Financing for the EdTech Ecosystem: A Working Paper

SUZANNE RODDIS, WITH VICTORIA COLLIS, LIESBET STEER,
AND MADELYN SWIFT CUNNINGHAM

December 2021

Financing for the EdTech Ecosystem

A Working Paper

SUZANNE RODDIS, WITH VICTORIA COLLIS, LIESBET STEER, AND MADELYN SWIFT CUNNINGHAM

The authors wish to thank Amy Bellinger and Nick Vaughan from the Education Commission, and Harry Patrinos and Michael Trucano from the World Bank for their valuable contributions to this paper.

Contents

Foreword

The Education Commission has prepared this paper to stimulate discussion at the High-Level Panel on Innovative Financing for the EdTech Ecosystem at RewirEd on 14 December 2021.

It asks four fundamental questions:

Why should we invest in the EdTech ecosystem?

We identify three reasons: ensuring the *resilience* of our education systems; building *equity and educational justice*; and harnessing the power of technology to *transform learning outcomes*.

What is holding us back?

We identify four barriers: *access* to technology; *understanding* of the EdTech ecosystem and its interdependencies; *collaboration and cooperation* between actors; and *financing* for well-chosen technology.

What do we need to invest in, and how much will it cost?

We identify the range of elements that comprise the EdTech ecosystem, drawing on existing models. We postulate that *each one is necessary, but not on its own sufficient, to help us realize the potential of technology* in education.

How could we finance the EdTech ecosystem?

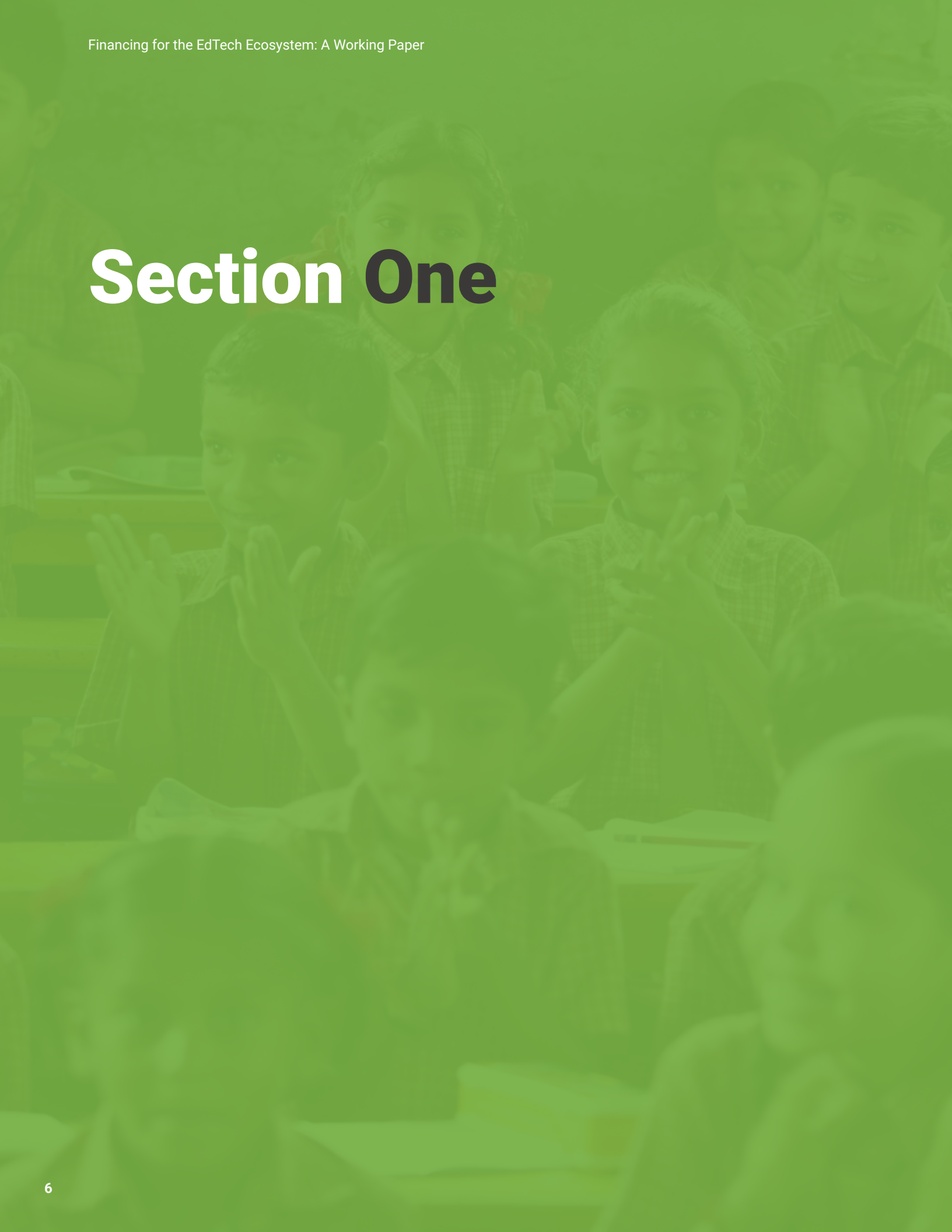
We explore a *range of innovative financing approaches*. These include ways of increasing domestic public finance, approaches to multilateral development bank (MDB) financing, the use of blended finance, and private sector investment (for profit and philanthropic). Each is assessed for its potential for leverage, mobilization, concessionality, demand, and actionability.

Note on terms used

It is a sign of the fast-evolving nature of this area that terms may be used in different ways by different actors. In the interests of common understanding, this is how the most common have been used in the paper:

EdTech:	A portmanteau of education and technology. We have used this as the umbrella term to cover everything we need to invest in to take advantage of digital technologies for learning, from devices and open-source content to workforce development. It does not, however include basic access (see below).
EdTech Ecosystem:	We refer to the EdTech ecosystem when discussing the full requirement for taking advantage of digital technologies for education, including connectivity and electricity, the underpinning enablers of access.
Digital Learning:	We use this to refer to any type of learning, or any type of instructional practice that uses digital technology. Digital learning is independent of place, so could take place in the classroom, virtually, or in any other setting.
Open Educational Resources:	We use this to refer to material, including images, written word, audio and video, and games, which may be freely and legally reproduced, edited, excerpted, expanded, and republished. This content is also referred to as open educational resources.

Section One



Section One

Why should we invest in the EdTech ecosystem?

COVID-19 created the largest ever disruption of education systems, affecting nearly 1.6 billion learners in more than 200 countries. The extent of pandemic related closures highlighted the fragility of education systems across the world. It also threw into stark relief the challenges that face the most marginalized students, including those in low-income countries (LICs), girls, children with special educational needs and disabilities, refugees and internally displaced learners, and those from poor families, even in the richest countries in the world.

In the immediate term, these included unequal access to remote learning and poor quality of instruction.[1] But it is also feared that learning losses may translate into significant long-term challenges, including reduced access to higher education, lower labor market participation, and lower future earnings.[2] Estimating this impact is a fast-evolving area. In December 2021, one study put global long run losses at US$17 trillion, considering impact on future earnings, well-being, and life prospects for the generation affected by school closures.[3] This paper further estimated that the most disadvantaged learners would be worst affected.

Investing in education offers well documented long run benefits. For individuals, investment in learning delivers a positive rate of return above any competing alternative including government bonds, stocks, bank deposits, and housing investments. On average, the global individual rate of return to education is 10 percent. Returns are higher for women than men, and the long run financial benefit of an additional year of schooling is highest in low-income countries.[4] At system level, it makes sense for governments to invest in the education sector, since social returns are higher than for alternative investments, including in school infrastructure. The benefit associated with education is important for social issues including economic progress, racial and ethnic equality, gender parity, and income equality.[5]

As schools, institutions, and other learning spaces closed their doors around the world in 2020, affecting more than 94 percent of the world's student population,[6] long running debates about the potential of digital technologies moved closer to the top of the education sector's agenda. Three compelling reasons to invest in the EdTech ecosystem have emerged:[7]

First, the COVID-19 pandemic and earlier crises have highlighted the *need to build up the resilience of our education systems to enable them to deal with an increasingly*

uncertain environment. We cannot rely purely on the traditional classroom model of education delivery. Digital technologies, well applied, can help us find new ways of teaching and learning that don't necessarily rely on people always being in one location.

Second, *we need to invest in equity and educational justice* if we are to realize the ambition of Sustainable Development Goal (SDG) 4, ensuring every child secures her right to education and right to learn. Digital technologies offer a plethora of possibilities, from helping administrators allocate resources more effectively to providing specialized solutions for marginalized learners. Yet if actions and investments are poorly targeted or partially implemented, EdTech can significantly *increase* inequities, as experienced by many learners during COVID-19.[8]

And third, we need to *reimagine education, transforming learning outcomes and unlocking the potential of the next generation*. Digital technologies can help us deliver learning experiences that are better personalized and adapted to learner levels, as well as equipping educators with new materials and approaches to work increasingly effectively with learners.

1. Building resilience

During the pandemic, innovation moved from the margins to the center of many education systems as governments and private sector providers faced the acute challenge of delivering education outside the classroom.[9] The boundaries between traditional and digital learning blurred, with multimodal delivery becoming the norm.

Student experiences of virtual and blended learning varied enormously. Many low- and middle-income countries became overwhelmingly dependent on radio and television for education delivery, with a multimodal approach of radio, television, and take-home packages a common response.[10] In many cases, the pandemic also highlighted a lack of suitable materials and the preparedness of educators to work in a new way. Governments are, now the immediate crisis has passed, starting to take stock of what will be needed to address these shortcomings.

However, this forced shift towards digital learning also presented an opportunity to reimagine how education could be delivered. The use of multiple delivery modes is likely to remain, with future iterations of digital learning no longer bound to the traditions of single teaching modes, as educators increasingly have access to a range of instructional delivery options.[11]

2. Delivering on equity and educational justice

SDG4 promotes inclusive and equitable quality education and lifelong learning opportunities for all. This includes the provision of 12 years of free, publicly funded, inclusive, equitable, quality primary and secondary education for all children by 2030. While tremendous progress has been made, 258 million students were still out of school in 2019, including 59 million children of

primary school age. The situation is graver in communities afflicted by conflict and violence. And girls and children with special educational needs stay most likely to be left behind.[12] In addition, even when in school, learning opportunities have been highly uneven. Even before the pandemic, more than 50 percent of children were unable to read by the age of 10[13] and 70 percent of children and young people were unable to achieve basic secondary level skills.[14]

Digital learning has the potential to be a great equalizer in education by increasing access to education[15] and learning.[16] At a time when resources for education systems are stretched, EdTech has the potential to increase access and learning in a cost-effective way. Blended models of learning may allow governments to enroll more students than traditional assumptions about pupil teacher ratios, or pupils per classrooms might suggest. Well-designed digital technologies can also reach learners in areas where schools either do not exist or are very overcrowded. This includes children living in refugee camps and urban and peri-urban slums.[17]

3. Reimagining education

If building resilience and delivering equity are the *must have* reasons for investing in the EdTech ecosystem, the potential to rethink the way we approach education service delivery to the benefit of learners everywhere offers the promise of *transformation*. There is a spectrum of ways in which this manifests itself, from impact on the individual learner, through to system level change.

Case Study

Instant Network Schools

In 2013, Vodafone, in partnership with UNHCR, launched Instant Network Schools to provide young refugees, their hosts, and their teachers access to the internet and digital learning content in refugee camps in the Democratic Republic of Congo, Kenya, Mozambique, South Sudan, and Tanzania.

