, including in local languages” and also “include issues such as health and psychosocial well-being, both of which are important in supporting populations affected by the threat of COVID-19” (UNESCO, 2020c).

Although the above-referenced works provide important insights on obstacles to ensuring learning continuity, they do not shed light on the reachability of remote learning policies. Specifically, the effectiveness of government policies in reaching students while schools are closed is not known. This study seeks to address this knowledge gap by estimating the number of children who have been able to continue learning during school closures.

3. Methodology and data

Two data sources were used to address the outlined research questions. One is the first round of the joint survey carried out by UNESCO, UNICEF, and the World Bank on national education responses to COVID-19 in June 2020, which was used to obtain information on remote learning channels deployed as a part of national education responses. The survey was sent to ministries of education, and they were asked to respond if radio, TV, or online platforms were deployed as “education delivery systems as part of the national (or subnational) distance education strategy for different levels of education”, or if at the national level the “teachers have been trained to use remote learning platforms” for different education levels from pre-primary to upper secondary school (UNESCO, UNICEF, World Bank, 2020). Although the survey also addressed the delivery of paper-based materials and their coverage for different education levels, these data were not used due to the very low response rates, with about 25% reported countries responding to these questions. As such, a low coverage does not allow for producing regional aggregates, the data on paper-based delivery was excluded. To increase the coverage of countries used to calculate the aggregated reachability indicator, UNICEF country offices collected data on remote learning policy responses adopted by national officials from countries that did not initially participate in the joint survey.

The second data source is household surveys such as Multiple Indicator Cluster Surveys (MICS), Demographic and Health Surveys (DHS), STEP Skills Measurement Household Surveys, and other national household surveys. Surveys carried out from 2010 onward in low-, middle- and high-income countries were used to calculate three major indicators: (i) the percentage of schoolchildren living in households with access to radio; (ii) the percentage of schoolchildren living in households with access to television; and (iii) the percentage of schoolchildren living in households with access to the internet or a computer (depending on the availability of the data). This paper analyzes data from 100 countries that responded to and also had household survey microdata available. The data used in the analysis includes the most populous countries such as China, India, Indonesia, Pakistan, Brazil, Russia, etc., which allowed for covering more than 80% of the global student population. The regional estimates were calculated when the available data covered at least 50% of the regional population. However, due to the lack of data, no estimates were produced for Western Europe and North America. Furthermore, the same applies to the group of high-income countries as data availability constrains allowed for producing regional estimates only for low- and middle-income countries.

The indicators were disaggregated by education level (pre-primary to upper secondary) to match the adopted remote learning policies. Further, these two data sets were merged for each country to examine the reachability of each remote learning policy. As such, a schoolchild was considered to be potentially reached if: (i) there is a nationally deployed remote learning policy for his or her education level via a certain channel, and (ii) the schoolchild has the necessary ICT asset (radio, television, internet/computer) at home required to learn via the adopted policy.

The reachability indicator quantifies the share of schoolchildren that can be potentially reached by remote learning policies adopted by governments to ensure learning continuity in a country. For instance, the maximum potential reach of a remote learning policy used to ensure learning continuity among lower secondary school through television-based classes refers to the share of lower secondary students in that country who have a television at home. Schoolchildren were considered to be among those who cannot be reached if either there was no policy adopted for their education level, or they do not have the technological asset necessary to benefit from the adopted policy.

The reachability indicator was produced for each education level, as well as for each country, and it expresses how many schoolchildren at all education levels could potentially be reached via the country’s remote learning policies.

It must be noted that the suggested indicator does not quantify the actual reach, actual use of remote learning platforms or actual learning. The presence of a remote learning policy and possession of a necessary technological asset does not guarantee that a child is studying; it suggests only that a child could potentially continue learning while the schools are closed. It should be taken into account that there are many other obstacles that could prevent a schoolchild from learning, such as a lack of ICT skills or parental support, a low-quality internet connection, an outdated computer and many other factors.

In addition to potential coverage, the reachability indicator also enables identification of the most vulnerable schoolchildren by identifying the cohorts of schoolchildren that will certainly be left behind. This refers to another important methodological pillar of the analysis: to identify populations at higher risk and formulate targeted policy messages to help them remain on track. To this end, the profile of schoolchildren who cannot be reached was estimated by sex, household wealth, and place of residence. This step, in turn, allowed for estimating the share of girls, students from the poorest families, and students living...
in rural areas among those who cannot be reached.

As a final step, the data were aggregated by the world regions to produce regional estimates of percentages and headcounts. For weighting the estimates and converting percentages into the headcounts, the UIS data on number of enrolled students per education level was used (UNESCO Institute for Statistics [UIS]).

