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Educational innovation and digitalisation during the COVID-19 crisis: lessons for the future

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This chapter identifies some lessons from the initiatives undertaken by governments and non-governmental organisations to ensure education continuity during the first wave of the health crisis. Having to go without much notice from in presence to remote learning required the quick repurposing and use of resources as well as a spirit of innovation that could inspire the reshaping of education systems. The reliance on digital technology highlighted the promises but also the current shortcomings of digitalisation and calls for an international collaborative agenda to make the best of digitalisation in education after the pandemic.

Introduction

During the first wave of lockdowns of the COVID-19 crisis (March-June 2020), most (though not all) countries tried to ensure some form of learning continuity while schools were closed, usually by making remote education resources available and asking teachers to remain responsible for the students in their classes. Information about country efforts in providing support have been documented through different surveys of ministries and reports during the crisis (Schleicher and Reimers, 2020^[1]; OECD, 2021^[2]; OECD, 2021^[3]; UNESCO, UNICEF and the World Bank, 2020^[4]; The World Bank, UNESCO and UNICEF, 2021^[5]).

The collection of case studies in this book supplements this information by documenting in more details how education continuity was assured from the double perspective of the actors who designed the innovation and at least one external analyst. Initially, the objective of those “education continuity stories” was to inspire or support other actors in different countries facing similar challenges so that they could adapt some aspects of solutions developed elsewhere in their context. The case studies can still fulfil this role while the crisis continues. Their collation in a single publication also serves different purposes. They can also contribute to the retrospective analysis of the crisis once it is over. They will provide a basis to draw some lessons from the successes and challenges of innovations that governments and other education stakeholders had to design and implement in an emergency mode. In many ways, the pandemic and sudden closure of school buildings could be seen as a stress test for education systems to implement remote learning solutions, but also just to quickly implement innovative solutions.

The contingency plans to continue education during the school closures (or restricted access to school) targeted different objectives and different stakeholders. A variety of stakeholders initiated them, independently or collaboratively, including ministries and national governmental agencies, local public actors, non-governmental organisations, organisations newly created as a response to the crisis as well as private companies. Some of the initiatives could be grouped in “families” of solutions, although their differences remind us that the devil lies in the details and that different contexts require specific adaptations and implementation models. While some of the contingency plans present an overall solution, many education continuity stories cover just one or two elements of a more complex solution, so as to describe them in more depth. The collection shows the complexity of the education innovation ecosystem but also the range of actors, competences, resources and ideas learners, teachers and parents around the world could benefit from.

This chapter provides a thematic overview of the education continuity stories. The first section covers the types of learning support that were given to learners and teachers. The second section focuses on selected challenges faced by the stakeholders and how they were addressed. The third section highlights some of the conditions that made those initiatives feasible. Finally, looking forward, the fourth section proposes further collaborative work to advance one aspect that became particularly salient during the crisis: digitalisation in education. The conclusion summarises some of the lessons for the post-pandemic future of education.

Supporting the continuation of education during school closures

What learning resources and tools were provided?

Many OECD countries have set up online platforms with learning resources, but accompanied them with TV education, radio education or other means in order to use technologies that are more accessible to learners from different socio-economic background or to learners living in different parts of their territory. Most of these infrastructures target different possible users (students, teachers, parents) and often all of them simultaneously. Multimodal infrastructures, defined as solutions using different technology media or channels to provide access to learning materials, have thus become the signature of digital learning

infrastructures during the pandemic. Multimodal solutions include a variety of technologies, from paper learning packages handed or mailed to students, digital learning resources provided on memory sticks or CD-Roms, TV, radio, digital resources on online platforms working with phone and Internet services, through to the direct use of mobile phones.

For example, Mexico built on its long-standing TV education experience (Telesecundaria) to develop *Aprende en Casa*, which mainly draws on audiovisual content broadcast across a network of TV stations and streamed through Internet platforms (Ripani and Zucchetti, 2022^[6]). During the school closures, the content was expanded from secondary education to all levels of education and was broadcast at specific times for each educational level, complemented with learning activities and assessment questions available online or delivered in print in unprivileged areas with no Internet access. During the first wave of the health crisis, the programme also delivered 300 000 printed educational materials to students from rural and isolated communities with no Internet access, and included a special radio strategy to reach students from indigenous communities.

Several similar initiatives could be observed in middle- and low-income countries. For example, in Madhya Pradesh (India), the state developed digital and non-digital programmes under the campaign “*#ab padhai nahi rukege*” (*# learning will not stop*) to ensure learning continuity during school closures (Batra, Nangia and Reimers, 2022^[7]). The non-digital programmes for students included school lessons on the radio for primary school grades (1-8), educational television programmes for secondary school grades (9-12), as well as books, worksheets, and one-on-one teacher interactions for all grades. The digital learning component, the “Digital Learning Enhancement Programme” (DigiLEP) shared curated learning material for all grades through WhatsApp groups. The CM RISE digital teacher training programme supported online teacher professional development. A TopParent mobile application was developed to help parents monitor primary school students’ learning. Interestingly, the initiative was thus not only multimodal but also multi-stakeholder: it developed solutions targeting learners, teachers and parents. Initiatives based on multimodal platforms were developed in other Indian states, for example Nagaland (Shanavas, Vivek and Tiwari, 2022^[8]), and several other countries, such as Pakistan or Peru (Zacharia, 2022^[9]; Munoz-Najar, 2022^[10]). Where access to radio could be complicated, podcasts were developed instead, for example in Colombia (Saenz, Medina and Uribe Holguin, 2022^[11]).

Multimodal solutions do not characterise the response of middle- and low-income countries only though. In countries such as Finland, France, Latvia, or Spain, similar approaches were used. In Spain, the Ministry of Education launched a web portal, *Aprendo en casa* (Learn at home), bringing together educational resources, online training, tools and apps for teachers, families and students (Encinas-Martin, 2022^[12]). One aspect was the partnership with the national TV to broadcast 5 hours of education programmes every morning during the school week – that could then be watched on replay on the portal and used by teachers as learning resources. In Latvia, the Ministry of Education developed a TV education platform called “Your class” (van der Vlies, 2022^[13]). In Finland, TV materials (that were not broadcast) were made available to teachers and learners (Tuominen, 2022^[14]). In France, the Ministry of Education supported learning with a variety of learning resources delivered online, by mail, as well as on TV and radio (Thillay, Jean and Vidal, 2022^[15]; Vincent-Lancrin, 2022^[16]).

While technologies such as TV or radio used to be criticised because of their lack of interactivity, one lesson from the crisis is that they can become part of an active learning strategy by being supplemented with interactions via phone or even paper-and-pencil assignments. The next-generation infrastructure should be more intentional in mobilising all these different media and ensure their complementary so that education resources can reach all students in an effective way and provide them with additional (or alternative) learning opportunities.

The role and support of teachers

In a number of countries, teachers played an essential role in the development of learning continuity solutions. In Finland, Yle, the Finnish National Broadcasting Company, set up a small in-house team to select the resources that could be useful for distance learning. Yle opened up a Facebook for “forerunner” teachers, whom they identified and invited by visiting the most popular Finnish Facebook groups for teachers. Teachers were asked to test and improve the service. Within days, they launched a special service, *Yle Etäkoulu* (Yle Distance School), to disseminate these educational resources (Tuominen, 2022^[14]). The teachers provided instant feedback on an ongoing basis on what they understood and what they did not, what was useful and what was lacking. The involvement of teachers in the definition of the TV programme allowed for its constant improvement and relevance.