Instant Network Schools is a free digital program that provides tablets for learners, laptops for teachers, a projector and speaker, and 4G connectivity. Content is localized and aligned to national curricula. Materials were developed through Learning Equality using their platform Kolibri, in collaboration with educational partners, ministries of education, and local education experts in each country.

A recent evaluation of the program shows a positive impact on learning outcomes, including an increase in ICT literacy of 61 percent for students and 125 percent for teachers, improved confidence, motivation, and academic performance by students.

Vodafone Foundation and UNHCR are jointly investing €26 million to expand the program to benefit 500,000 refugee and host community students and 10,000 teachers, with an additional 255 new INS opening by 2025. In 2020, Instant Network Schools won a Financial Times/IFC award for Transformational Solutions in Education, Knowledge and Skills.[18]

First, EdTech brings the idea of truly personalized learning for students closer, enabling proven approaches of interactive and adaptive learning.[19] Over the past 15 years, multiple randomized evaluations have shown that reorienting teaching to the level of the student consistently improves learning outcomes. Promising evidence is emerging of the potential of using technology in this area, including a recent study of multiple randomized controlled trials (RCTs).[20] This found that the use of tech-enabled personalized learning has the potential to improve learning outcomes significantly and may be most beneficial in closing gaps for lower attaining students.

Meanwhile, a combination of EdTech and a more differentiated education workforce can allow instruction to be delivered in ways that maximize school resources *and* enhance student experience. For example, the African School for Excellence operates a model where students rotate between teacher-facilitated lessons, small group peer learning activities, and individual work on computers. This places the teacher in a facilitator role, supported by technology. For each cycle, a fully qualified teacher is only needed in the first rotation while in the other two, academic advisors can manage the classroom.[21] Students outperform the wealthiest in South Africa by 2.3 times in math and 1.4 times in English, at a cost of $800 per student per year.[22]

Third, EdTech has considerable potential to strengthen teacher time on tasks, including more personalized approaches to learning, by automating daily tasks, including attendance, and communicating with students and caregivers. Online

Case Study

High Touch High Tech

In partnership with Vietnam's Ministry of Education and Training and Arizona State University, the Education Commission developed a prototype that explored the role of teachers within an adaptive learning context.

Math test scores saw improvements of 0.436 standard deviations in one semester, equivalent to two years of learning. The approach delivered positive impacts for all students, with greater benefits observable for those who were lower performing. This is consistent with results from other studies of tech-enabled adaptive learning.

Additionally, more students perceived their teacher to be effective after the intervention, as measured on the basis of their instruction, student engagement, and classroom management.

These findings mirrored those for teachers themselves. Perceptions of the usefulness of adaptive tools increased by 0.83 standard deviations and educators reported increased confidence in their ability to motivate and engage students.

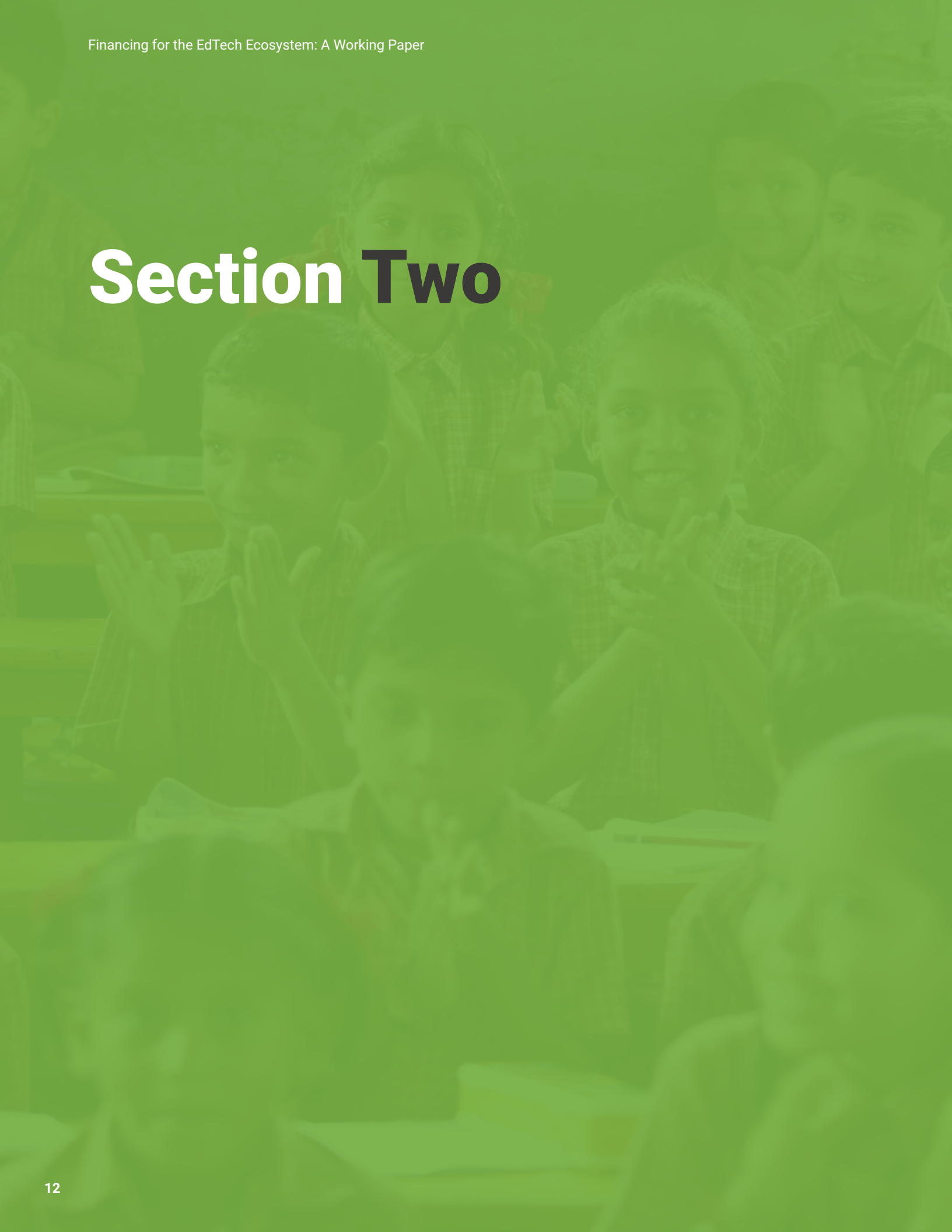
Personalized teaching practice became observably stronger across the board, by between 0.78 and 1.80 standard deviations. Meanwhile collaboration between educators increased by 0.98 standard deviations.[23]

assessments can make grading easier, with caregivers messaged automatically when students receive a failing grade. EdTech can also enable learning assessments to be conducted at scale, with resulting data shaping the future learning needs of students.[24]

Next, multiple governments have used EdTech over the last decade to track and aggregate information about aspects of education service delivery. One example connected to learning specifically is Kenya's Tusome program, where Curriculum Support Officers used tablets to support teachers during their periodic observation sessions, as well as to upload data on reading progress and teacher practice into a dashboard. This in turn gave district offices valuable information on progress compared with other districts, as well as comparative data on their own schools.[25]

And finally, at whole system level, EdTech offers promise for improving the efficiency and effectiveness of administration, as well as for transforming the availability of data for benchmarking, planning, and budgeting purposes. For example, building digital collection, processing, and analysis of education management information system (EMIS) data could help realize the goal of more timely data-based policymaking. Similarly, the application of artificial intelligence and modeling can help tackle entrenched issues such as teacher deployment and resource allocation across a system in a more equitable way.

Section Two



Section Two

What is holding us back?

The three arguments advanced in Section One for investing in EdTech are collectively compelling. This raises the question of why we are not already doing so at scale. We have identified four major barriers we need to address to make progress.

1 **First, *access to EdTech* remains a huge issue in many contexts, particularly in low- and middle-income countries and among marginalized learner populations, including in high-income countries.** While this remains true, the case for investing in technology for personalized learning, or to evolve teaching practice is weakened, and the promise of transforming education outlined in Section One remains distant. We can use low tech alternatives in the meantime – but cannot settle for learners in low resource environments having less access than their peers. Therefore, access is critical.

2 **Second, we need to take steps better to *understand the full EdTech ecosystem, interdependencies between its constituent parts, and what mix of interventions delivers results* to inform the investment choices we make.** Investing in access alone will not deliver on improved resilience, equity, nor a transformation in learning outcomes. Meanwhile, continuing to deliver well targeted and accessible research, and the connection of research to policy decisions, is critical.

3 **Third, *stronger cooperation* is essential if we are to make more progress on EdTech. This matters at all levels.** Collaboration will be important between education ministries and workforces, across government departments at state level, and between funders and low- and middle-income country governments. Meanwhile the international community must work in coalition to support the scale of work and investment required. And we need to find new ways of working between public and private sectors, particularly involving internet providers and EdTech entrepreneurs.

4 **Finally, *securing sufficient finance* is currently a significant obstacle to scaling up the use of EdTech.** Financing the education sector is already an entrenched issue for many low- and middle-income countries, and the economic impacts of the pandemic have only added to those pressures. Meaningful investment in the EdTech ecosystem will require more resources, including significant capital investments. At global level, UNICEF estimated the total requirement at $474.5 billion, of which $428 billion is the cost of connecting every learner to the internet. An additional $498 billion will be needed to make data usage affordable for all.[26]

1. Access to EdTech

The most obvious reason low- and middle-income countries are not already investing in EdTech is that connectivity remains a fundamental issue, as well as the availability of devices for digital technology and affordable mobile and online data, where this exists. The pandemic has brought the scale of this gap into focus, with around 3.6 billion people still lacking an internet connection.[27]

To realize even the basic resilience benefits of EdTech, low- and middle-income countries will need to be able to offer access to learners and teachers alike. Digital learning cannot take place without access to technology. Not only will electricity and broadband access need to be extended to rural communities, but they will need to become more affordable for low-income ones.

Limitations to access include four fundamental barriers. In many cases, learners are faced with multiple obstacles, particularly in low-income countries and among marginalized populations. First, the absence of broadband internet remains a major issue in many countries where investment in infrastructure remains prohibitively expensive under current financing models.[28]

In low-income countries, only about 35 percent of the population has access to the internet. Rural communities in a much broader spectrum of Low- and middle-income countries also often lack broadband connectivity. For example, while broadband use in the capital cities of India, the Kyrgyz Republic, and Moldova is at the same level as some OECD member states, access in these countries' rural areas is among the lowest in the world.

Second, even more basically, access to electricity remains limited for some learners. In some low-income countries, less than 10 percent of the poorest households have electricity.[29] Meanwhile, the high cost of devices and data is a third significant access barrier. Devices needed to access digital learning remain prohibitively expensive for low-income households.[30]

Finally, the cost of data in low-income countries is dropping but remains prohibitive in many cases. According to a recent survey, data costs in 45 percent of the participating countries remain above the 2 percent affordability target set by the Broadband Commission.[31] In countries with consolidated broadband markets, data costs are kept high. In these markets, consumers with no option to switch providers can pay as much as $7.33 more for 1GB of data.[32]

These access issues are magnified among marginalized groups of learners in all settings. Recent studies highlight the issues for girls, children with disabilities, and displaced learners respectively.