4. Research limitations

The carried-out analysis has a number of limitations. First, despite it covers more than 80% of the global population, high-income countries were excluded from the analysis due to the data availability constraints: they either did not take part in the joint survey of UNESCO, UNICEF, and the World Bank, or there was no household data available. However, despite the figures presented in this research merely exclude wealthy countries, they present a realistic picture by covering most of the populous countries of the world.

Second, acknowledging that administrative data have certain biases, the efforts were put to ensure a quality control: UNESCO Institute for Statistics that was carrying out the data collection, contacted ministries of education if the submitted data presented some quality constraints. Further, while analyzing the data, UNICEF team contacted their country offices located in the field for the additional quality check.

Furthermore, the data do not capture inequalities in the use of technology at the household level, as there are some factors that could influence the actual use of technical devices by different age groups and gender. Therefore, the availability of technology does not presume that a child is actually learning by using the respective household asset.

Finally, the study does not account for a variety of alternative remote learning delivery modes that also help ensuring learning continuity. While the evidence exists that social media apps such as WhatsApp were adopted for virtual classrooms at the level of local initiatives, the study provides the assessment of national interventions carried out by the governments to ensure learning continuity.

5. Results

Despite the efforts of many ministries of education to ensure continuity of learning, not all schoolchildren have the necessary radio, television, or computer and/or internet access at home to continue their education. As noted in the methodological section, this study only estimates the maximum number of children who could potentially be reached, and so by the same token, estimation of children who cannot be reached represents the minimum number. Even if both remote learning policies and the necessary household assets are in place, many obstacles preventing children from continuing to learn might exist: results from telephone surveys reveal large gaps in access to electronic devices like computers or mobile phones – in the latter case, households may not have enough devices for all the children in the family. These inequalities become even more exacerbated in the context of the poor and rural areas (UNICEF, 2020a).

With these caveats, our calculations suggest that globally, as Fig. 1 shows, at least 31% of students from pre-primary to upper secondary schools cannot be reached due to either the absence of remote learning policies or a lack of the technological assets required for continuing education through online or broadcast channels. The highest share of the schoolchildren that cannot be reached is observed in sub-Saharan Africa: 49% in Eastern and Southern Africa and 48% in Western and Central Africa. At the other end of the scale, Latin America and the Caribbean region has the lowest rate of those who cannot be reached with only 9% of schoolchildren.

When it comes to the number of schoolchildren who cannot be reached, the highest figures are observed in South Asia and East Asia and the Pacific – 147 million and 80 million respectively. Regions with the highest number of children that cannot be reached are also the regions with more populous countries such as China, India, Indonesia, and Bangladesh, where the sheer number of children attending school is also very high.

With regard to education levels, in most of the regions the share of those schoolchildren that can potentially be reached tends to be the
lowest for pre-primary schoolchildren and the highest for the upper secondary schoolchildren. Pre-primary education deserves special attention as almost 70% of these children cannot be reached. Being widely observed, low reachability at the pre-primary level is due to the fact that policy responses for schoolchildren at this level were weak – only 60% of countries implemented any kind of remote learning policy for pre-primary education (UNICEF, 2020b). Furthermore, the data suggest that in terms of reachability, Latin America and the Caribbean is the only region where disparities in reachability by education level do not appear to be critical, which is because governments in this region provided a substantial policy response.

While the minimum share of those who cannot be reached drops significantly at the primary level to 29%, this is the largest cohort of the student population. As Fig. 2 shows, of the at least 463 million schoolchildren who cannot be reached globally, almost half – 217 million – were primary school students. When it comes to secondary school, at least 24% of lower secondary students and 18% of upper secondary students cannot be reached. This finding – that the percentage decreases as the education level increases – can be attributed to two factors: first, households with older students are better equipped with the remote learning technologies, especially digital ones; second, 77% of countries deployed online learning policies for upper secondary education, which is more than any other education level.

As the literature analysis has shown, remote learning in emergency settings or humanitarian action contexts introduces another critical angle to the education policy response. This reachability analysis of remote learning policies in countries included in UNICEF’s 2020 Humanitarian Action for Children (HAC) appeal (UNICEF, 2020c) leaves room for hope: Three quarters of these countries implemented at least one remote learning policy, potentially reaching as many as half of their schoolchildren. However, the pre-primary education situation is the most critical – only 35% of these countries deployed any policy at this level, which means that at best, only 22% of pre-primary schoolchildren were reached. However, at higher education levels the situation substantially improves. At the upper secondary level, more than 60% of schoolchildren experiencing a humanitarian crisis could potentially be reached by remote learning policies.