In Korea, in consultation with the Ministry of Culture, Sports and Tourism, the Korean government also temporarily relaxed copyright rules to allow teachers to produce online class content using existing content materials. Furthermore, a website called “School-On” was established to provide a platform for teachers to exchange and share self-created online class content and class information. 58.4% of the content was created by teachers.

Several other initiatives were initiated by teachers to support learners as well as other teachers. Organisations belonging to the global “Teach for all” network developed different initiatives in their countries: Teach for Chile designed a radio/podcast programme designed for students and their family (Recart, Chadwick and Reimers, 2022^[17]); Teach for Colombia developed a similar initiative supplemented with support provided by WhatsApp (Saenz, Medina and Uribe Holguin, 2022^[11]); Teach for Peru developed some of the TV and radio programme aired by the government as well as a “leadership training” for some of their peers with the aim of continuing the development of 21st century skills in line with its recent curriculum reform (Mosso and Reimers, 2022^[18]; Munoz-Najar, 2022^[10]).

Finally, some initiatives focused on teacher professional development. Edcamps, organised by teacher volunteers in which educators lead their own learning experiences, is an example of the kind of professional development which has emerged during the pandemic. It builds on the idea that teachers can learn from each other to enhance their professional skills with the goal of improving student outcomes. Since March 2020, online Edcamps have supported many teachers to learn about and share their experiences with teaching remotely during the COVID-19 crisis, as exemplified in Ukraine and in the United States (Modica, 2022^[19]). Edcamp Ukraine hosted a national online Edcamp, “High Five for Education”. In the United States, Digital Promise hosted a series of online Edcamps collectively titled “Edcamp: Powerful Learning at Home”.

In Flanders (Belgium), KlasCemans provides a good example of government-supported teacher network, created in 1998 and designed as a “community for and by teachers”, targeting teachers at all education levels, including teachers in adult education and student teachers (Mineau-Pic, 2022^[20]). A similar platform was created in England (United Kingdom) during the crisis, described as a platform by teachers and for teachers (the National Oak Academy) but supported by the government, and in Korea, one called “let’s go to school” was also launched.

These models could remain powerful for the recovery.

A new role for parents?

During the pandemic parents have become more involved in their children’s academic learning. In fact, many initiatives tried to proactively involve them in their children’s learning. This was particularly the case for early childhood education initiatives.

In Maranhão (Brazil), a state programme targeted parents by developing a family engagement curriculum offering them concrete suggestions to encourage young child learning by interacting with them during daily

routines and household tasks (Paulet Piedra and Reimers, 2022^[21]). In Colombia, “My Hands Teach You” offers an example of collaboration between state services promoting comprehensive early childhood development and involving pedagogical, nutritional, health and psychosocial interventions. It targeted all families with vulnerable children aged zero to five (and pregnant women) through a multimodal approach ranging from billboards to online resources, while prioritising those with greatest need (Gutierrez Bernal et al., 2022^[22]). In India (Madhya Pradesh), the government developed a mobile application called TopParent to help parents keep their children (aged 3-8) engaged in learning (Batra, Nangia and Reimers, 2022^[7]).

Initiatives to support parents were not limited to early childhood education and younger students though. In the United States, “Wide Open School” offered resources for educators and families aiming to develop disciplinary knowledge, but also creativity, critical thinking or social-emotional skills at all levels of education, while others just supported family and informal learning activities. Beyond offering access to curated resources, the platform also suggested a daily schedule to help students and families have a good balance of activities. The overall idea was to help parents offer their children a mix of activities balancing academic and family activities when they spent most of their time together (Vincent-Lancrin, 2022^[23]). In some education districts, parents were a secondary target in the district’s strategy. For example, at the Central Falls district (in Rhode Island, United States), particular attention was paid to parents speaking a different language than English at home and learning resources were provided in several languages so that all parents could support the learning of their children. Multi-language staff was available at all time to interact with families and support them (Paez and Reimers, 2022^[24]).

Educational policy and practice rely on some level of engagement of children’s parents. Some of the initiatives during the pandemic went much further than usual in both accompanying parents in supporting their children and in turning the family activities and knowledge into learning opportunities. These practices and mindset could inspire new ways for education systems and education stakeholders to engage parents and families after the pandemic.

Addressing challenges

All case studies highlight specific challenges the documented initiatives wanted to address or that they had to overcome during their implementation. One challenge that was pervasive was of course the lack of time and the need to respond quickly to the adverse situation. Ensuring that the health crisis would not exacerbate existing inequalities was certainly one of the most common objective of the initiatives. In addition to inequity, at least two other challenges are worth mentioning: curating educational resources and keeping students engaged in learning.

Addressing inequity

Reinstating some level of educational equity has been a key challenge of many responses to the school closures. Stakeholders immediately recognised that the pandemic could have a stronger adverse impact on less advantaged students, students in rural areas, or students that face learning difficulties.

The crisis seems to have reminded everyone that part of students’ learning takes place at home, where housing and other material conditions for learning differ across households. Teachers faced a similar problem, as they often had to share their living (and often work) space with family, including children. In some ways, school as a social place may give the impression that all the formal teaching and learning takes place in school, making the learning conditions outside of school irrelevant. School closures forced everyone to depart from this assumption and to think (to some extent) about students’ learning conditions at home. Many of the documented contingency plans have tried to level the playing field by targeting measures related to nutrition, technology or social support to students and families that needed it the most.

(There was obviously not much that could be done in terms of housing conditions.) In many ways, the pandemic has exposed educational inequalities – as much as it probably exacerbated inequity.

In the State of São Paulo (Brazil), one of the first measures of the State Department of Education was to deal with nutrition (Dellagnelo and Reimers, 2022^[25]). Public schools in São Paulo usually offer one free meal to all students on a daily basis. But during school closures, the State Department of Education decided to target students living in extreme poverty and launched a social support programme called “Merenda em Casa” aimed at providing food to students from families in the lowest quintile of the income distribution by transferring a cash allowance using a platform called PicPay. For students whose families do not receive Bolsa Família, a national cash transfer programme, the allowance was doubled by donations from Comunitas, a national non-profit organisation that promotes public-private partnerships. Several other initiatives also targeted nutrition. For example, in the United States, a decision allowed to extend the federal nutrition programme to children attending a school to its whole family. One of the first measures of the Phalen Leadership Academies was thus to provide free meals to the families of its students at dedicated “grab and go” locations (Phalen and Reimers, 2022^[26]).

A second concern that needed to be addressed in many places related to connectivity and the availability of devices. This took mainly three forms: providing digital devices as a donation or loan to students and families; supporting families with no Internet access or data package subscription; providing free access to some educational platforms so they could be accessed at no cost by families using limited data packages.

In Colombia, the national government created a learning resources platform for mobile phone (movil.colombiaaprende) and published a decree requesting mobile operators to provide zero-rating conditions for access to specific education services and websites (both voice and data). The government reached an agreement with mobile and Internet operators ensuring all inhabitants have access to educational content and guidelines, in particular lower income households, with a cap at about USD 20 (Sánchez Ciarrusta, 2022^[27]).

In Korea, in co-operation with the Ministry of Science and ICT, Statistics Korea, local governments and 17 Metropolitan and Provincial Offices of Education along with private companies, the Ministry of Education provided digital devices and subsidised Internet subscription fees to students from disadvantaged backgrounds to fully support all students with online classes nationwide. All students who apply for digital devices could rent them at no cost. As of April 2021, 5.3% of all students (that is, 280 000 students) had rented digital devices (Government of the Republic of Korea, 2020^[28]).

In France, the Ministry of Education also lent equipment to eligible families and its digital education advisers worked with local authorities to identify local IT needs and solutions. To that effect, it established two partnerships with the public mail service: one to print, deliver and return paper learning worksheets for students with no connectivity; a second to deliver the equipment lent by their schools or acquired by local authorities to the eligible families (Vincent-Lancrin, 2022^[16]).