Girls are rarely given equal access to technology compared with their male counterparts, both in the classroom and outside school. The evidence suggests this is due a combination of gendered household attitudes and roles, cost, and fears for security. This limits girls' access to formal and informal educational content and further impacts upon their technology experience and literacy. Where girls do have access to EdTech, studies have shown they are likely to respond with a high level of engagement. Furthermore, access to technology has been shown to be disproportionately empowering for girls and women than for boys and men.[33]

Meanwhile learners with disabilities also have little access to EdTech, with most initiatives still in the early stages, and access in rural areas and funding for scaling up both limited.[34] And displaced persons and refugees face multiple barriers to digital learning, despite the fact the 93 percent of all refugees live in areas covered by at least a 2G network. On top of the barriers mentioned above, such as a rural/urban divide in connectivity and the high cost of a mobile phone and data plan, this group also faces additional obstacles to accessing tech, including a lack of literacy in any language, and a lack of digital knowledge and familiarity.[35]

2. Understanding the ecosystem

Removing barriers to access is fundamental to realizing the potential of EdTech. However, it is important to register that tackling access is not in itself sufficient to deliver on any of the resilience, equity, or transformational reasons for investment in digital technology for the sector.

This means considering the whole EdTech ecosystem, ensuring we understand and act on the relationship between the things we invest in, as well as building our knowledge about which interventions are likely to deliver most strongly. Ministries across the world are beginning to think through what they need to do to put EdTech at the heart of service delivery. In a resource constrained environment, it is especially important these decisions are well informed by evidence that is robust as possible.

Developing a common framework for the EdTech ecosystem is a work in progress. Omidyar's influential 2019 approach is currently being revised by others, including UNICEF's Reimagine Education and the Education Commission's High Touch High Tech initiative.

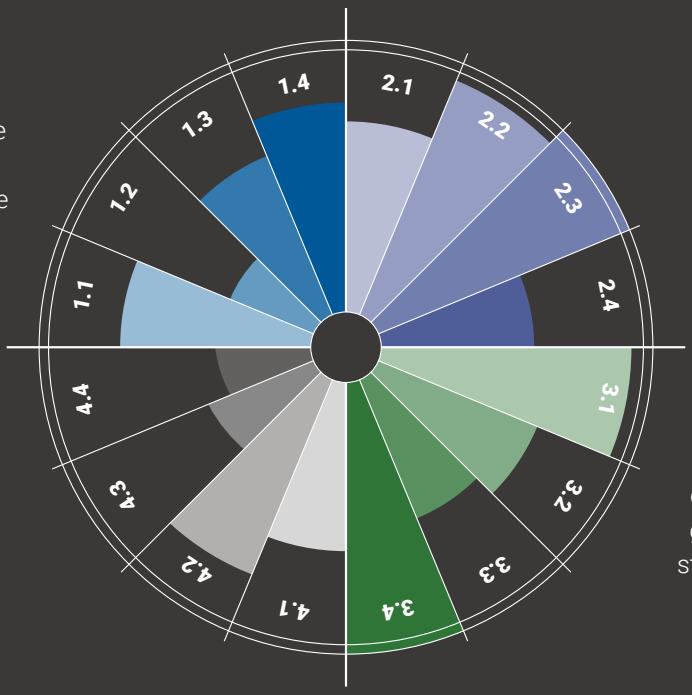
The most critical aspect of the Omidyar framework, aside from its attempt to capture all aspects of the EdTech ecosystem, is its emphasis on achieving balance between these interdependent elements. One often overlooked aspect, for example, is the change in the education

workforce needed to harness EdTech to its full potential, discussed in Section One. At the same time, while the evidence base on, for example, the benefits of tech-enabled personalized learning is strengthening, it remains important to keep building and communicating our collective understanding of what really delivers, to avoid the specter of expensive investments in technology that fail to improve learning outcomes.

The EdTech Ecosystem[36]

EdTech Supply and Business Model
EdTech market similar in size to the textbook market. Some efforts to incubate innovation, yet little private capital for new business ventures.

Human Capacity
Although attention has been paid to developing teacher skills along with hardware connectivity, transformative pedagogical use remains limited.



Enabling Infrastructure
All schools have digital infrastructure for learning, mostly computer labs for digital learning resources. Administrative platforms are widespread.

Education Policy and Strategy
Growth of EdTech largely driven by central government, introduced in a gradual planned manner. Education standards and value placed on basic digital literacy.

3. Collaboration and cooperation

A broad coalition of actors will need to form behind a common purpose to deliver any of the resilience, equity, and transformation potential of EdTech at country, let alone regional or global level.

Within sovereign governments, simply tackling the access barriers of electricity, connectivity, and the affordable availability of data and devices as they apply locally will require significant coordination and a joint vision. Education ministries cannot fix, or in many cases even initiate, this work on their own. The decision to make digital technology available to all people, including learners, must be taken, and acted on collectively, with strong commitment needed from finance, planning, civil works, and Information and Communications Technology (ICT) ministries.

In some countries, governing bodies have been established to oversee this work. For example, in Thailand, a new Ministry

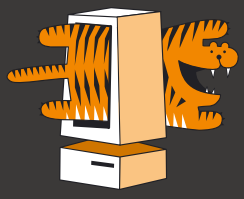
of Digital Economy was created, as well as a Digital Economy Policy Committee presiding over the implementation of Digital Thailand 4.0, a vision that includes a broadband digital infrastructure, innovative ecosystem, technology for a more equitable society, e-government services, human capital development, and holistic frameworks for a Digital Thailand that break down siloed development.[37]

Resourcing and delivering on these commitments in turn requires strong collaboration between governments and their partners, national and international, along two axes. First, it is critical in a resource constrained environment, particularly post-COVID, to make decisions about how to prioritize investments based on the best available evidence of which intervention will deliver most strongly. Governments should work with researchers and practitioners to understand more clearly how to direct their focus for better resilience, more equity, or transformation of learning outcomes, and preferably all three. At the same time, governments are also likely to need to work with a coalition of funders and partners to finance and deliver a multi-faceted EdTech strategy. In Estonia, for example, the government collaborates closely with the private sector (see case study).

Finally, it is incumbent on the international community, including bilateral donors, multilaterals, foundations, and others, to ensure it advises and supports in a joined up and collaborative way.

Case Study

Estonia



In 1996, Estonia launched the Tiigrihüpe (Tiger Leap) program. Five years later, every school in the country was connected to the internet and equipped with computers, largely through government investment. Subsequent steps in the program included developing digital teaching and learning resources or teaching and learning, and focusing on building digital literacy skills among students and the education workforce.

Among the most interesting aspects of Tiigrihüpe was its use of public private partnerships to finance and deliver EdTech innovation. For example, eSchool is an administrative system delivered by the education ministry with the private sector that automates many routine tasks for teachers, freeing up valuable time for instruction.

The focus on partnership has had a stimulating effect on the EdTech sector in Estonia. During COVID-19, EdTech start-ups have multiplied significantly. Startup Estonia, a public initiative, working with the education ministry, has now set out its ambition to bring 20 new EdTech companies to the market in the next two years.

The early introduction of digital learning had a significant impact on Estonia's experience of pandemic service delivery. Not only did students maintain access to education, but Estonia's latest PISA results indicate high levels of learning, even in the most difficult times for face to face education.[38]

4. Financing for the EdTech ecosystem

At global level, governments account for approximately 82 percent of education spending. Households spend 17 percent, and development assistance contributes less than 1 percent. These proportions have remained relatively constant over time. The share of development assistance in total education spending rises to 18 percent in low-income countries, is at 2 percent in lower-middle-income and 0.3 percent in upper-middle-income countries.[39]

In response to COVID-19, many governments quickly invested in remote and digital learning solutions, using funds assigned or earmarked to upgrade digital infrastructure, purchase digital devices, develop distance-learning platforms, and create new tools. These responses were possible mainly because governments undertook large-scale fiscal and monetary measures or relied on international donor support, particularly in low-income countries. In other countries, more funding was available through contributions from infrastructure, ICT, and energy ministries, or from savings from other budget lines.[40]

In low- and middle-income countries, households typically account for 25 to 35 percent of total education expenditure, tending to cover costs such as supplies, transport, and uniforms. In low-income countries, the cost per student of secondary education for families is close to 15 percent of the average income per capita. Evidence shows that economic or past epidemics increase the financial burdens families face in sending children to school. The economic consequences of COVID-19 are therefore likely to squeeze household budgets even further and reduce families' capacity to fund their children's education.[41]

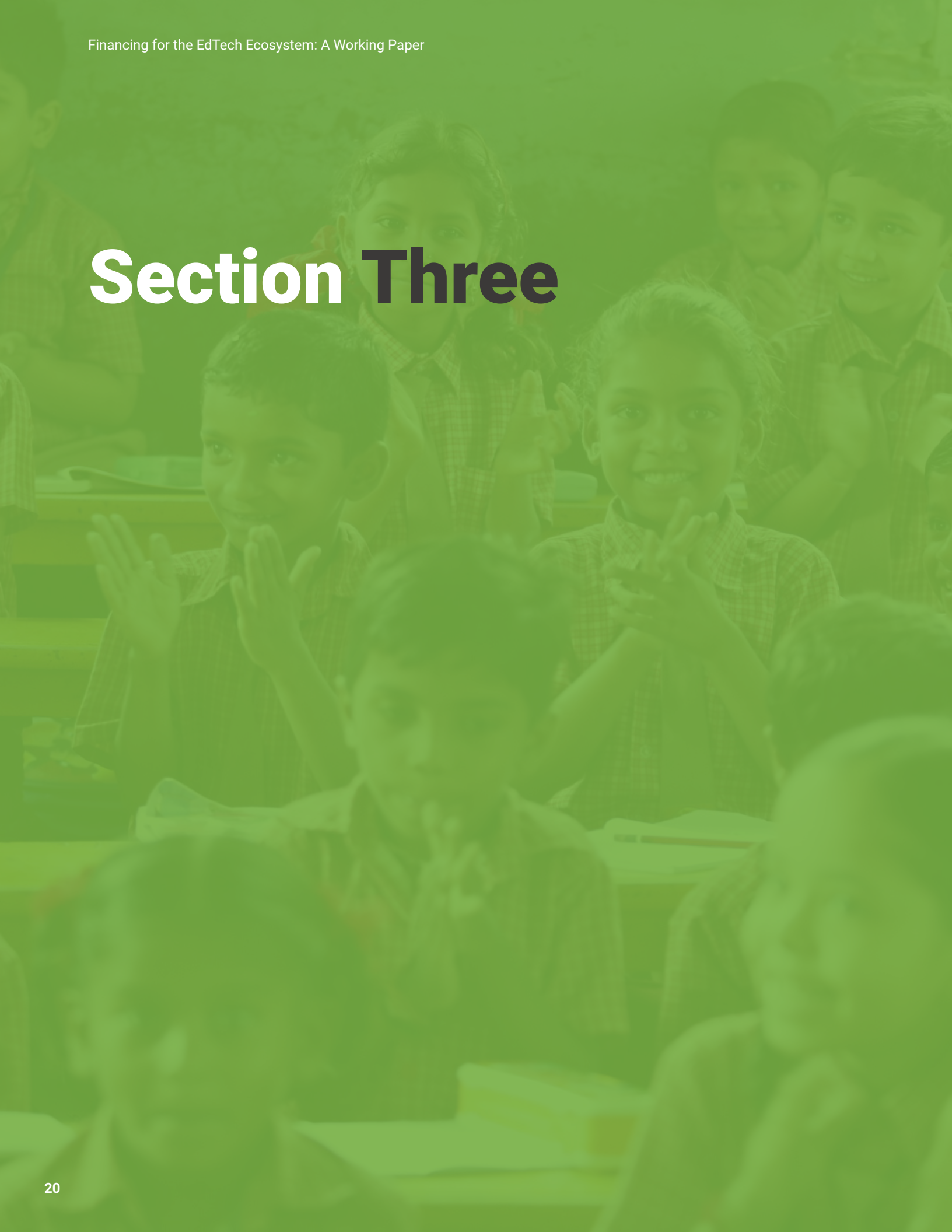
Meanwhile, donor aid in the education sector peaked in 2016, growing by $1.5 billion, or 13 percent in real terms from 2015, to reach $13.4 billion. However, the share of basic education aid to low-income countries fell from 36 percent in 2002 to 22 percent in 2016.[42] Lower-middle-income countries also face a financing gap and MDB lending for education remains low. The donor response to the COVID-19 pandemic has focused overwhelmingly on health. And while some donors have allocated additional funds to education response efforts, these contributions remain relatively small.[43]

Underfunding of education, lack of transparency and accountability about financing commitments, fragmentation of international financing flows, and limited progress with innovative finance are recurring themes yet to be addressed.[44] One estimate is that between 2021 and 2030, $1.4 trillion will be needed for the universalization of digital learning, including $428 billion for universal internal connectivity, $498 billion equivalence of zero-rating to make data usage affordable, and $46 billion for delivery.[45] This is based

on data and assumptions from various pre-COVID-19 models, and notes that the amount of investment varies widely by country. It is also important to note that financing for electricity expansion and achieving affordable data is a cross government, rather than an education sector, responsibility.