Examining the association between the potential reach of remote learning policies and a country’s economic development could shed light on the factors behind the remote learning coverage. To explore this association, we applied a local polynomial function to understand how GNI per capita explains variations observed in the share of students that cannot be reached. Fig. 3 shows the relationship between the GNI per capita placed on the x-axis and share of students that cannot be reached per country on the y-axis; the color of the dots indicates a country group, whereas its size highlights actual headcounts of the schoolchildren that cannot be reached. As the figure suggests, there is a clear downward trend in this relationship – i.e., higher GNI per capita means a lower share of schoolchildren that cannot be reached, and conversely, poorer countries have higher shares of students that cannot be reached. The model summary suggests that country’s wealth predicts 31% of variation in the share of students who cannot be reached by remote learning policies. This means that the quality of a policy response is associated with the country’s level of economic development. Moreover, as chart shows, some countries have 100% of schoolchildren that cannot be reached which highlights the lack of policies to support education and learning of children there. However, it does not mean that poor countries cannot respond efficiently: the chart clearly shows that even some low-income countries that are in humanitarian emergency situations (shown in red in the chart) have managed to potentially reach relatively large shares of their student populations. This analysis clearly indicates that while schoolchildren in low-income countries are at higher risk, targeted policy measures can help overcome these risks.

It’s critical to understand the coverage of specific remote learning channels in reaching student populations, as this will help identify the best ways to design remote learning policies. For example, despite the potential reach of radio-based remote learning, as shown in Table 1, it had the lowest actual reach globally compared to television or the internet. The only exceptions are found in the sub-Saharan Africa regions of West and Central Africa and Eastern and Southern Africa, where radio-based remote learning policies were the most effective channel in terms of increasing the potential reach for 44% and 33% of
Overall, television-based remote learning could potentially reach 62% of schoolchildren worldwide, and television-based policies demonstrated either the highest or the second highest potential reach among remote learning policy options throughout the seven regions analyzed. Although television presents constraints in sharing course materials and has a number of disadvantages when compared to learning via online platforms, the high prevalence of televisions in households worldwide allows television-based remote policies to reach potentially the highest share of schoolchildren on a global scale.

Remote learning through online platforms has the potential to reach only a quarter of schoolchildren globally. Despite being the modality closest to classroom instruction by proving the opportunity to organize virtual classrooms, the internet cannot be the only tool used to ensure continuity of learning. While high-income and some upper-middle-income countries are well prepared to use online platforms, lower-income countries cannot achieve effective coverage through online channels. Policies should therefore be based on blended approaches and respond to the unique of the socioeconomic context in each country.

Understanding the composition and profile of students that cannot be reached by remote learning policies points to another important pillar of the reachability analysis, which is presented in Fig. 4. Targeted policies cannot be deployed without knowing the groups that face the greatest risks. It must be emphasized that schoolchildren who cannot be reached come from various backgrounds, although we can identify some key patterns.

For example, schoolchildren that reside in rural areas account for more than 70% of those who cannot be reached in all country income groups and on a global scale. Furthermore, schoolchildren from the poorest two quintiles comprise 72% of those who cannot be reached globally. The share of poor children who cannot be reached is associated with the country income group – in low-income countries they comprise...
47% of the total, but in upper-middle income countries they comprise 86%. An interesting pattern observed in the low-income countries, where schoolchildren from the poorest families comprise less than half out of those who cannot be reached, is explained by the fact that in low-income countries digital and broadcast media are not always available even amongst the richest groups. In other words, this situation is due to lower overall availability of remote learning assets at the household level in poorer countries. Finally, no gender effect was identified as girls and young women tend to have approximately equal prevalence among those who are disadvantaged and left behind, which in many ways is a result of the sex distribution amongst student population globally.

6. Conclusion

Partial and ongoing school closures mean that the delivery of learning through remote channels will continue to be a core element of the global education agenda for the foreseeable future. The policies adopted by governments in 2020 at the beginning of the global health crisis caused by the COVID-19 pandemic made it possible to reach more than 1 billion students globally. However, almost half billion students, especially those in lower-resource settings, were unable to continue learning.

Remote learning policies should be created or redesigned based on access to the relevant technologies among the targeted population. These policies must also be inclusive and accommodate the learning needs of the most vulnerable, who may not have the necessary technological assets at home. Blended learning approaches that combine in-person and remote instruction will be key to ensuring learning continuity and reaching the greatest number children and could also play a role in reaching school-age children and youths who were out of school before the pandemic.