In the United States, many school districts lent devices to students who did not have one or supported families whose mobile subscription was suspended. This was for example the case at the Phalen Leadership Academies, which raised funds to provide equipment to its students. At the Central Falls public school district, equipment was also provided, but many families struggled to use the materials and eventually preferred paper worksheets. The Wide Open School initiative also got private companies to provide equipment to US students who needed it.

While the “digital divide” was expected (and did materialise) in low- and middle-income countries, it is noteworthy that high-income countries experienced more difficulties than expected. While statistics showed a high level of household equipment, relatively small percentages of unequipped households turned into large numbers of households and led to logistical challenges in some countries. Moreover, in most of these well-equipped countries, there was also a quality problem: computers sometimes proved to

be too old or insufficient in number when the whole household needed them at the same time; connectivity was unstable; mobile phone subscriptions were just theoretical as they had been suspended. Moreover, families with no prior equipment did not always have the skills to use the provided devices and hotspots.

One lesson of the pandemic seems to be that the digital divide has not disappeared in OECD countries. Although information technology has become more pervasive, should education increasingly rely on digital resources and tools for homework or make remote learning a more important component of education after the pandemic, public policies ensuring equitable access to devices and technology will have to be reviewed and strengthened.

Navigating online educational resource

Surprisingly, one of the main challenges in the first weeks of the health crisis pertained to the identification and curation of digital learning resources. This was perhaps especially true in countries with widely spoken languages such as English and Spanish. As a result, a variety of actors first contributed to the emergency by identifying and tagging existing platforms of open educational resources as well as the resources themselves so that teachers, learners, schools and parents internationally could use and adapt them. This is for example the first collaborative contribution of the Harvard Global Educational Innovation initiative, HundrED, the OECD and the World Bank (Reimers et al., 2020^[29]), which organised resources according to language, subjects, disciplines and targeted skills (cognitive, intra-personal and interpersonal skills).

While other similar initiatives could be mentioned, the education continuity stories show that this is also the typical first activity that many education organisations undertook within countries. In the two US district and school network featured in the report, education staff spent significant time to identify and curate online resources for their teachers – in one case with the additional willingness to provide resources in Spanish so that parents from its large Spanish-speaking population could more easily support their children (Phalen and Reimers, 2022^[26]; Paez and Reimers, 2022^[24]).

The “over-abundance” of digital learning resources was often identified as a challenge. In many cases, curating the resources consisted in reducing their number and making sure that they were relevant to the curriculum and approaches taught by teachers. In spite of powerful search engines on the Internet and within these platforms, there was no easy and time-efficient way for teachers and learners to curate the host of resources available, especially where curricula are decentralised and left to the discretion of regions, municipalities/districts or schools. Where digital learning resources were already mapped against the national curriculum and organised through a common taxonomy (e.g. in France, see (Thillay, Jean and Vidal, 2022^[15])), educational resources became more readily available to all education stakeholders and this time-consuming curation stage became more time-efficient.

Technology progress might help teachers and learners to more easily identify relevant resources in the medium term. Nevertheless, the crisis showed that the numerous digital learning resources available to teachers and learners in 2020 would have been even more helpful if stakeholders could have identify the most relevant ones faster and more easily. A common international taxonomy making their mapping against school subjects and curricula easier would have made their identification and curation easier. It would also have allowed an easier mutualisation of digital learning resources internationally.

Keeping students engaged

Ensuring that students did not “drop out” and remained engaged in their learning in spite of the difficulties was probably one of the biggest challenges during the first wave of the health crisis. How do you keep students engaged in their learning when you see them much less than usual (or not at all)? In an overview of the research on learning engagement, (D’Mello, 2021^[30]) points to two different approaches: *proactive* approaches that try to make learning more exciting to keep people engaged and *reactive* approaches that

monitor learners' engagement and try to intervene when learners seem to disengage. Initiatives to keep people engaged were based on both approaches.

Before engagement can happen, there needs to be awareness of the available resources and programmes. Many programmes did promotion campaigns and monitored the uptake of their resources so that more families, teachers and students would be aware of them. In Madhya Pradesh (India), a call centre was established and large-scale randomised calling was set up at the state level to get feedback from teachers, parents, field officers, etc., to continuously understand and get feedback on the implementation on the ground and to collect stakeholders' views. The call centre reached out to over 500 teachers and parents every day, which allowed both to let the population know about the provided resources and make them more engaging (Batra, Nangia and Reimers, 2022^[7]). Peru's "I learn at home" initiative also used a strong monitoring strategy to adapt its materials and adjust its visibility strategy.

A common "proactive" strategy to sustain student engagement across the different innovations documented in this book concerned the format of the learning resources provided. Many of the initiatives developed their lessons or programmes with the intention to make them "engaging" and "entertaining" – with usually short formats, space for reflection or quizzes, and a consideration of the context in which they will be listened to or watched. Many radio programmes were for example designed to be listened to by the entire family.

Some initiatives put student assessments in place as incentives to keep them engaged. For example, in Nagaland (India), the Department of Education created a web-based assessment portal and trusted students to take assessments without proctors, then offering a combination of rewards and recognition to well-performing students as well as schools (Shanavas, Vivek and Tiwari, 2022^[8]). In Nigeria, the EdoBest@Home initiative also provided automated interactive quizzes/assessments through WhatsApp or text messages (Munoz-Najar and Oviawev, 2022^[31]).

The balance in the proposed activities was a key ingredient in the initiatives' strategy to keep students engaged. Several initiatives used creative activities to keep students more engaged (e.g. the Indian "Arts for All" (Agrawal et al., 2022^[32])) or as a way to express themselves (see the New Zealand arts programme described in (van Lieshou, 2022^[33])). Many of the programmes had a strong focus on socio-emotional skills, ensuring that students' possible anxiety could be dealt with and that their voice could be listened, as exemplified by the Tokkatsu online case in Japan (Tsuneyoshi, 2022^[34]). As mentioned above, several initiatives also tried to support parents to help their children remain engaged in their school learning activities.

A marketing strategy for learning was to use famous athletes, singers, actors, etc., to support the online platforms or the learning activities that were provided. For example, Wide Open School proposed some physical education lessons delivered by famous athletes (but co-designed with teachers); famous singers were featured on the "Your class" TV education initiative in Latvia (van der Vlies, 2022^[13]). A similar approach was taken in Peru, where famous actors and journalists initially presented the learning content, before being joined by teachers and students given teachers' feedback about the programme (Munoz-Najar, 2022^[10]).

Reactive approaches to engagement consist of intervening when engagement seems to fade. They were more difficult to implement in a remote learning environment. A key element of this approach was to keep teachers in charge of their usual students and classes so they could identify their (possible) disengagement. Regular interactions between staff and families served a similar purpose (plus possible other ones). For example, in the United States, the Phalen Leadership Academies asked each school to have an "engagement plan" and teachers have got in touch with each of the students and their family through bi-weekly one-on-one calls, in addition to some possible other initiatives such as "virtual pizza parties", virtual "dance offs" etc. The Central Falls district designed a "learning engagement rubric" and set up a team to contact families, carefully recording phone calls, communicating via Class DoJo, Facebook messages and conversations. In Madhya Pradesh (India), teachers were asked to call five students every

day to help them access the learning material and answer their questions. This communication was tracked via a simple Google form. The State Department of Education of São Paulo also established a task force to contact parents of “out-of-reach” students by phone or any other possible way, including home visits, after teachers reported their disengagement in learning (Dellagnelo and Reimers, 2022^[25]).