However, the scale of these estimates makes clear that significant additional investment will be needed to achieve the promise of EdTech for the resilience of education systems, as well as for delivering on educational justice and realizing the transformative potential of technology for learning.

Section Three



Section Three

What do we need to invest in and how much will it cost?

In Section Two, constrained access to broadband, electricity, devices, and affordable data was identified as the first barrier to investment at scale in EdTech for low- and middle-income countries. The need for collective vision, planning, and action across multiple government ministries was identified as one of the main areas where stronger collaboration was required to achieve this.

Achieving the goal of universal access is fundamental and will involve significant capital investments, as well as allowing for recurrent costs of maintenance. However, while both necessary and fundamental, tackling access is not by itself sufficient to realize the potential of EdTech. Investment must be planned for using a comprehensive approach that looks not only at infrastructure, affordability, regulation, and technologies, but also at the human component, which includes closing digital and literacy barriers for all learners and teachers, having localized and meaningful content, measuring the impact on learning outcomes, and strengthening the capacities and the role of educators.[46]

There have been various attempts to scope the range of investments required, including by UNICEF for Reimagine Education, and UNESCO in the development of a new costing model for the EdTech at country level. For the purposes of this paper, we have pooled these approaches, adding additional items as required.

We have sorted costs into those that underpin our ability to access EdTech on the one hand (electricity, connectivity, and devices), and those that use EdTech to deliver learning on the other. Priorities and costs will be highly variable, depending on the operating context, but the principle that all these items need to be available to unlock the potential of EdTech holds true in all situations.

1. Investments to enable access

Capital investments required for electricity and connectivity are significant. They can generate profit, but potential varies widely in part due to barriers to entry and other legislative restrictions on competition. As of the first quarter of 2021, the average net profit margin in the utility sector was 10 percent.[47] A 2016 World Bank study of 39 African countries, found that 20 were not even covering operational expenses. Of the remaining 19, only 5 were covering half or more of their capital expenditures. Improving operational efficiencies, along with increased bill collection and increased

Cost Estimates for Universal EdTech Ecosystem Coverage by 2030[50]

	Investment	Cost, Coverage, and Source (NB: these vary widely by country)
Supporting ecosystem investments	Electricity	**$410 billion** for universal coverage. Usually delivered by the public sector but important to note requirement for household level expenditure in blended situations
	Connectivity	**$428 billion** for universal coverage. Usually delivered by the private sector but important to note requirement for household level expenditure in blended situations
	Devices	**$38 billion** for universal coverage. Usually delivered by the public sector, with private donations and out of pocket household spend
	Data usage	**$498 billion** to ensure data is universally affordable for learners. This finance could be raised through zero rating and subsidies in a partnership between private and public sectors
EdTech investments	Workforce professional development	**$3.1 billion** on the assumption that one trained teacher or facilitator is needed for every 20 students. This estimate does not consider (a) the full range of education workforce professionals or (b) the impact of EdTech on traditional approaches to professional development. Usually delivered by the public sector
	Open educational resources	**$2.4 billion** on the assumption that 30% of the curriculum is digitized. This estimate does not consider (a) impact of EdTech on the curriculum or (b) the availability of open source materials. Usually delivered by the public sector
	Administrative systems	**No estimates available**. Spend on EMIS is currently less than 1% of average recurrent budget

tariffs could potentially put the electricity sector on a sustainable path in about one-third of African countries.[48]

Meanwhile, broadband providers have seen overall growth but widely varying profitability between 2006 and 2021. Internet service providers tend to be reluctant to enter rural 'last mile' markets. However, governments can introduce incentives and mitigate risk to make thus a more attractive investment that can achieve market rate returns. One estimate suggests that there is an attainable market opportunity of $144 billion in annual untapped demand to connect the next one billion people.[49]

At country level, studies indicate that increasing broadband penetration by 10 percent can increase gross domestic product (GDP) by approximately 1 percent, with similar results for both low- and lower-middle-income countries.[51] Capital investments, such as electricity and broadband connectivity underpin not only access to EdTech but also economic growth, increased competitiveness and productivity, innovation, and financial inclusion.[52] Investing in connectivity and power particularly is therefore a whole country, not a sector specific decision.

A. Electricity

Digital learning requires access to electricity, which is still not accessible for millions of the most vulnerable people.[53] According to Sustainable Energy for All, an investment of roughly $410 billion ($41 billion per year) will be required to achieve universal electricity access by 2030, or a marginal cost of $520 per person to enable access to electricity.[54] Half of the investment, $205 billion, is needed in Sub-Saharan Africa, while South Asia needs $153 billion.[55]

International finance for energy access overall remained steady between 2013-14 and 2015-16, at an average of $11.7 billion committed per year. While international public finance declined to $8.8 billion in 2015-16 from $10.5 billion in 2013-14, international private finance more than doubled from the 2013-14 amount to reach $2.9 billion in 2015-16.[56]

Currently, government finances most electricity projects in LICs. However, investments in grids continues to fall. Governments in LICs, already in a weak financial position before the COVID-19 crisis, are now further constrained, driven by more limited fiscal capacity and higher financing costs as sovereign risks increase.[57]

As with connectivity, universal access to electricity is a challenge for communities which are remote or poor, or both. For remote households, extending the main grid can be prohibitively expensive. Even using off-grid systems to serve these disbursed populations can be financially challenging. Other challenges include a lack of sufficient power generation capacity and poor transmission and distribution infrastructure.[58]

There are very few private sector-led, new-build infrastructure electricity projects. They are financed through project finance that is usually syndicated, to spread

Global Energy Alliance for People and Planet

The Rockefeller Foundation and its partners have launched the Global Energy Alliance for People and Planet. The Alliance plans to unlock $100 billion in public and private financing in order to:

Provide underserved people with reliable, renewable power

Avoid and avert four billion tonnes of carbon emissions

Drive economic growth by creating, enabling, or improving 150 million jobs

In 2021, The Rockefeller Foundation and IKEA committed $500 million each in catalytic grant capital with the addition of Bezos Earth Fund. The Alliance is targeting $2.5 billion from world-class philanthropies that is intended to leverage $40 billion in 5 years from MDB, DFI, and other investors. The Alliance will provide grant funding, technical assistance, and a range of financing options.[59]

the risk among multiple investors, who face similar risks to digital connectivity investors.[60] Public private partnerships (PPPs) typically make up only 5-10 percent of overall investment in infrastructure electricity projects. Private sector risk can be mitigated by a transparent regulatory environment, and incentives including tax breaks and power purchase agreements.[61] A recently launched new alliance, the Global Energy Alliance for People and Planet, aims to address some of these challenges.

B. Connectivity

According to the International Telecommunication Union, $428 billion will be required to achieve universal access to broadband internet connectivity at the global level by 2030.[62] A large share of spending - $125 billion - is needed for South Asia, followed by $82 billion for East Asia and Pacific, and $54 billion for Eastern and Southern Africa. This means a marginal cost of $114 per person to connect everyone everywhere. The total amount of $428 billion includes $288 billion investment by the private sector and $94 billion by the public sector covering infrastructure, metro and backbone fiber, network operation and maintenance, and remote area coverage.[63]

Currently, 71 percent of rural and 95 percent of urban communities have 4G coverage globally, principally delivered through private capital.[64] Industry operators that invest in digital infrastructure are large mobile network operators, internet service providers, or tower companies such as American Tower Corporation. Industry operators have a low appetite for risk and low economic incentive to invest beyond densely populated urban areas.

Venture capital (VC) and private equity (PE) investors, who seek highly scalable investment opportunities, do not invest in connectivity especially in rural 'last mile' transactions and transactions valued below $5 million. Many institutional investors have a minimum transaction size of $10 million with the anticipation of making follow-on investments of an additional $10 million plus. Smaller transactions below $100,000 do not face as much difficulty finding funding because of the presence of various funding agencies and mechanisms that support seed stage transactions. Angel investments, early stage philanthropic funding, corporate accelerators, and university incubators often fund ventures at this stage due to the small transaction size and experimental nature of such investments.[65]

Digital infrastructure projects face multiple risks, including political and regulatory risk as well as macroeconomic risk. By addressing these and introducing incentives, governments can encourage private sector investment in rural areas considered high risk due to a lack of supporting infrastructure, difficult terrain, and high illiteracy rates.[66] Currently, government finances most connectivity projects in high-risk areas.

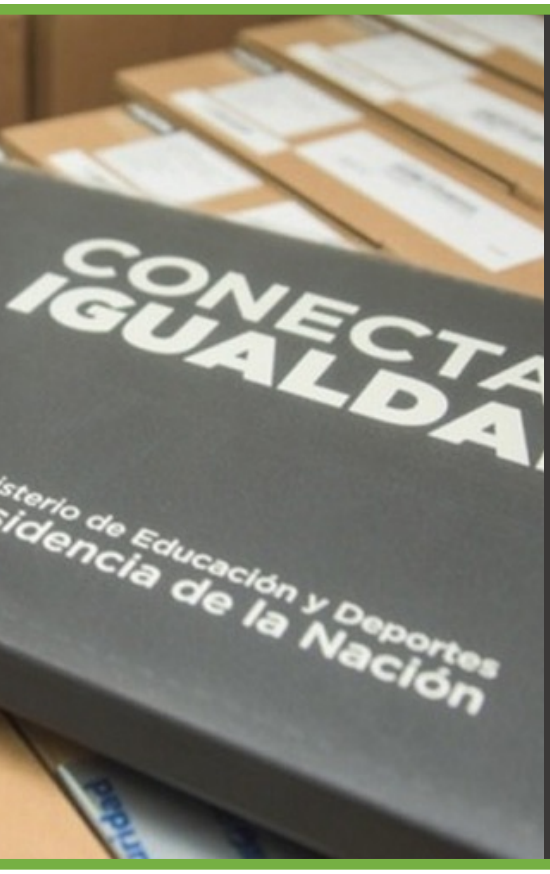
C. Devices

The global cost of devices is estimated at $38 billion, of which about $36 billion would be spent on devices for children and young people and $2 billion on devices for teachers and facilitators. A digital learning device can be a phone, tablet, laptop, desktop computer, or other digital equipment such as digital whiteboard. The estimate of total cost depends on device cost and the number of people in need.

Based on expert analysis, default device cost is estimated at $20 for each learner reached, and $50 for each teacher or facilitator. The administration, logistics, and utility are reflected by the current unit cost. It is estimated that 1.8 billion children and young people plus 40 million teachers and facilitators need to be targeted for device provision to reach universal access by 2030.[67]

Hardware and devices for education are additional capital investments and purchases are sometimes made by government through procurement processes, although many systems rely on privately owned devices. Public financing for hardware and devices as part of education expenditure can be increased using innovative financing, while judicious use of leasing can also reduce costs.