The results of the analysis suggest that reachability is based on the defined policy and household possessions, but many children cannot continue learning despite having necessary assets due to the lack of policies deployed for them by the governments. To determine the most effective remote learning policy for a given country, investments should be made to identify an appropriate combination of online and broadcast instruction and to develop the infrastructure necessary to reach children who live in remote rural areas or are displaced by emergencies. Connectivity extension and the electricity extension and education cannot work alone on this aspect. For expanding technological infrastructure, education stakeholders cannot act alone, therefore a need exists to establish sustainable partnership with the energy and telecommunication sectors to connect remote and unconnected communities to power and internet. First, this approach will help strengthen countries’ national education systems by making them more resilient to future emergencies that could lead to school closures (Dreesen et al., 2020).

Second, and even more important, the benefits of these investments would go far beyond education sector only, contributing to economic development of disadvantaged communities.

Successful remote learning policies will address several points. First, the education content must be tailored for remote delivery and account for the learning needs of schoolchildren at different education levels and grades. Second, new approaches must be established regarding how to assess the learning outcomes of schoolchildren who study remotely, particularly those who use broadcast modalities.

Well-organized management of virtual classrooms is also essential to ensure productive learning. Teachers must be trained to deliver classes remotely and possess the necessary ICT skills, yet the joint survey of ministries of education found that at least one in three countries did not provide any training for teachers to use remote learning platforms (UNESCO, 2020d). Further implementation of the blended learning approaches however explicitly outlines the need for both initial and ongoing teacher training in terms of providing them with the ICT skills necessary to operate in remote or blended modalities. Parental support is also vital: many schoolchildren, particularly younger ones, need the help of their parents or caregivers to acquire and digest learning materials. Encouraging parental involvement in children’s education should also be a priority (Brossard et al., 2020; Kamei et al., 2020; Mishra et al., 2020).

Policymakers and education stakeholders should place special focus on pre-primary education, which is currently the most critical level in
terms of reachability. Pre-primary school enrolment yields significant benefits to society and has a tremendous positive impact on children’s future learning as well as their lifelong earnings (Muroga et al., 2020), so policymakers’ efforts in this area are well worth it.

The only way to provide equitable remote learning for all is to universalize access to it and ensure children and young people of all backgrounds have equal possibilities to study. Accessible and inclusive education is key to delivering learning both during the current pandemic and beyond. The innovative solutions currently in use could continue to be used and help make national education systems more efficient. Advanced learning infrastructure and policies, particularly those that adopt a blended approach, will play a key role in helping countries navigate the COVID-19 pandemic and increase their preparedness for the future crises.

Author statement

Garen Avanesian: processing and analysis of the data, methodology and results section, original draft preparation.
Suguru Mizunoya: introduction and conclusions, review and revision of the manuscript.
Diogo Amaro: analysis of the data, drafting the literature review, review and revision of the manuscript.

Appendix A. Data sources

1 Botswana AIDS Impact Survey 2013. Ministry of Health (Botswana), National AIDS Coordinating Agency (Botswana), Statistics Botswana.
2 Brazil Continuous National Household Sample Survey (Continuous PNAD) 2018, IBGE.
3 Bulgarian Longitudinal Inclusive Society Survey (BLISS) 2013. Open Society Institute-Sofia, World Bank.
4 China Health and Nutrition Survey 1989–2015, Carolina Population Center, University of North Carolina at Chapel Hill, Chinese Center for Disease Control and Prevention (CCDC).
5 Demographic and Health Survey, 2010–2019.
6 Ecuador National Health and Nutrition Survey 2012. Ministry of Public Health (Ecuador), National Institute of Statistics and Censuses (Ecuador).
7 Enquête Djiboutienne Auprès des Ménages pour les Indicateurs Sociaux 2012 - Données pour utilisation publique.
8 Japan Household Panel Survey (JHPS/KHPS) 2009–2018, Panel Data Research Center at Keio University, Japan.
9 Multiple Indicator Cluster Surveys, 2010–2019.
10 Nicaragua National Demographic and Health Survey 2011–2012. Ministry of Health (Nicaragua), National Institute for Development Information (Nicaragua).
11 Russian Federation Household Budget Survey (HBS), Russia Federal State Statistics Service (ROSSSTAT).
12 The Qatar 2010 Population and Housing Census.
13 UK Data Archive Information for the Study 8298. Statistical Bulletin: Internet Access – Households and Individuals, 2016.
14 World Bank. STEP Skills Measurement Household Survey.