Whether these engagement strategies worked well remains to be proven. The little available evidence in selected OECD countries shows that from 6 to 20% of students lost contact with their teacher or their school during the first wave of the pandemic (Thorn and Vincent-Lancrin, 2021^[35]). In rural India, about 70% of students did some school learning activity during school closures, setting the level of disengagement at 30% (ASER Centre, 2021^[36]). However, the pandemic made it clear that most of the usual strategies and tools developed to keep students engaged in learning assume school attendance. Shall remote learning remain important in the future, new strategies to monitor engagement outside of school will need to be developed, including through new types of interactions with students and families.

Responding quickly and effectively

It is comforting to see the host of initiatives that quickly provided students with some education continuity, even if the education possibly came with lower quality and quantity compared to normal times (the first deployment of those plans was arguably far from perfect, and probably improved significantly during the subsequent waves of the pandemic). Most of the solutions documented in the report were implemented within 2 weeks. Thirteen of the 45 initiatives documented in the report were implemented with no delay when the schools closed, and another 13 were ready within two weeks of the closure. Over half of them (23) were fully deployed within 2 weeks. How was this possible? One exceptional reason lay in the willingness of many to contribute to solving the crisis, and thus to partner and support one another. Part of the time and resources donated to assure education continuity were a response to the exceptional nature of the crisis and cannot be expected to be sustained or replicated after the pandemic. (After the crisis, one may however keep in mind that the willingness to contribute to the common good is possible when the need is clearly visible)

Most initiatives could respond quickly because they expanded existing infrastructures, mobilised pre-existing knowledge and networks, relied on partnerships and were willing to start with a “good enough” proposition that would (or could) be improved over time. This gradual improvement strategy followed the “quick prototyping” innovation method and partly relied on a continuous monitoring of the uptake and effectiveness of the proposed solution.

Building on existing capacity

Governments and other organisations could provide quick solutions to support learning while schools were closed because they built on their existing capacities, both in terms of human competences and available infrastructure. In most cases, the solutions expand or repurpose existing infrastructures – or they create an umbrella service bringing together many services that were separately available to make them more visible. The crisis accelerated the uptake of existing solutions or of solutions in the making. The initiatives sometimes used existing technical solutions and knowledge or implemented existing plans.

The French case studies are examples of initiatives expanding and repurposing existing digital learning infrastructures and building on the human capacity and innovation built prior to the crisis. Like most other countries, the French government deployed a multimodal solution to support its learners and teachers based on the provision of learning resources through a variety of online platforms, the provision of a virtual classroom facility at the national level, and the broadcasting of educational programmes on public TV and radio. The main extension of the learning infrastructure lay in opening existing platforms comprised of licensed commercial resources to teachers who could previously not access them (they could only access

materials for the school levels they taught) and to open some other student resources entirely to the whole French (and worldwide francophone) population (Thillay, Jean and Vidal, 2022^[15]). To support teachers and principals, the French authorities built on their prior experimentations and innovations related to the use of digital resources in education. They were indeed documented and supported by a network of local digital advisers. Those champions and experts of technology in education organised training workshops and supported interested teachers in their pedagogical use of technology (Vincent-Lancrin, 2022^[16]). Many other case studies are based on the expansion of repurposing of pre-existing platforms or solutions, as is for example the case in the above-mentioned Mexican example.

The Egyptian case study presents an example of accelerated implementation. While Egypt's pre-existing knowledge bank of open educational resources was mainly expanded, the Ministry of Education accelerated the system's transition to new forms of teacher-marked project-based assessments that was planned but not started yet. The idea aligned with a reform encouraging more active learning and personalisation of education. The context of remote learning allowed for a greater social acceptance for this new assessment model (El Zayat, 2022^[37]).

The move to online exams proctored by artificial intelligence (AI) technology in Saudi Arabia can also be seen as the deployment of a solution that was already considered but that could have taken years to be implemented (Al-Qataee et al., 2022^[38]). In a similar way, the TV education solution deployed in Latvia was based on an existing plan that had been considered but had never been implemented (and may never have been implemented had there been no crisis) (van der Vlies, 2022^[13]). The previous preparation and knowledge gained during the preparation of those plans allowed for their quick deployment as everyone could just focus on the adaptation, finalisation, and implementation of the initial plans given the pandemic situation.

This highlights the importance of investing in innovation as well as the usefulness of projects that do not appear as successful as they should or that were eventually not implemented. The contribute to a system's knowledge base and can help face an unexpected situation.

Mobilising knowledge networks

Pre-existing knowledge, competence and experience as well as the ability to make it flow within “knowledge networks” drive innovation (OECD, 2000^[39]; OECD, 2015^[40]). This proved true for innovations that were expanding existing practices but also for those that were building “from scratch” and were thus new to the organisation (or the country).

The knowledge and experience of policy makers and innovation leaders was one important source of knowledge speeding up the implementation process. For example, in São Paulo (Brazil), the Secretary of Education led an initiative in 2007 that broadcast live classes on TV to small villages along the Amazon River (the *Centro de Mídias de Amazonas*). This personal experience helped to set up quickly the new education media centre in São Paulo as the leadership could quickly envision the impact of the solution and support its design and implementation. In New Zealand, the arts programme supporting pupils' socio-emotional skills built on the past experience of the programme designers with school closures resulting from earthquakes (van Lieshou, 2022^[33]).

A second source of knowledge and ideas came from people's networks (and friends). For example, the “Teach for All” network is comprised of 53 organisations trying to support good teaching for low-income students internationally. Inspired by the development of teacher-designed radio education by Teach for Nigeria, the idea inspired other network members in Chile, Colombia and Peru (Recart, Chadwick and Reimers, 2022^[17]; Saenz, Medina and Uribe Holguin, 2022^[11]; Mosso and Reimers, 2022^[18]). Organisations in the network could easily build on what others were doing in other countries and receive feedback and guidance as they adapted and implemented the idea in their country. Similarly, the above-

mentioned media centre in São Paulo was then replicated in several Brazilian states. The general idea of publishing the case studies in real time was also to allow for such adapted replications around the world.

A third way to mobilise knowledge was to identify relevant existing networks and mobilise them to support the initiative. In the Finnish case on education TV, expert teachers were identified on social networks and mobilised to help design and curate the TV resources as well as their possible uses. While the method was slightly different, governments in other countries (or states) resorted to existing networks of teachers (e.g. Teach for Colombia in the case of Colombia).

Finally, many of the solutions could be delivered because people had built personal relationships while working with their work partners and counterparts. The speed of changing contractual conditions for accessing educational resources in France was for example possible because staff in the central administration knew well their counterparts within companies thanks to their procurement process. Local digital advisers also had a good knowledge of the actors on the ground and could negotiate quick solutions. Similarly, initiatives such as Wide Open School in the United States were possible because representatives of the different companies knew each other following their participation in trade fairs, conferences, etc.

Developing partnerships

Partnerships are an engine of innovation (OECD, 2000^[39]; OECD, 2015^[40]). In education, public-private partnerships have long been supported as a driver of improvement and effectiveness. During the first wave of the pandemic, all sorts of partnerships flourished, be they public-public, public-private, private-public or private-private – way beyond what can usually be observed. Sometimes they took a contractual nature, but sometimes they were a philanthropic venture. One example was mentioned above when private organisations amplified the public budget to provide financial support to families in São Paulo (with a level of private donation amounting to 0.6% of the annual budget of the State Department of Education, a significant amount). This philanthropic dimension of partnerships will be difficult to sustain after the pandemic.