Capital investment in devices, as in the case of electricity and connectivity, can also offer governments incidental benefits in the form of increased employment opportunities, for example by specifying locally manufactured hardware, where skills and plant exist.



Case Study

Conectar Igualdad

Conectar Igualdad was launched in 2010 to strengthen education and promote economic development by closing Argentina's digital literacy gap. The program provided students with netbooks, expanded internet access, created digital content, and included ICT training for teachers.

Educ.ar, a PPP within the Ministry of Education, oversaw school infrastructure readiness. Launched in 2000 by HNI Martin Varsavsky, Educ.ar was initially designed to assist teachers in the development of an ICT curriculum by creating a standard set of materials for use throughout all schools.

Conectar Igualdad benefits from a clearly defined funding stream. ANSES, the national retirement and pension fund, financed the program in exchange for government bonds. The program required a $300 million investment in 2010 and another $1 billion in 2011 and 2012.

Over 5 million netbooks were distributed and 1,400 digital classrooms created between 2010 and 2015. In the government's 2012 tender, all equipment was mandated to be assembled or manufactured in Argentina. Under the subsequent administration, Conectar Igualdad lost funding and netbook distribution plummeted. However, in 2021, President Alberto Fernández launched the Juana Manso Federal Plan to build on the earlier initiative.[68]

Strategies for Financing Infrastructure Investments

	Investment	Strategies for increasing financing
Electricity	**$410 billion** needed to achieve universal access by 2030. Financing typically comes from the public sector and focuses on rural/high risk areas.	**Government can raise revenue:** a. Through taxation including universal service funds and solidarity taxes b. By issuing connectivity bonds and/or Infrastructure bonds c. By encouraging PPPs with supportive regulatory frameworks and incentives
Connectivity	**$428 billion** needed to achieve universal access by 2030. Financing typically comes from the private sector and focuses on urban areas.	**Government can reduce risk and encourage private investing by:** a. Easing regulatory requirements for community network operators b. Promoting tax and customs duty breaks to enable more investment in infrastructure c. Enhancing transparency and ease of doing business to encourage investment in infrastructure d. Focusing on complementary access networks that service underserved markets
Devices	**$38 billion** needed to achieve universal access (students and education professionals) by 2030. Financing typically comes from the public sector, although personal devices are often used.	**Government can raise additional resources** for devices and hardware through concessional financing, such as IFFEd.

D. Recurrent costs for infrastructure investments

Investment in infrastructure to enable access to EdTech brings significant recurrent costs related to maintenance which must be factored into government budgeting and planning.

This applies particularly hardware and devices, where ongoing costs include replacement, maintenance contracts, damage or theft, and end-of-life disposal. These could be reduced through leasing. A range of equipment can be leased, including tablets, laptops, personal computers, and smartphones. In some low- and middle-income countries such as India, leasing ICT equipment is common.[69] Hewlett-Packard, through its World E-Inclusion program, plans to sell, lease, or contribute $1 billion of information technology hardware to low- and middle-income countries.[70]

2. Investments in EdTech

A. Teaching practice development

Significant investment in the education workforce and teacher capacity to work effectively with digital resources will be crucial to realizing the potential of EdTech to transform learning outcomes. Many education systems are moving to blend face to face with digital forms of instruction. Meanwhile, COVID-19 forced millions of

Leasing Hardware[71]

Benefits

- ✓ Regular, predictable payments
- ✓ Flexible disbursement schedule
- ✓ Lease packages reduce overall cost
- ✓ Conserving capital
- ✓ Tax-exempt lease terms
- ✓ No more obsolescence
- ✓ Option to buy at end of lease
- ✓ No disposal costs

Drawbacks

- × Expensive interest rates
- × School does not actually own systems
- × No computers to hand down
- × Repair costs for damaged or broken systems

teachers worldwide to move their practice online. This disruption highlighted the fact that many education professionals have not been equipped with even basic digital skills, let alone the adjustments that a new way of working will require.

The cost of preparing teachers, facilitators, and other education workers including administrators to work with digital learning and pedagogies has been estimated at $3.1 billion globally. This model assumes that one trained teacher or facilitator is needed for every 20 children and that, over time, more training will be offered online or self-paced when a national or regional digital platform becomes functional. For most countries, the cost falls between $1-30 million.[72] However, it is important to stress this is a conservative estimate.

Some countries do offer educators professional development in digital technologies, particularly during pre-service training. There is also evidence that some systems are beginning to prioritize in-classroom experience of EdTech. However, professional development for digital teaching is neither widespread nor systematic in most education systems. Just 56 percent of teachers polled by the OECD reported that they had received formal training in ICT for teaching. And where this is available, it is often an add-on or retrofit rather than an essential component,[73] and is often divorced from pedagogy.[74]

EdTech can help make good teachers better, informing their decisions in the classroom, through more systematic data about their students' performance and behaviors. It can help teachers make learning engaging, interactive, and innovative. It can also help to open new perspectives and illustrate concepts in a better way. The Education Commission's High Touch High Tech initiative has demonstrated this in Vietnam and is currently working in Uruguay to expand on promising early findings (see Section One for case study).

Even simple technologies can be used for teacher professional development, for example using video clips of good teaching to demonstrate best practice, and through participation in communities of practice and peer learning. As an example, in Zambia, the Roger Federer Foundation developed the iAct Android application to offer support to school-based communities of practice.[75] It provides scaffolding for teacher-facilitators to organize and administer workshops on learner-centered teaching and videos of interactive teaching to watch and discuss.[76]

B. Learning content development

Digital access can offer students not only the ability to learn anywhere, but also supplemental classroom learning, and access to open-source content. Open educational resources (OER) open the possibility of more personalized learning and an improved use of resources, which promote equity by increasing the availability of knowledge by allowing individuals to learn anytime, anywhere, with the support of anyone, using any device.[78]

OER can also provide logically structured content for school-centered teacher and workforce education programs. In Zambia, the OER4Schools program developed openly licensed teacher professional development materials with session plans and exercises for 28 peer-led workshops on interactive subject pedagogy, questioning, group work, and assessment for learning.[79] Participants increasingly adapted their teaching to students' learning levels.[80] Meanwhile in Ghana, Transforming Teacher Education and Learning developed a set of OER to support teacher education in public colleges of education, structuring

Case Study

Teachers for Teachers

The Teachers for Teachers program in Kenya used mobile technology to strengthen teacher development in Kakuma Refugee Camp, one of the largest in the world. It was launched in 2016 as a collaboration between Finn Church Aid, the Lutheran World Foundation, and Columbia University with guidance from UNHCR.

Teachers for Teachers received financial support ($10,000) through the DFID-funded Amplify program. Facebook and WhatsApp platforms for the program were designed by NGO Ideo.org and the content was based on open-source material.

The program combined in-person teacher training with mobile mentoring support. Short, regular, practical messages delivered through Facebook and WhatsApp on mobile phones kept up the momentum between training sessions, reinforced key learnings, and motivated teachers to test new ideas in the classroom. Teachers were able to participate in discussions with trainers and shape future content.

The impact of the project was therefore assessed primarily through teacher-generated data - this reported increased preparation, confidence, and pedagogical knowledge among teachers, which had led to a marked improvement in teaching effectiveness.[77]

content into thematic areas such as questioning and group work. During the first two years of program implementation, the percentage of teachers using student-centered pedagogies rose from 26.1 to 65.9 percent.[81]

However, many school systems may struggle to access high quality, free to use OER for two reasons. In some cases, materials may not be offered in the country's medium of instruction. In others, OER may not cover the topics in a national curriculum, or not map easily against curricular objectives. School systems may incur translation and mapping costs if they opt for OER, which should be factored into planning for using existing content. However, this may still be more economical than developing content from scratch.

Approximately $2.4 billion globally will be needed for content, assuming 30 percent of all content is digitized. This cost would cover identifying, curating, and scaling-up digital solutions to meet individual learning needs and context. As for other items, cost will vary by country. Countries with high levels of learning poverty will need more resources to assure digital learning access and quality.[82]

C. Wider education workforce development

Developing and supporting teachers in their pedagogical practice is not the only area of professional development important to harnessing the potential of EdTech. Investments are needed at all levels in the system, from classroom, school, district to state level - investments must be made in professional development and for all roles.

Teachers need training in how to use EdTech, even for technologies they know well, as well as how to use it as part of their pedagogy and instruction. It is important to ensure that barriers to acquiring technological skills are minimized and that specific groups of teachers are not marginalized in the process.[83] Meanwhile, school leaders need professional development in technology for instruction and school-based professional development as well as technology for more efficient school management and data-driven decision-making.

Among national and sub-national administrators in the sector, district education officers and inspectors need training in how to use data and technology for data-driven school improvement, coaching, and other forms of instructional leadership support that target the schools and students who need it the most, and at a system level, planners, data analysts, and policymakers will need professional development to harness the latest technology and data techniques such as geographic information system (GIS), big data algorithms, dashboards, etc., for more real-time, accurate, and up to date data for more equitable decision-making and streamlining of often cumbersome processes.

D. Administrative systems

Strengthening the management and analysis of data in education is critical.

Both a lack of data and the poor use of existing data impede evidence-based policymaking in many countries at present. Putting actionable data in the hands of the education workforce can deliver vastly improved decision-making and accountability. Data collection makes it possible to continuously monitor and improve at every level. Data can also allow personalized lessons and content. Unleashing the full potential of data, in turn, will also require a focus on creating the right enabling digital foundations, including data governance and privacy rules.[84]

One of the most promising uses of EdTech is in supporting the collection and use of data across a whole education system. Where governments lack evidence or are not able to use it effectively, they may find themselves making critical policy and resourcing decisions with long range unintended consequences. At present, only 23 percent of countries worldwide are reporting on the full range of SDG4 indicators to UNESCO's Institute for Statistics. Available data tends to focus on access to learning rather than learning quality.[85]

EMIS serve to collect, integrate, process, maintain, and disseminate data and information to support decision-making and policy analysis at all levels of an education system. They should include data on

Strategies for Financing EdTech Investments

	Expenditure	Strategies for increasing financing
Professional development	**$3.1 billion** needed globally. Financing typically comes from the public sector or via partner-led projects.	Governments can raise additional resources for professional development through concessional financing, such as IFFEd. Open-source training materials can also be customized where appropriate.
Content development	**$2.1 billion** needed globally. Financing typically comes from the public sector or via partner-led projects.	Governments can raise additional resources for professional development through concessional financing, such as IFFEd. Open-source training materials can also be customized where appropriate. Content development is also an area where there is potential to develop PPPs.
Administrative systems	**No estimates yet exist.** Financing typically comes from the public sector or via partner-led projects.	Governments can raise additional resources for devices and hardware through concessional financing, such as IFFEd. Open-source building blocks for coding can also reduce cost and risk of developing bespoke systems.
Data usage	**$498 billion** required to reach the affordability threshold globally. Financing is typically out of pocket household spend.	Governments can use a number of levers to increase the affordability of data, including: **a.** Direct subsidy of costs **b.** Working with the private sector to offer zero rated access for educational purposes **c.** Increasing competition in the market to drive down prices