References

Amaro, D., Pandolfelli, L., Sanchez-Tapia, I., Brossard, M., 2020. COVID-19 and Education: the Digital Gender Divide among Adolescents in Sub-Saharan Africa. https://blogs.unicef.org/evidence-for-action/covid-19-and-education-the-digital-gender-divide-among-adolescents-in-sub-saharan-africa/.
Brossard, M., Cardoso, M., Kamei, A., Mishra, S., Mizunoya, S., Reuge, N., 2020. Parental Engagement in Children’s Learning. September, Retrieved from. UNICEF. https://www.unicef-irc.org/publications/1091/parental-engagement-in-childrens-learning.html?utm_source=mailchimp.
Carvalho, S., Hares, S., 2020. Six Ways COVID-19 will Shape the Future of Education. http://www.cgdev.org/blog/six-ways-covid-19-will-shape-future-education.
Dreessen, T., Akseer, S., Brossard, M., Dewan, P., Giraldo, J.P., Kamei, A., Mizunoya, S., Ortiz, J.S., 2020. Promising Practices for Equitable Remote Learning. Emerging Lessons from COVID-19 Education Responses in 127 Countries. https://www.unicef-irc.org/publications/pdf/IRR 2020-10 CL.pdf.
Hereward, M., et al., 2020. Remote Learning Amid a Global Pandemic: Insights from MIC6. https://blogs.unicef.org/evidence-for-action/remote-learning-global-pandemic-insights-mic6/.
Kamei, A., Brossard, M., Cardoso, M., Mishra, S., Mizunoya, S., Reuge, N., 2020. Can we Count on Parents to Help their Children Learn at Home? May 8, Retrieved from UNICEF. https://blogs.unicef.org/evidence-for-action/can-we-count-on-parents-to-help-children-learn-at-home/.
Marshall, L., Moore, R., 2020. Access to Digital Learning during COVID-19 Closures: Compounding Educational Inequality? https://www.ukfiet.org/2020/access-to-digital-learning-during-covid-19-closures-compounding-educational-inequality/.
Mishra, S., Brossard, M., Reuge, N., Mizunoya, S., 2020. How Involved are Parents in their Children’s Learning? MIC6 Data Reveal Critical Insights. April 20. Retrieved from. UNICEF. https://blogs.unicef.org/evidence-for-action/parental-involvement-childrens-learning/.
Muroga, A., et al., 2020. COVID-19: A Reason to Double Down on Investments in Pre-Primary Education. https://www.unicef-irc.org/publications/1137-covid-19-a-reason-to-double-down-on-investments-in-pre-primary-education.html.
Powers, S., Azzi-Huck, K., 2016. The Impact of Ebola on Education in Sierra Leone. http://blogs.worldbank.org/education/impact-ebola-education-sierra-leone.
Save Our Future, 2020. Averting an Education Catastrophe for the World’s Children. https://saveourfuture.world/white-paper/.
The World Bank, 2019. Ending Learning Poverty: a Target to Galvanize Action on Literacy. https://www.worldbank.org/en/news/immersive-story/2019/11/06/a-learning-target-for-a-learning-revolution.
UNESCO, 2020a. 2020 GEM Report – Inclusion and Education. https://en.unesco.org/ge2020.
UNESCO, 2020b. Education: from Disruption to Recovery. https://en.unesco.org/covid19/educationresponse.
UNESCO, 2020c. Learning Through Radio and Television in the Time of COVID-19. https://en.unesco.org/news/learning-through-radio-and-television-time-covid-19.
UNESCO, 2020d. Technical Cooperation Group on the Indicators for SDG 4. Survey on National Education Responses to COVID-19 School Closures. http://tcg.unesco.org/survey-education-covid-school-closures/.
UNESCO, UNICEF. World Bank, 2020. What Have We Learned? Overview of Findings from a Survey of Ministries of Education on National Responses to COVID-19. UNESCO, UNICEF, World Bank, Paris, New York, Washington D.C.
UNHCR, 2020. Coming Together for Refugee Education. Education Report 2020. https://www.unhcr.org/publications/pdf/IRB 2020-10 CL.pdf.
UNICEF, 2020a. Education Update #14: Reaching the Most Vulnerable Children. https://www.unicef.org/learningspace/.
UNICEF, 2020b. COVID-19: are Children Able to Continue Learning during School Closures? https://data.unicef.org/resources/remote-learning-reachability-factsheet/.
UNICEF, 2020c. Humanitarian Action for Children Appeal. https://www.unicef.org/appeals.
UNICEF, 2021. COVID-19 and School Closures: One Year of Education Disruption. https://data.unicef.org/resources/one-year-of-covid-19-and-school-closures/.
World Bank Group, 2020. Simulating the Potential Impacts of COVID-19 School Closures on Schooling and Learning Outcomes: A Set of Global Estimates. http://publicdocs.worldbank.org/en/798061592482682799/covid-and-education-June17-r6.pdf.