Public-private partnerships were probably the most common ones – either because governments received support from private actors or because they supported or amplified the role of private actors. By nature, most initiatives that involved radio or TV education relied on public-public or public-private partnerships: education innovators needed to get access to public or private TV channels to air their learning resources – sometimes in addition to making the programmes available on the Internet. In some cases, the regulation made one form of partnership easier to implement than the other. For example, in Nagaland (India), the Department of Education developed both types of partnerships: it chose public broadcasting platforms to ensure a fast collaboration and implementation and reach greater accessibility even in remote areas within a short time frame. At the same time, it worked on getting its public education channels included in the free list of TV channels offered by private cable companies (as some families get their TV services exclusively via private cable) (Shanavas, Vivek and Tiwari, 2022^[8]).

Some private-public partnerships allowed for the quick diffusion of resources, as was the case of the (private) ProFuturo digital learning platform which was incorporated in the governmental resources of eight Spanish-speaking south-American countries (Encinas-Martin, 2022^[41]).

Partnerships were not only important because they allowed to mobilise quickly various resources that were owned by different partners, but also because they enabled a division of labour able to meet the specific time constraints imposed by the crisis. Many of the resources that were developed were crowdsourced so that they could be developed quickly. In Vietnam for example, each school in the different Vietnamese provinces was asked to take charge of at least one subject at one particular grade level. The school's subject department was responsible for creating and reviewing lesson plans and nominated teachers with ample professional and information technology experience to receive training and deliver the lessons.

Thousands of teachers across the country contributed to developing lesson plans following the simplified framework curriculum circulated by the Ministry of Education (Hoang, Le and Reimers, 2022^[42]).

Finally, some partnerships were private-private partnerships. Wide Open School brought together a group of non-profit and for-profit private organisations. In that case, giving a non-profit organisation well known and trusted by the target audience a lead role was a success factor (Vincent-Lancrin, 2022^[23]). In some cases, public-private partnerships involved not-for-profit private institutions, for example a teacher organisation, a foundation, and it could similarly happen that the private organisation was better positioned to take the lead and be trusted by its intended audience, for example in the case of resources or services advertised as “designed by teachers for teachers”.

While some of these partnerships may remain useful beyond the health crisis, some only happened because of the willingness to contribute that the circumstances of the COVID-19 pandemic triggered. Partnering institutions did sometimes have an interest in joining those partnerships in terms of image (and marketing of their resources), but they do not necessarily have an interest in staying for a long time. While partnerships will remain very important after the crisis, they will probably need to take different forms and be driven by different types of incentives and motivation.

The best is the enemy of the good

In order to make things happen quickly, innovation leaders developed their initiatives with a multi-stage strategy, which either prioritised one dimension while others were developed, or that provided initial solutions that would be overtaken by others. This approach reflected a more important mindset of going for the good rather than the best: solutions that could be quickly implemented even if they were not totally satisfactory were usually privileged – and often improve over time.

Many of the “comprehensive” initiatives were rolled out in multiple stages.

First, several public authorities bought some time by changing the dates of the school vacation to buy some time – by either prolonging them (when students were on holiday) or calling for an advanced school holiday. This was for example the case in Chile (Madero, Vargas and Reimers, 2022^[43]) or in the State of São Paulo (Brazil).

The deployment of the strategies in several stages (or phases) also allowed for speed. Several of the educational innovations described in the report had a multi-stage approach: this was for example the case for some initiatives in Colombia (Jaramillo, Forero and Reimers, 2022^[44]; Sanz de Santamaria and Reimers, 2022^[45]), India (Zacharia, 2022^[46]; Shanavas, Vivek and Tiwari, 2022^[8]), Peru (Munoz-Najar, 2022^[10]), Turkey (Vidal, 2022^[47]), Uganda (Kaiser Schuster, Ringe and Reimers, 2022^[48]) and the United States (Paez and Reimers, 2022^[24]; Phalen and Reimers, 2022^[26]; Vincent-Lancrin, 2022^[23]). In the city of Bogota, the largest “school system” in Colombia, the contingency plan was rolled out in three phases: first, distributing in-school nutrition and online resources; second, developing TV and radio education and turning in-school nutrition to an out-of-school model (as the in-school grab model of the first phase quickly appeared inappropriate); third, addressing the digital gap (Sanz de Santamaria and Reimers, 2022^[45]). At the Phalen Leadership Academics in the United States, academic learning was continued in three phases: first, students were given paper learning worksheets; second, they had access to an online platform with curated materials and videos and supported by their teachers; in a third phase, they were provided with one-to-one devices with connectivity with virtual instruction by their teachers. Each phase allowed to prepare the next one(s) (Phalen and Reimers, 2022^[26]).

The Wide Open School platform also exemplifies the willingness to provide quickly a good service without necessarily going for perfection (Vincent-Lancrin, 2022^[23]). Several practical executive decisions were taken. First, the technology had to be cheap. Second, legal issues (and slow speed of negotiations) were largely bypassed by directing users to contributors’ websites, and thus out of the platform – a solution that a platform designer would usually not favour. Indeed, the partners owning the different learning resources

did not have time to negotiate some legal issues, including intellectual property rights issues, and even less agree on common practices in this regard. The platform just noted that the different partners' websites had their own privacy policies, data-collection practices and encouraged the users to review them. Without this disclaimer, it would have taken months to launch the platform.

Monitoring and evidence

An active monitoring of the uptake of the proposed solutions as well as the collection of feedback on their usefulness was in many cases a full part of the initiatives. As mentioned above, where teachers continued to have a personal contact with students and families, mainly for engagement and academic purposes, they were often asked to provide feedback on the effectiveness of the learning resources so they could quickly be improved.

When they relied on digital solutions, indicators about the access to the platform or to the digital resources were usually collected. For TV and radio programmes, audience shares were the typical indicators. This proved more difficult for interactions with text messages. Accessing this information was also more difficult in some contexts than others. In spite of being important indicators, access to resources or reach of population only provide some basic information and do not allow one to improve learning resources or the design of an initiative. Nor do they indicate whether the resources are used effectively.

Many organisations established some kind of qualitative monitoring of their initiative. They collected feedback on the quality and reach of the solution/resources from users or peers. For example, the TV initiatives in Latvia and Finland asked expert teachers feedback on the produced resources. In other places, such as Vietnam or India, this was done through the administration rather than by peers. In Nigeria, the "Quality Assurance team" shifted its usual on-site school visits to the random monitoring of the virtual classes offered through its platform to get a sense of the use and quality of the teaching and learning during the school closures. It also analysed the quizzes taken by students to get a sense of their learning progress (Munoz-Najar and Oviawev, 2022^[31]). In Bogota (Colombia), in addition to the indicators of access of their digital platform, the city relied on regular meetings with stakeholders and qualitative evaluations performed by the municipal Department of Education's Evaluation unit (Sanz de Santamaria and Reimers, 2022^[45]).

Monitoring policies based on actual statistical methods were less frequent, even for governmental initiatives. The Department of Education in Peru put in place such a monitoring strategy. Its "monitoring and evaluation" unit regularly evaluated the adoption of its "I Learn at Home" solution with phone surveys based on a representative sample of teachers, parents and principals. They evaluated their awareness of the solution, whether and how they could access the resources, their level of satisfaction with them, as well as the level of support given by teachers to students. The information was used to continue and improve the development of the platform: for example, negative feedback received from teachers on the presentation of the resources on TV led to the inclusion of teachers and students alongside the "star" presenters (Munoz-Najar, 2022^[10]).

As of March 2021, among OECD member countries, France, Germany, Ireland the United Kingdom, and the United States were the main countries that had collected representative data based on probability samples giving a comprehensive picture of the education experience of students, teachers and households during the first wave of the pandemic. Some studies with more limited scope cast light on specific aspects of the first phase of the health crisis, for example learning gains in Australia, Italy or Luxembourg. Most of the national evaluations were put on hold or could not take place given the sanitary circumstances. Thorn and Vincent-Lancrin (2021^[35]) present a first overview of those studies. Among non-OECD members, those studies seem to have been even less frequent (even though some information in at least Brazil (São Paulo), Morocco or India has become available).