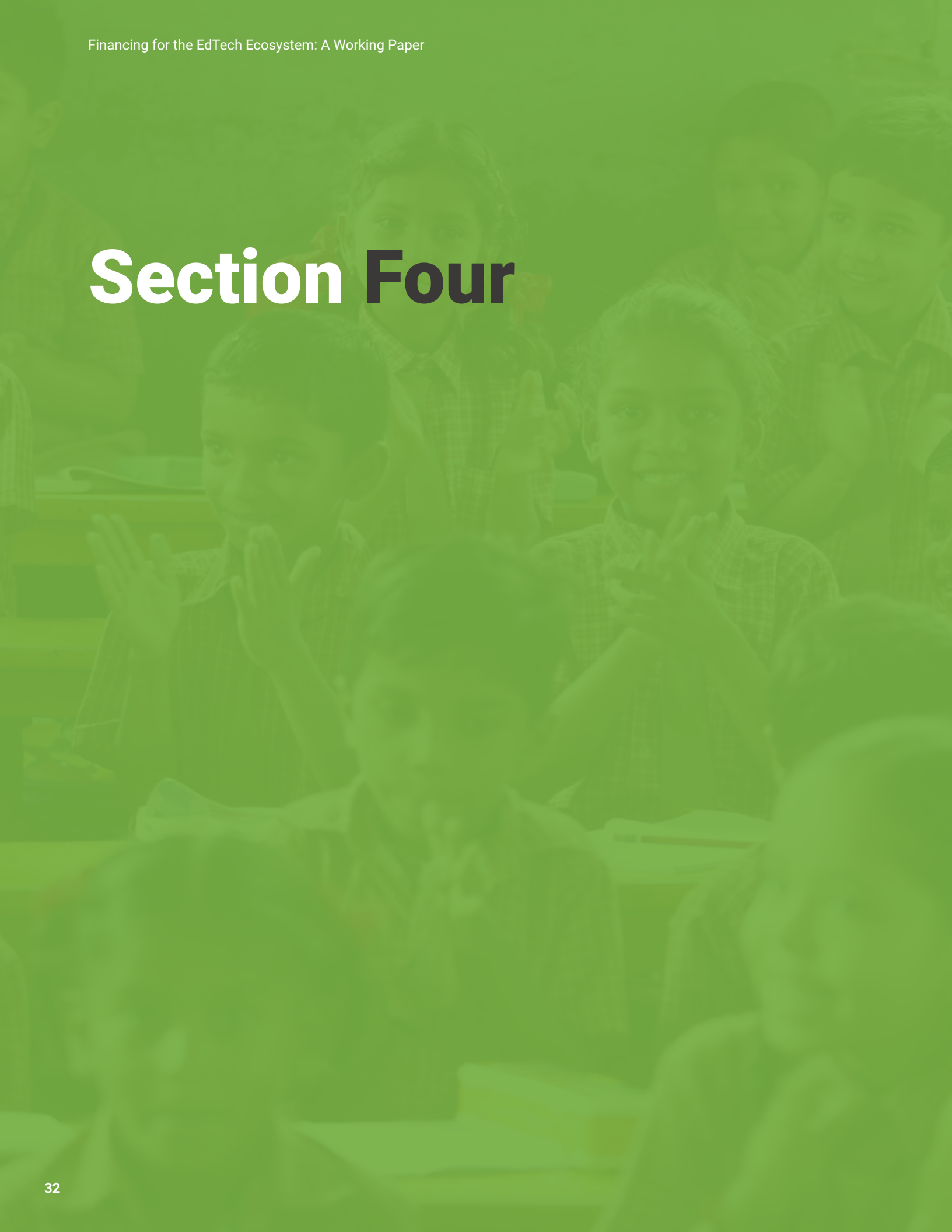
enrollment, attendance, completion rates, learning assessments, finance, teacher characteristics, and administrative statistics.

Data can be used in different ways to allocate resources more effectively, particularly in low resource environments. For example, GIS data and mapping can determine how remote school districts could pool scarce resources, by sharing a specialist teacher or using a wider learning team approach. Data and modeling technology can also be used to deploy the workforce in a way that minimizes the mismatch between personal preferences and the needs of the school system. Taking teacher preferences into account reduces requests for early transfers as well as absenteeism linked to post location.[86]

Additionally, digital platforms can be used to support teaching and learning, through content management systems (CMS), e-libraries, and bulk messaging tools. They can also be used as data collection tools. Digital platforms can be used for test scores, learning outcomes, teacher reimbursement, or promotion platforms as well as teacher/student attendance monitoring.[87]

Currently, most governments spend less than 1 percent of the total education budget on information management systems. No estimated costs yet exist for this aspect of applying technology in education, which signals the lack of focus given to this critical area to date. The potential of this type of investment in technology for education merits further exploration.

Section Four



Section Four

How could we finance the EdTech ecosystem?

Innovative financing can be defined as any financing approach that helps to achieve one or more of:

- generating additional development funds by tapping new funding sources or by engaging new partners
- enhancing the efficiency of financial flows, by reducing delivery time and/or costs
- making financial flows more results-oriented, by explicitly linking funding flows to measurable performance on the ground

The flow of resources from innovative instruments is still very small, but significant untapped potential exists.[88] New initiatives are bringing together multiple sources of funding, combining public and private financing, and previously underused sources of financing in the education sector, such as high net-worth individuals (HNIs) and foundations, are increasingly being harnessed.[89]

In this section, we explore a range of innovative instruments that could be used to deliver additional finance across the EdTech ecosystem. In most cases, governments in low- and middle-income countries are likely to need to combine a range of approaches to resource their plans. We consider in turn proposals to increase domestic public financing, MDB financing, blended finance, and private sector financing, including both for profit and philanthropy. We assess each against five criteria, drawn from a paper on innovative financing for the SDGs:[90]

Leverage: Defined as a financing vehicle's ability to multiply its capital or equity base, enabling it to disburse more development finance. This serves as an efficiency measure of the use of donor capital or grant resource to finance loans.

Mobilization potential: Referring to a vehicle's capacity to crowd-in actors who would otherwise not have provided financial input. In some contexts, this ability to mobilize additional resources is also referred to as the catalytic function of instruments.

Concessionality: Assessing potential to increase the concessionality of financing, contributing to address the wider challenge around low levels of concessionality. A vehicle capable of increasing concessionality levels could help make finance available to harder to reach actors, countries, and sectors, and offer a way toward greater mobilization of private finance through blended finance.

Demand: Considering to what extent the vehicle meets the demand of both recipients and donors. This would include the concessionality of the finance provided when evaluated from the perspective of the recipient (the grant element within overseas development assistance). From the donor perspective it would also include preferences over the application, for example, sector and types of outcomes that meet donor preferences.

Actionability: Encompassing a range of factors that will influence whether the innovation can be delivered in the short term and scaled-up quickly.

Financing Instruments Primer

International Financing Facility	The International Financing Facility is a partnership between sovereign donors, governments, and Development Finance Institutions along with public and private donors to mobilize additional financial resource for Lower-middle-income countries
Zero rating	Zero rating is the practice of providing internet access free of charge. Models include limiting access to certain sites, exempting some sites from data allowances, or the use of advertising as a subsidy
Results based financing	Results based financing involves any contract where a principal (e.g. donor or foundation) transfers funds to an agent (e.g. government or NGO) in exchange for delivery of mutually agreed outcomes
Bond	A bond is type of loan. The issuer (e.g. company, municipality, development bank, or sovereign government) raises capital from investors by selling bonds. Investors receive interest at pre-determined times, and the issuer returns the principal at bond maturity date
Syndicated loan	A syndicated loan is finance raised by a group of lenders to provide funds to a borrower (e.g. company, large project, or sovereign government). Syndication among a group of investors mitigates the risk of very large loans
Social bond	A social bond exclusively finances projects that address or mitigate a social issue, or that aim to achieve a positive social outcome. This includes education bonds and those supporting the SDGs more broadly
Solidarity tax	A solidarity tax is levied by a government to fund socially unifying activities or projects. In the private sector, this can take the form of voluntary sales taxes, often matched by the vendor
Public private partnerships	Public private partnerships (PPPs) are long-term contractual arrangements between the government and a partner (usually a private operator). Typically, the private partner may design, build, finance, and operate a dedicated asset to provide public services for which the government pays regular fees
Private equity	Private equity investors, whether high net-worth individuals or firms, invest directly in companies or projects or engage in company buyouts
Venture capital	A subset of private equity, venture capital is finance given to high-risk high potential start-up companies or projects over a 5-10 year period. Assuming the project matures, VCs realize a profit
Foundation	A foundation is a non-profit corporation or charitable trust that makes grants to organizations, institutions, or individuals for charitable purposes
Angel investors	Angel investors are usually high net worth individuals who invest in early stage start-ups with seed capital in exchange for ownership equity or convertible debt
Crowdfunding	Crowdfunding is the use of small amounts of capital from many individuals to finance a new venture. It uses social media networks and bespoke websites to bring investors and projects together. In the public sector, crowdfunding often focuses on diaspora populations

1. Domestic public finance

An important source of finance for EdTech ecosystem investments will be from domestic revenues, of which a growing share will need to be allocated to technology. In the short term, additional resources could be mobilized by ensuring that national recovery stimulus packages include allocations for education and digital learning. In the long term, additional domestic revenues could be mobilized through a combination of economic growth, tax reform measures, and greater prioritization of education.[91]

A. Universal service funds

Universal service refers to the practice of providing a baseline level of services to every resident of a country and has been most adopted in the areas of postal, electricity, and telecoms services. Universal service funds (USFs) are typically funded by a contribution from service providers, most frequently in the form of a levy based on annual operating revenues. Some countries offer other options. In Morocco, operators are invited to develop their own universal service project or respond to central tenders. This lets operators actively participate in USF design.

In the United States of America, the Telecommunications Act of 1996 requires telecommunications companies to extend access to their services to rural and/or low income and disadvantages groups. All providers of telecommunication services contribute to the USF based on their revenues. But not all companies cover the charge themselves; some charge their customers to make up the amount.

The Telecommunications Act helped increase the number of schools in the United States with internet connections from 14 percent to effectively 100 percent in a decade.[92] It also increased connectivity for rural and low-income families and rural healthcare facilities. However, the sustainability of the USF is in question. Over the past two decades, the contribution base (revenues used to calculate USF contributions) has declined by 63 percent. Over the same period, the contribution factor (fee assessed on telecommunications companies) has increased from 7 to 33 percent.[93]

Leverage	None
Mobilization potential	Low, although it is possible to collect contributions from CSR funds and grants from foundations and philanthropic institutions.[94]
Concessionality	None
Demand	N/A
Actionability	Many countries use USFs including 37 in Africa. However, disbursement is an issue. Unspent funds in African USFs total $408 million, and just four have a zero balance.[95]

B. Sovereign SDG Bonds

In 2020, Mexico became the first country to issue a Sovereign SDG Bond for $890 million, followed by a second in 2021 for €1,250 million. The bonds have a seven-year term[96] and will use finance to invest in projects that improve education infrastructure and ensure inclusive and quality education, in addition to other projects that align with the SDGs.[97]

All projects must prioritize vulnerable populations living in landlocked and disadvantaged areas.

UNDP will partner with the government of Mexico to monitor transparency. Impact will be measured against gains in the proportion of schools with electricity, connectivity, devices, and adapted infrastructure for students with disabilities.

Leverage	High. Increased public revenue through private investors.
Mobilization potential	Promising. The Mexican example attracted investors to consider education projects.
Concessionality	None
Demand	N/A
Actionability	Untested. The Mexican example is the first of its kind.

2. Concessional financing from multilateral development banks

Concessional finance is below market rate finance provided by major institutions such as MDBs. It comes in a range of forms. Concessional finance can be applied as grants, supporting results-based financing projects targeting education systems in low- and middle-income counties. It can also take the form of a first loss guarantee where a third party compensates lenders if the borrower defaults, or of a low interest loan to finance long run system strengthening, or even of an equity investment in a product with lower expectation in terms of share transfer than the market would demand.

In many low- and middle-income countries, governments will need to borrow from MDBs to finance domestic investments in EdTech. Historically, concessional loans in education have been used in areas like professional and curriculum development, as well as investment in school buildings. Additional concessional financing will be needed to expand EdTech. There are several ways to achieve this.

A. MDB bonds and labelled bonds

MDBs are important intermediaries between project funding and the international capital markets, issuing bonds and using the proceeds to finance development activities. MDBs issue bonds as part of their regular resource mobilization and financing activities. In some cases, MDBs have issued labelled education bonds to mobilize finance for education projects specifically including digital learning and transformation. These bonds are very similar to regular bonds. The major difference is that MDBs issuing the bond must prove that proceeds are being used for the purpose of education.[98]

In 2012, the African Development Bank launched an Education Support Bond to raise financing for projects with a focus on technical and vocational education and training (TVET).[99]

In 2021, the Asian Development Bank (ADB) issued an Education Bond to support increasing opportunities for high quality education following COVID-19 closures. This will finance distance and online learning and digital technologies, scaling equitable learning, training and teaching, and expansion of affordable and reliable internet connectivity. These efforts are expected to mitigate potential dropouts and learning losses, help to prepare students and young adults for an increasingly digital world, and support countries in digital transformation. The entire issue (a total of approx. JPY 6 billion) was purchased by the Dai-ichi Life Insurance Company of Japan.[100]

Leverage	The same as existing non-concessional finance of MDBs from paid-in capital, for example, up to 5 through IBRD to middle-income countries.
Mobilization potential	Unclear. Private investors are mobilized to pay greater attention to specific issues but it is yet unclear whether this has created additional interest beyond regular bond issues and/or whether this may have a knock-on effect on their wider investments.
Concessionality	Non-concessional
Demand	N/A
Actionability	High. These bonds are part of regular bond issuance activities of MDBs. Implementation is only dependent on the development of a mechanism to track if proceeds of the bond issuance are indeed deployed for education.

B. International Finance Facility for Education

The International Finance Facility for Education (IFFEd) has been developed by the Education Commission and partners. A combination of paid-in capital and guarantees from investors will enable MDBs to lend to governments with enough incentive to ensure investments in the EdTech ecosystem, especially in areas that do not have an immediate stream of returns. This new mechanism will enable lower-middle-income countries to access a new source of affordable financing to protect education spending without trading off against other priorities. It will also use MDBs to channel funding to middle-income countries, without placing additional administrative burdens on developing countries.[101]

Leverage	Very high. IFFEd will leverage every $1 of donor grant contributions in the form of paid-in capital and grants to recipients to provide over $7 of soft finance through MDBs. Using $0.375 billion of paid-in capital with $2.125 billion in equity guarantees, IFFEd could mobilize $10 billion in additional finance, and with donors supplying a further $1 billion in grant resource to buydown the loans and make the financing even cheaper, the IFFEd would deliver a leverage of 7 on $1.4 billion in donor grants and 27 on paid-in capital alone. IFFEd will benefit from a triple-A credit rating.
Mobilization potential	High. IFFEd aims to mobilize private donors as contributors to paid-in capital and grant windows who may be attracted by its leveraging potential.
Concessionality	High. By increasing the amount of and affordability of funding for education in MICs through MDBs.
Demand	High. IFFEd grants with loans allows LMICs to borrow for education on more affordable terms. A grant element of $1 billion for every $10 billion of additional financing would make IFFEd financing concessional and official development assistance (ODA) eligible.
Actionability	High. IFFEd's design was completed in 2020 with support from several donors and MDBs and it is ready to launch. Using MDBs to deliver financing, IFFEd will benefit from their extensive experience developing and implementing education programs.

IFFEd

IFFEd will create a consortium of public and private donors and international financial institutions to work in coalition to raise additional financing for education and ensure it is spent more effectively.

It will create attractive financing packages for LMICs by multiplying international resources allocated to education through innovative capital leverage of MDBs. It will also increase demand in MICs for financing education through buy-downs of non-concessional loans.

International donors will supply guarantees to be used by MDBs to raise finance on the international money markets. Because the MDBs have strong credit ratings, they will be able to raise $4 for every $1 guaranteed by donor countries.

For example, if IFFEd received guarantees from donor countries for $5 billion, MDBs could generate $20 billion of new finance for LMICs to spend on education. Donors will be required to pay 15% of the guarantee up front as paid-in capital, meaning that only $750 million in cash would be needed to back the $20 billion in new funding.

Donors would also provide grants to the IFFEd - these grants provided alongside the loans would enable the MDBs to provide concessional finance to LMICs, equivalent to very low interest rates over long periods of time.

3. Blended finance

Blended finance can be used to finance infrastructure and connectivity through bonds as well as through public private partnerships (PPPs). PPPs can also be used to finance country-wide digital learning projects.

A. Giga Connectivity Bond

Giga plans to launch a $5 billion Connectivity Bond, providing upfront financing to expand connectivity in low- and middle-income countries. Proceeds will be used to invest in 'last mile' infrastructure, research and data gathering, as well as real-time monitoring of school connectivity and local community connectivity. Giga is currently seeking donor governments and private foundations to provide multi-year commitments to serve as backing for the bond.

Donors will make multi-year grant commitments to Giga, allowing it to issue donor-backed bonds to raise upfront capital. Connectivity projects are then funded directly or in partnership with Giga using bond proceeds.

Leverage	None
Mobilization potential	High. Donor grant pledges will allow Giga to raise financing on the bond market and repay the bonds issued. It is also seeking financing from private foundations. Giga aims to use finance raised by its bonds and from donors to promote connectivity, including using guarantees and grants to catalyze and mobilize private sector investors operating on commercial terms.
Concessionality	High. Giga will finance projects at concessional rates.
Demand	High. There is currently a lack of financing for 'last mile' connectivity projects.
Actionability	High. The successful Gavi International Finance Facility for Immunisation (IFFIm) bond issuance provides a proven model and demonstrates potential to raise finance.

Giga

Giga was launched by UNICEF and the ITU in 2019 with the goal of connecting every school in the world to the internet. The project has three pillars. It:

a. Maintains a real-time map of school connectivity to identify demand for infrastructure and funds, measures progress toward increasing internet access, and continuously monitors global connectivity

b. Works with governments to build affordable and sustainable country-specific models for finance and delivery, subsidizing market creation costs and incentivizing private sector investment

c. Advises on the best technical solutions to provide schools with connectivity, and countries with safe, secure, reliable, fit-for-purpose infrastructure to support future digital development needs

For example, in Kazakhstan, the designated 'Regional Lead' for Central Asia, Giga is working with the government to achieve their goal of integrating the country's 7,398 schools into Giga's global mapping platform, connecting the remaining 30 schools with innovative approaches and technology. It is also creating financing packages for national connectivity and helping to match the government with possible financing partners.

B. Blended digital infrastructure bond

While bonds represented only about 20 percent of private infrastructure financing in primary transactions in low- and middle-income countries as of 2020, this has nearly doubled since 2015. Digital infrastructure companies in Africa have recently issued bonds allowing for the expansion of digital infrastructure across the continent.

Bonds are also being issued with support from development banks. In 2021, Liquid Intelligent Technologies (LIT), Africa's largest independent fiber, data center, and cloud technology provider, issued a bond raising $620 million that will allow it to refinance debt and expand digital infrastructure across Africa.[102] The Emerging Africa Infrastructure Fund (EAIF), along with development finance institutions (DFI) - the International Finance Corporation (IFC) and Deutsche Investitions-und Entwicklungsgesellschaft mbH (DEG) - anchored the bond issue, committing to purchase up to $178 million in the bond offering, which was six times oversubscribed.[103]

Leverage	High. The anchoring of the bond by two DFIs introduced development finance into the LIT bond issue.
Mobilization potential	High. DFI bond anchoring increased interest from private investors, leading to oversubscription.
Concessionality	High. The LIT bond increased concessional financing with the anchoring purchasing by DFIs.
Demand	Unclear. Blended finance in digital bond issues could further increase digital infrastructure bond issuance.
Actionability	Mixed. The LIT bond raised financing for digital infrastructure expansion across Africa. Possible barriers could include government regulation and risk.

C. Public private partnerships

PPPs can help extend the reach and effectiveness of government funds, accelerate investment, and encourage innovation.[104] They are being used in some countries to finance EdTech expansion, using different sources of funding, including the Conectar Igualdad case study discussed above, and the two examples summarized below. They can also be used to extend the reach of connectivity.

PPP models vary widely, being designed as both context and issue specific. A well designed and managed PPP takes advantage of the potential for efficiency gains from working with the private sector by including appropriate rewards and penalties to incentivize efficiency, by including operational and delivery as well as design responsibilities for the private partner, and by encouraging competition at bidding stage.[105]

This is a mature financing model where government involvement can vary significantly. Most commonly, in a PPP infrastructure project covering commercially non-viable areas, the government brings capital or subsidies that expect a sub-investment level of risk-adjusted return, to allow private capital to achieve acceptable risk-adjusted returns.

Leverage	Most frequently, none, but models vary.
Mobilization potential	High. PPPs draw in private finance, and can include contributions from CSR funds, foundations, and philanthropic donors.
Concessionality	Varies, depending on contracts.
Demand	High. This is a mature financing model that can benefit both the public and private sector.
Actionability	High. PPPs offer a good balance of shared responsibility. Public subsidies tend to decrease project risk and increase profitability while models with private management have proven to be more viable financially and therefore sustainable over the long term.[106]

Case Study

Plano Tecnológico

In 2007, Portugal launched its National Technology Plan for Education (Plano Tecnológico). The goal was to build a knowledge-based society, modernizing education by increasing the use of computers and access to the internet. The program focused on primary and secondary students and teachers, adult training, and youth associations.

Financing for educational programs came from the government's sale of 3G mobile licenses through a spectrum auction, with the private sector brought in to share costs and spread risk. Telecoms donated broadband services and media groups time and resources. Parents contributed to the purchase of the computer based on income levels.

Between 2008 and 2012, 1.7 million K-12 students, educators, and adults in training were given access to laptops and broadband. Internet access in the country increased from 52% in 2006 to 91% by 2012. Technology exports rose substantially and Portugal became a leader in eGovernment services.

The PISA 2009 learning assessments showed an increase of 20 points in math, reading, and science for Portugal's students, who also ranked at the top of all countries on computer literacy.[107]

Case Study

Connectivity

In 2011, the government of São Tomé and Príncipe received a $15.06 million grant from the World Bank to expand its telecommunications infrastructure, improve its regulatory framework, and connect to the Africa Coast to Europe Optical Fiber Submarine Cable (ACE).

To receive the grant, the government and the telecommunications operator CST formed a new company, STP-Cabo. Measures were put in place to introduce competition to the market by awarding a telecommunications license to Angolan mobile phone company Unitel. The project generated $8 million of revenues for the government through the sale of STP-Cabo shares to Unitel and awarding the company a second license.

This project succeeded in increasing geographical reach and usage of broadband network, reducing data cost, and improved project efficiency. In addition, the grant supported the creation of an enabling environment for the development of the ICT sector in São Tomé and Príncipe through regulatory reform and the launch of a second mobile telecommunications operator to provide fixed and mobile services, as well as development of PPP mechanisms.[108]

4. Private sector financing

EdTech is unique in the diversity of its players which range from private enterprise, both for and not for profit, as well as a wide range of investors including foundations, venture capitalists, and government. This may be reflective of an emerging trend in education investments more broadly in the USA, in which philanthropic foundations and venture capitalists are converging in their aims. Known as strategic philanthropy, this approach to investment moves away from framing of education investment decisions in terms of simply the public good.