During the crisis, many surveys were conducted using convenience samples or were reweighed to try to be more representative. The reasons for this are understandable: a perceived need to gain information quickly and the absence of easily accessible sample frames covering the target populations of interest. However, such approaches do not provide a secure basis for making valid inferences about the populations and groups of interest from the responses collected. As a result, as of January 2022 we may only speculate on the effectiveness of the different “education continuity” solutions that were provided during the first wave of the pandemic, except in the countries that collected statistical information. Retrospective studies are possible and necessary but have their limitations as stakeholders’ memory remains less and less reliable. Hopefully, quality information about the subsequent waves of the pandemic has been collected so that its effects on the teaching and learning experience as well as on a variety of outcomes can be assessed.

In any event, while the efforts to monitor the uptake of the provided solutions in quantitative and qualitative ways can be laudated, the crisis exposed the limited capacity of many governments to continue the evaluation, documentation and data collection about their education systems during a crisis that led to remote learning.

Advancing a global digital education agenda

The pandemic has made the potential (and need) of a digital transformation of education evident. It has accelerated the policy agenda related to digital education. How could international collaboration help education systems to harness the potential of digitalisation worldwide through collaboration and joint knowledge production and sharing? Digital tools and resources can improve the quality, equity and efficiency of education, but digitalisation can only make a difference if accompanied by human capacity to use the resources properly, smart governmental investments and policies, and the reshaping of some social institutions, including formal education perhaps (OECD, 2021^[49]).

In spite of its limitations, the experience of remote learning during the pandemic showed the power of technology to support teaching and learning – both remotely and in presence. In spite of the fast progress of smart education technology, the pandemic showed a gap between the technology available to education stakeholders and the frontiers of advanced technology. In the collection of contingency plans presented in this report, few rely on AI or learning analytics. Proctored exams in Saudi Arabia (Al-Qataee et al., 2022^[38]), a recommendation tool for active learning in Russia (Zavalina and Lyubimova, 2022^[50]), resources for special needs students in Turkey (Vidal, 2022^[47]), the matching of students and tutors in the Netherlands (van de Vlies, 2022^[51]): here are some of the few examples of initiatives involving some use of AI-based technology. This shows the somewhat expected gap between where most education systems stand and where the technology frontier is. At the same time, it highlights missed opportunities and a need to rethink the role that digital tools and resources could play to improve education around the world, even once differences in the underlying technology infrastructure across countries are acknowledged.

This section sketches a possible agenda for an international collaborative initiative among countries, international organisations, universities, educational non-governmental organisations, foundations and companies. Table 1.1 summarises the proposed framework for such an initiative that would encompass work on three different pillars: frontiers, practice and policy.

The work on *frontiers* would focus on “advanced” practices, innovation and foresight, and how to mainstream the most effective or affordable uses of those technologies. The work on *practice* would focus on the use of technology by practitioners in the field, that is, learners, teachers, administrators, schools and universities. The work on *policy* would focus on how policy makers could best support, through incentives, guidelines and regulation, the adoption and further development of effective and trustworthy digital solutions in education.

Each of the pillars could include different types of work, possibly involving different organisations, stakeholders and working methods. International organisation could work collaboratively in line with their missions, and their members in line with their interests. A lot of analysis to understand the different dimensions of the opportunities and the challenges of digitalisation would still be needed. This would also allow for the development of a set of comparative indicators about the availability and use of technology in education. International standards and guidelines (and the mutual learning required to develop them) could facilitate the adoption of and trust in digital education solutions: depending on the subjects, those could take different forms. Finally, capacity development based on international projects and peer learning would be helpful for policy makers and practitioners: this could take the form of training, e-learning, joint international projects but also the development of global public goods and tools supporting all education stakeholders in absorbing and developing new models adapted to the digital world.

Frontiers

Work on the frontiers of technology development and use in education is essential to understand possible trajectories for digital education, to anticipate possible policy issues and identify “leapfrogging” opportunities. This is true for both high- and low-income countries. In fact, this may be even more important for low-income countries: while their current lack of sufficient infrastructure may make digitalisation look irrelevant, they often have more benefits to reap from it than high-income countries. The pandemic also accelerated the level of equipment in low-middle-income countries such as India, where 70% of the population in rural India had access to a smartphone, partly as a response to the pandemic (ASER Centre, 2021^[36]). Moreover, technology applications requiring less hardware (from electricity to stable connectivity) are making progress (Akkinapally, Lichtman and Petrie, 2022^[52]).

Five types of activities could be developed in this area:

- *Analysis.* Policy makers and stakeholders need to better understand the current possibilities of technology to improve teaching and learning in the classroom, the administration of education systems and institutions as well as the learning and tutoring possibilities it offers when students are at home. This type of analytical work will typically involve academic researchers but also company developers who will know where the technology frontiers are and in which direction they are moving. The pandemic and its possible silver linings have raised new questions about the use of technology and the organisation of education. Can technology support a new balance between autonomous (in presence or remote) learning and social learning supervised by teachers? How can technology be used to support new educational arrangements, and how should school and university education be remodelled as social institutions if this were the case? Another big question concerns the digital education infrastructure available to teachers, learners and education administrators. The pandemic highlighted interesting new models and ideas that may enrich pre-pandemic infrastructures after the crisis. An observatory of most advanced uses of AI (and other advanced technology) in education could be established to document case studies of what advanced technology can do in practice and enable networking and knowledge sharing across countries/organisations interested in similar technology uses in education.
- *Indicators.* Monitoring what the education technology industry (EdTech) is developing is important to identify the frontiers, but also the dynamics of and the market for education technology. This is key for policy makers to develop sound innovation policies on digital education and to identify the room for international collaboration in this area. Where and by whom are education technology solutions developed? Are the innovations developed by the education technology industry covering the range of issues faced by education systems worldwide? Market research companies have developed indicators on the education technology market worldwide, including the range of solutions proposed, technology used, the investment by region, etc. However, further comparative data and indicators could be developed to inform the international dialogue on the development of education technology that should include questions such as: are there some market failures that

Table 1.1. Framework for a global digital education agenda

	Frontiers	Practice	Policy
Analysis	<ul style="list-style-type: none"> Innovative uses of technology in education (AIED Observatory) Hybrid human-AI systems and automated solutions to support learning in and out of class Advanced digital solutions to support system improvement 	<ul style="list-style-type: none"> Evidence on effective use of technology Public digital learning infrastructure Information Systems (aka Data systems or EMIS) 	<ul style="list-style-type: none"> Investment, procurement and relations with the private sector Digital education infrastructure Supporting teachers' digital competences Reshaping social institutions and practices Identifying regulatory barriers
Indicators	<ul style="list-style-type: none"> Investment in and development of EdTech Innovation, R&D and collaboration in EdTech 	<ul style="list-style-type: none"> Online/hybrid enrolments, provision of online programmes, online resources, etc. Modules on digital education in international educational surveys (access, use, etc.) 	<ul style="list-style-type: none"> Policy, regulation Public infrastructure Expenditures on technology in education
Standards	Standards <ul style="list-style-type: none"> Interoperability standards for digital solutions and data 	Assessment framework <ul style="list-style-type: none"> Coding/AI education Learning in digital world Standards <ul style="list-style-type: none"> Taxonomy standards for learning resources 	Guidelines <ul style="list-style-type: none"> Data protection, data sharing, privacy Algorithm bias and transparency Solutions accuracy and bias
Capacity development	<ul style="list-style-type: none"> International for a/summits on the advancement of digital education Innovation prizes 	Training <ul style="list-style-type: none"> MOOCs for teachers on using digital tools in their pedagogy Curriculum/Course/design Examples of lesson plans (Coding, technology, digital media literacy, critical thinking) 	<ul style="list-style-type: none"> Policy forums for countries to exchange about policies and practices Training <ul style="list-style-type: none"> Courses for policy makers on digitalisation in education
Development and evaluation	Innovation networks <ul style="list-style-type: none"> Development projects on digital education in schools and higher education institutions Impact evaluations 	Apps <ul style="list-style-type: none"> International bank of learning resources Public goods developed/curated by international organisations 	Reviews <ul style="list-style-type: none"> Country reviews

could be addressed? Is there sufficient investment at the different steps of the company development? This work will typically involve market research and education technology companies, associations of education suppliers, statisticians, etc.

- *Standards.* The fragmentation of education markets within and across countries is difficult for the development of solutions that are not limited to a specific education system (or sub-system). One reason is that technology solutions do not share similar technical or nominal standards. While a full harmonisation would be unrealistic, especially as education systems need to use their legacy systems and are path dependent, there is room to discuss some level of harmonisation and develop some international “interoperability” standards for digital education solutions and resources. Some organisations try to develop international technical standards and in some areas international organisations could do so (e.g. comparative statistics). Those standards should be developed early on in the technology development cycle.
- *Capacity development.* When it comes to frontier technology and its adoption, capacity development mainly takes the form of knowledge sharing and dissemination. All stakeholders could come together at global education industry summits to discuss the progress of digital education as well as the forthcoming challenges that may emerge from its development (or adoption). Another way to support the development of solutions in countries that need them more would be the establishment of hackatons or innovation prizes aimed at addressing some specific challenges.
- *Development and evaluation.* Finally, frontier work also aims at developing new practices and new tools. International practice-engaged development projects involving practitioners on the ground could help experiment and develop field-trialled practices and tools supporting an effective, trustworthy and human-centric adoption of AI and technology in education. These developed interventions could then be evaluated as “efficacy studies” within countries and adapted to the country context. This could also contribute to the development of an innovation culture within countries.

Practice

By definition, a big gap separates the frontier uses and possibilities (that concern early adopters and sometimes just laboratory experimentation) and the actual use of digital education resources at scale by teachers, learners and administrators in education systems. Harnessing the potential of digital education requires the monitoring of the “mainstream” state of adoption and use of technology by education stakeholders and its positive and negative effects.

- *Analysis.* Analytical work on the practices of digital education should research and synthesise evidence about different ways to effectively and equitably integrate technology in pedagogical or administrative practice. Because technology is a mere tool at the disposal of humans, technology should not so much be the main focus of research: pedagogy or administrative practices using technology should be. Regarding the administration of education systems, the development and use of administrative information (or data) systems (also known as “education and management information systems” [EMIS]) should be a priority research area: they are key to produce new evidence and make high-quality and well structured data actionable. In many countries, moving from current systems to longitudinal systems equipped with dashboards and other functionalities providing actionable information to all stakeholders is a key step to improve educational information and outcomes. Early warning systems show how this information could be turned into action.
- *Indicators.* While comparative international education has made great progress in the past decades with joint data collections and standards across several intergovernmental organisations, there is still relatively little statistical comparative information about the use and access of technology by education stakeholders. For example, we cannot compare the levels or shares of enrolments in online higher education courses, we do not know what share of schools or universities are

equipped with learning management systems, to what extent teachers and administrators use technology, for what purpose, etc. We do not know much about the digital learning infrastructure available to learners, teachers, administrators and parents and how it is used. Most information that is available comes from international surveys such as the OECD Programme for International Student Assessment (PISA) for 15-year-old students, the OECD Teacher and Learning International Survey (TALIS), the IEA surveys (TIMSS and PIRLS) for 4 year and 8 year students, or the BlinkLearning Global Survey on the use of technology in education. Secondary analysis of those data gives an evolution of the uses of technology over time (Vincent-Lancrin et al., 2019^[53]; OECD, 2014^[54]). More extensive information about the use of new forms of online and hybrid learning would be helpful, as we know that the availability of digital tools does not imply that they are used (Cuban, 1986^[55]). Co-ordinated questionnaires and standards could be developed to make domestic data collections on education technology internationally comparable – and even some specific international surveys.

- *Standards.* Some international frameworks could be useful to support the work of practitioners. If assessment drives teaching and learning, “assessment frameworks” capturing at a point of time the state of the knowledge of what students should learn could help all countries and their institutions develop their curriculum or benchmark their students against international standards. When it comes to digital education, different types of assessment frameworks could be developed. Some could relate to the use of digital tools, in the spirit of the PISA 2025 assessment framework on “learning in the digital age”; others could relate to the ability to navigate the wealth of information that characterises the digital age; others could be around the assessment at different levels of education of computer science or digital literacy (e.g. coding or AI). The same could be done for the assessment of the pedagogical use of technology by teachers. Another form of standards could be an international taxonomy for teaching and learning educational resources that would allow teachers to locate easily the educational resources according to their local curriculum or their subject of interest. The curation issues faced during the pandemic would be eased and resources from other countries would become more easily accessible.
- *Capacity development.* Capacity development for practitioners can take different forms – other than the practice-engaged research projects mentioned under the “frontiers” pillar. A series of freely available online courses (MOOCs) developed and peer-reviewed by world class experts or pedagogues could provide some initial guidance about simple and effective ways to use digital resources and tools as part of teaching, provide knowledge about the frontiers of digital education, the policy issues, etc.
- *Development.* Another way to support teachers and other practitioners supporting teaching and learning would be to provide examples of lesson plans or full courses exemplifying how to integrate technology in one's pedagogy or how to teach the basics of digital competences (e.g. the basics of AI, of coding, etc.). In the first case, this could typically be done by involving universities and their initial teacher education programmes; in the second case, with the support of technology companies. More broadly speaking, countries could work on the establishment of an international bank of quality pedagogical resources based on existing and newly developed open educational resources. Some other global public goods could also be made available. International organisations would be the right hosts and hubs for the establishment and maintenance of such resources.

Policy

Policy makers provide practitioners with the enabling regulatory environment, guidance and incentives. They play a key role in the further development of a trustworthy and human-centric digital education. The work on the frontiers of technology should allow them to anticipate some issues that might need regulation and reflect on the strategies used to address them while piloted. The practice work will provide information

about some directions in which practitioners may need to be “nudged”. Digital education raises new policy issues and will lead policy makers to revise some habits and ways of thinking that prevent some positive innovations to take place in “normal” times.

- *Analysis.* Three big areas could benefit from international learning and comparison in the policy domain. The digital education agenda will require significant financial investments from countries. What are the most effective models, strategies or programmes to mobilise financial resources to support the development of digital solutions as well as their effective use in education? How do governments use their innovation and research funding to that effect? A second, related area pertains to procurement, which is one of the powerful ways for governments to influence private companies or guide the purchases of their decentralised decision makers. More generally, analysing and discussing how partnerships and collaboration with private actors across the world are organised will help devise policies defending the independence of formal education and safeguarding the privacy and data of its actors while reaping the benefits of digitalisation. A third policy area is about the nature of the public infrastructure that should be made available to education actors in different settings. This is a question that the pandemic has brought to the fore and that will remain relevant after the health crisis. Is there a minimal infrastructure of learning resources and tools that should be made available to teachers, administrators and learners, and if yes, what does it look like? Where education is free, how can it remain so in learning environments that increasingly require home access to the Internet? Should some of the solutions that were experimented during the pandemic be sustained? A fourth area concerns the provision of professional learning opportunities so teachers and other education staff develop their pedagogical skills using digital resources and tools (that is, their “digital competences”). This may include the development of qualification frameworks or certification processes, etc.
- *Indicators.* Indicators focusing on countries’ investment on various aspects of digital education and on their policies regarding education could be collected in a way that allows for international comparison. This would inform a dialogue within and across countries.
- *Standards.* At the international level, policy standards usually take the form of guidelines or declarations. Some guidelines on “good practices” could be developed in the area of procurement and relations with the private sector, including some guidelines on the evidence criteria that technology solutions should meet depending on their stake level. Guidelines about data protection and data sharing practices that supplement existing laws and facilitate the large use and reuse of educational data could also be useful, especially as data protection regimes vary at the global level. Finally, in line with the “open data” movement, some guidelines related to the “open algorithm” movement could be developed in terms of transparency and testing of algorithms. Overall, this would contribute to guidelines on “ethics in using artificial intelligence in education”. These types of guidelines would be more easily elaborated and adopted at the regional level.
- *Capacity development.* Policy makers would benefit from being more aware of and learning from what is happening internationally in terms of digital education policies. International organisations could partner and propose different types of training and technical assistance. Some organisations such as the UNESCO International Institute for Education Planning propose such executive training, and this capacity could be developed within other organisations as well in a synergetic way.
- *Development and evaluation.* Countries could benefit from reviews of their digital education policy or of other specific aspects of their digitalisation agenda. International organisations could collaborate and conduct independent or “joint” country reviews and mutualise the lessons learnt (if acceptable to the reviewed countries). This would give countries some feedback on their advancement in this area compared to other peer countries and provide the international community with detailed analysis and information about developments within specific countries.

Concluding remarks

The health crisis was a stress test for education systems around the world. While they were arguably not prepared to shift to remote learning and teaching, most countries provided their learners and teachers with “education continuity” solutions when they had to close schools. To what extent these innovations were effective remains to be studied and evaluated. On the one hand, it would be surprising that they proved as effective as in-person teaching; on the other hand, it would be surprising they had no effect, and assuming that students’ education was interrupted during the first wave of the COVID-19 pandemic and school closures would be excessive. Many lessons were learnt from the crisis, and several organisations provided recommendations on how to deal with formal education during and after the crisis. The OECD developed joint principles for an effective and equitable recovery with Education International, the international federation of teacher unions, providing directions to education stakeholders, both during and after the pandemic (Box 1.1).

Box .1 10 Principles for effective and equitable educational recovery

Principles for schooling during the pandemic:

1. Keep schools open as much and as safely as possible.
2. Ensure equity and align resources with needs.
3. Provide a remote learning infrastructure which is designed to reach all students.
4. Support teachers in their professional lives.
5. Enable teachers and parents to support learners.

Principles for recovery towards effective and equitable education:

6. Provide targeted support to meet students’ learning and social and emotional needs.
7. Co-design a robust digital learning infrastructure with teachers and stakeholders.
8. Empower teachers to exercise their professionalism and benefit from professional learning opportunities.
9. Encourage a collaborative culture of innovation.
10. Learn from national and international evidence.

Source: OECD and Education International, *Effective and Equitable Educational Recovery*, 2021, <https://www.oecd.org/education/ten-principles-effective-equitable-covid-recovery.htm>.

Many lessons can be drawn from the experience of teaching and learning during the pandemic in order to rebuild more effective and equitable education systems after the crisis. In addition to those mentioned above, here are a few high-level lessons for the post-crisis times.

Lesson 1: Education systems are resilient and proved they could imagine and implement an alternative education model if needed. Education systems struggled to adopt remote and digital learning strategies. They probably implemented them in less than perfect ways. However, learners and teachers could use solutions allowing them to continue to learn and teach during the crisis. Education systems showed some level of resilience, that is the ability to face a hardship, to resist and recover. The variety of actors that make up education ecosystems have worked together (or independently) to develop these solutions and showed that different ways of learning and teaching are possible. During the pandemic, education systems have clearly demonstrated that there is room for formal education to be organised differently, to innovate its

balance between autonomous learning, possibly engaging parents, learning supervised by teachers, and learning mainly done with peers. Some initiatives during the pandemic may provide ideas and building blocks for a different and better education in the future – empowered by the innovation mindset of getting things done before gradually improving them that characterised most initiatives.

Lesson 2: Education systems' resilience depends on their existing capacity, including their past investment in knowledge, networks and partnerships. The ability of governments and educational organisations to propose quick solutions to ensure that academic learning would continue during the school closures depended on their prior knowledge, their connectedness to other actors and partners and their existing capacity. While some initiatives invented new models, most of them expanded an existing infrastructure, implemented ideas that had been already tested (though not mainstreamed), or borrowed their solution from knowledge partners. This shows the importance of investing in innovative projects in “normal” times and the importance of establishing knowledge networks, even if they do not seem to provide immediate benefits.

Lesson 3: Educational inequity are broader than commonly acknowledged and must be addressed. Inequity in education is well documented, both in terms of access to learning opportunities and achievement gaps. The health crisis reminded us that learning conditions at home, including space, IT equipment and support, are very different for students from different socio-economic and sometimes geographic background. Some of the solutions to support families that needed nutrition, equipment, connectivity, access to educational platforms at no roaming cost and extra support should continue to be explored and offered after the crisis so students have more equal learning opportunities and access to education.

Lesson 4: A new digital education agenda is needed. The pandemic has accelerated the digitalisation of societies and economies. In education, the health crisis has shown the importance of digital resources and tools but also highlighted the potential of digital education in the post-pandemic world. Education is a social endeavour requiring human interactions. They could be shaped differently thanks to technology. In many countries, the digital learning infrastructure was inadequate and will need to be revisited after the pandemic. This will require public investments and smart decisions. International collaboration would allow countries and education systems to harness more quickly the potential of digital education.

Lesson 5: Countries should invest more in monitoring and evaluation. Many initiatives used a “quick prototyping” method to develop their innovation and monitored their success. They monitored the uptake of their proposed solution, collected feedback, and used this information to improve it. This should continue to guide educational reforms and innovation in the future. On a less positive note, few countries have invested in rigorous statistical data collections during the pandemic, leaving many aspects of the experience of students, teachers and families undocumented. While the dearth of evidence will give rise to speculations about the impact of the crisis on the learning opportunities for students, their academic progress, their holistic development, and even the impact of the crisis on inequity, it raises a structural question about the strength and resilience of governments' institutions collecting data and evidence in education. For education to continue its shift towards a knowledge sector and design education policy on the basis evidence, these shortcomings will need to be addressed.

Perhaps because of the more autonomous nature of institutions at the higher education level, national authorities collected information about education continuity in higher education in a less systematic way than in primary and secondary education. This report reflects this state of play and includes less large-scale initiatives for higher education (or for formal vocational education). This is in no way a reflection of the importance of those sectors to the education of countries' citizens. Analysis and information about how higher education students experienced the crisis internationally will emerge as the various data collections and studies undertaken by various higher education stakeholders are brought together. In any event, rebuilding more effective and equitable education systems will require to reflect on and articulate the

lessons learnt from the educational innovations and positive aspects of the health pandemic at all levels of education.

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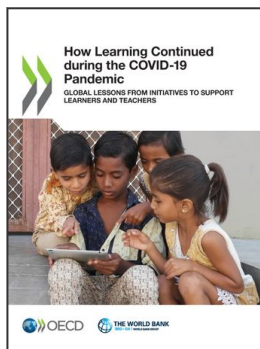
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