EdTech investors typically have overlapping goals that include investing in ventures that seek both the opportunity for scale and market reach and the biggest possible impact on teaching and learning. The balance of financial and social returns sought varies by investor with philanthropic funders emphasizing the latter, while others focus on the promise of financial returns and therefore the scalability of models.[109]

A. Private equity and venture capital

EdTech start-ups have been receiving increased attention from both venture capital and private equity firms. Even before COVID-19, EdTech investments reached $18.66 billion in 2019 and the overall digital learning market is projected to reach $350 billion by 2025.[110]

North America dominates the private EdTech market, with over 37 percent share of global revenue in 2020, spurred by VC and PE investments in the US. Asia Pacific is rapidly growing and anticipated to register the fastest compound annual growth rate (CAGR) of 23 percent from 2021 to 2028. Asia is home to 50 percent of the world's internet users and 600 million K-12 students.[111] Meanwhile, in Latin America, the EdTech market is small, but growing at an CAGR of 14 percent since 2013.[112] In Africa, the EdTech market is growing and with a rapidly urbanizing population, and rapidly growing economy, the market is attractive, with South Africa, Morocco, and Nigeria leading in digital learning growth.[113] EdTech spending in Africa is estimated at $3 billion in 2019 and is projected to grow to $57 billion by 2030. However, significant barriers continue to stifle market growth, including lack of investment capital, high hardware and data costs, and low mobile and internet connectivity.[114]

EdTech start-ups, particularly in low- and middle-income countries, often lack access to traditional bank loans. Governments can play a role in encouraging private investment in the EdTech market by:

- Setting standards for data privacy and security related to EdTech products
- Brokering partnerships with EdTech firms and academia to establish clear standards for performance and cost-effectiveness, and to evaluate products transparently and rigorously
- Investing in digital infrastructure and connectivity in underdeveloped areas and for underserved communities
- Encouraging dialogue between private firms and teacher, schools, and

parents to better understand public sector needs

Start-ups with no access to loans or financing from VC or PE firms can also seek financing through crowdfunding platforms, which allow individuals to make loans or equity investments in small amounts. The global crowdfunding market was valued at $10.2 billion in 2018 and is expected to reach $28.8 billion by the end of 2025.[115]

Leverage	None
Mobilization potential	None
Concessionality	None
Demand	High. There has been a marked increase in VC and PE investing in EdTech, with a lack of investment capital in some low-income countries.
Actionability	High. Governments can take action to encourage private investing in EdTech through dialogue, partnerships, and investing in digital infrastructure.

B. Philanthropic foundations

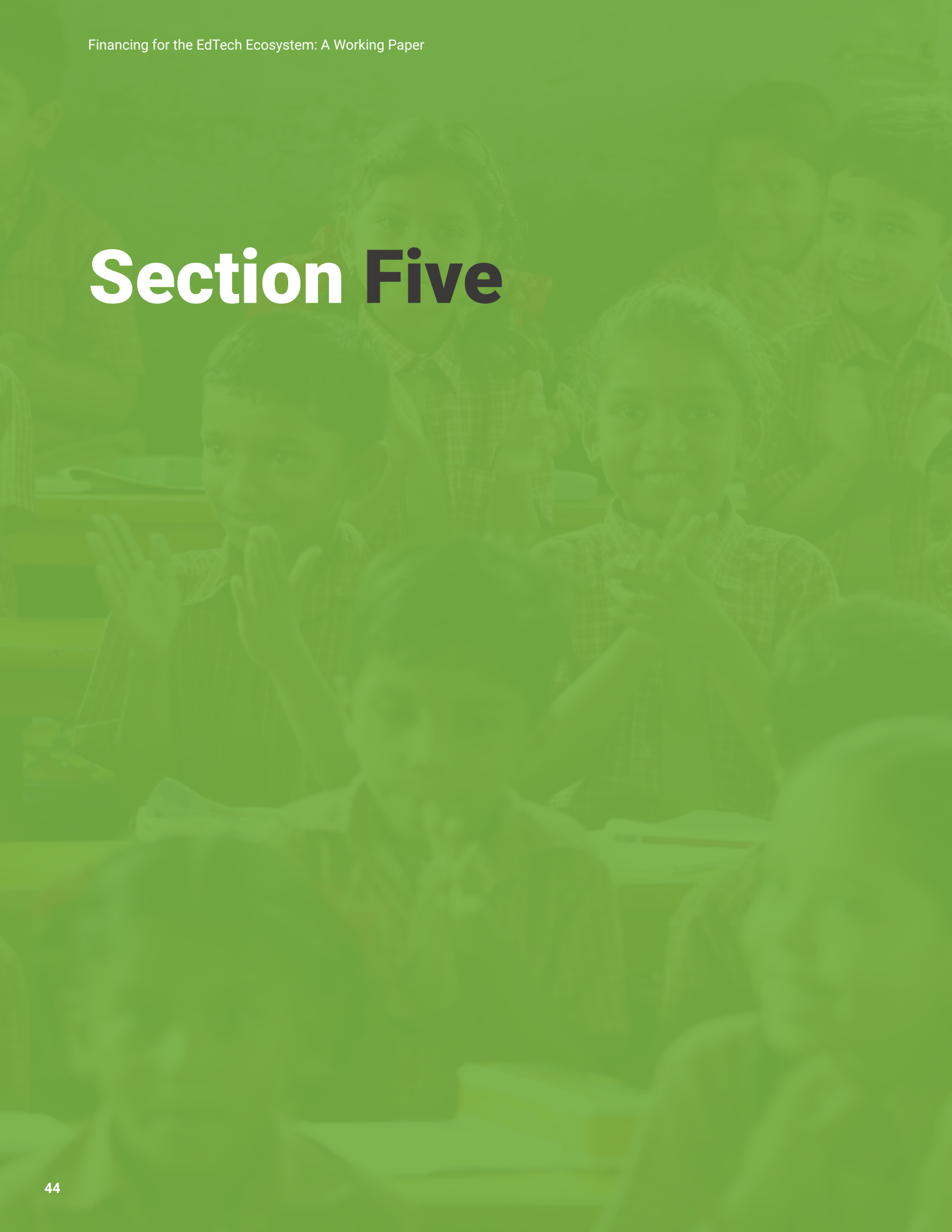
A foundation is a non-profit corporation or a charitable trust that historically makes grants to organizations, institutions, or individuals for charitable purposes. Foundations can be privately funded, with money coming from a family, an individual, or a corporation.[116]

Foundations have historically awarded grants to fund specific projects. Unlike private capital, grants cannot be recycled. Recently, foundations have become more interested in directing resources, either as grants or as return-seeking investments, to for-profit companies whose products or services have the potential to meet urgent social needs. For example, the Bill & Melinda Gates Foundation channeled a grant to a for-profit start-up called Scholar Rocket, which created a tool that allows teachers to record and share video lessons.[117]

Foundations are also starting to merge with impact investing. For example, the Omidyar Network, a philanthropic investment firm, is composed of a foundation and an impact investment firm, which provides financing to for-profit companies as well as non-profit organizations across various investment areas, including education and emerging technology.

Leverage	None
Mobilization potential	Possible. When providing start-up capital to for-profit companies and non-governmental organizations (NGOs), philanthropic foundations may encourage, and hence 'crowd-in', other investors.
Concessionality	Likely. Philanthropic investment firms may seek a below market rate of return on their investments, while grant funding is still the dominant modality.
Demand	High. Grant financing as well as concessional financing could help meet the need for start-up capital.
Actionability	Mixed. Some foundations have a long-standing interest in EdTech. Others cite wanting to know more about what works as a barrier to investment at this point.

Section Five



Section Five

Discussion points

In this paper we have:

1. Set out a triple case for investing in EdTech. Our view on this issue is that governments and investors alike ensure they keep all three of resilience, equity, and transformation in mind when considering options. Focusing exclusively on the importance of ensuring absolute equity runs the risk of discounting the potential of EdTech to deliver learning gains. Conversely, focusing only on transformation is likely to entrench existing inequalities both between and within countries, to the detriment of the most marginalized and vulnerable learners.

2. Concluded that ensuring affordable access to EdTech is critical but will not deliver the results we are seeking on its own. Connectivity, like any other element of the EdTech ecosystem, is necessary, but not sufficient. We need to take a portfolio approach to investing in the EdTech ecosystem. While implementing organizations and investors will likely have an interest in particular parts of the puzzle, it is important for everyone that this is balanced by others. No single investment will realize its full rate of social or financial return unless others are investing elsewhere.

3. Identified from a range of options for innovative financing, a small number of approaches that look especially promising. These include continuing to design high quality public private partnerships, and to share evidence of approaches that have worked well to enable others to emulate and adapt designs. They also include the proposed International Finance Facility for Education, with its potential to achieve additional leverage and hence added concessionality for borrowing governments. Meanwhile Giga's planned Connectivity Bond offers high potential to mobilize new finance, combined with an innovative response to typically hard to fund 'last mile' problems.

Recommendation 1:
We should take a balanced approach to investing in EdTech, thinking about the consequences of every decision for the resilience of education systems, the strengthening of educational justice, and making a significant impact on learning levels.

Recommendation 2:
Planning and costing for EdTech investment should be country led and context specific. Governments should ensure that all areas of their EdTech strategies are covered, using a mosaic of investment partners and approaches as appropriate.

Recommendation 3:
Globally, we need to gather around a limited number of potentially transformative approaches to EdTech financing, pooling resources to mobilize additional finance in a way that is coherent and easy to access for governments looking to fund a digital transformation in their approach to education service delivery.

Endnotes

1 UNESCO/UNICEF/World Bank/OECD. 2021. *What's Next? Lessons on Education Recovery: Findings from a Survey of Ministries of Education amid the COVID-19 Pandemic*. Paris: OECD Publishing

2 Donnelly, R. et al. 2021. "The Impact of COVID-19 on Education – Recommendations and Opportunities for Ukraine." *World Bank*. April 2, 2021. Available at https://www.worldbank.org/en/news/opinion/2021/04/02/the-impact-of-COVID-19-on-education-recommendations-and-opportunities-for-ukraine

3 The World Bank, UNESCO, and UNICEF. 2021. *The State of the Global Education Crisis: A Path to Recovery*. Washington DC, Paris, New York: The World Bank, UNESCO, and UNICEF

4 Montenegro, C. and Patrinos, H. 2021. "New comparable dataset finds that investments in education, tertiary in particular, lead to higher earnings." *World Bank*. November 9, 2021. Available at https://blogs.worldbank.org/education/new-comparable-dataset-finds-investments-education-tertiary-particular-lead-higher

5 Patrinos, H. 2016. "Trends in returns to schooling: why governments should invest more in people's skills." *World Bank*. August 1, 2016. Available at https://blogs.worldbank.org/education/trends-returns-schooling-why-governments-should-invest-more-people-s-skills

6 UNESCO/UNICEF/World Bank/OECD. 2021. *What's Next? Lessons on Education Recovery: Findings from a Survey of Ministries of Education amid the COVID-19 Pandemic*. Paris: OECD Publishing

7 Azevedo, J.P., Hasan, A., Goldemberg, D., Iqbal, S.A., and Geven, K. 2020. *Simulating the Potential Impacts of COVID-19 School Closures on Schooling and Learning Outcomes - A Set of Global Estimates*. Policy Research Working Paper 9284. Washington DC: World Bank. Available at https://documents1.worldbank.org/curated/en/329961592483383689/pdf/Simulating-the-Potential-Impacts-of-COVID-19-School-Closures-on-Schooling-and-Learning-Outcomes-A-Set-of-Global-Estimates.pdf

8 UNESCO/UNICEF/World Bank/OECD. 2021. *What's Next? Lessons on Education Recovery: Findings from a Survey of Ministries of Education amid the COVID-19 Pandemic*. Paris: OECD Publishing

9 UNESCO/UNICEF/World Bank/OECD. 2021. *What's Next? Lessons on Education Recovery: Findings from a Survey of Ministries of Education amid the COVID-19 Pandemic*. Paris: OECD Publishing

10 Dreeseni, T. 2020. "Promising Practices for Equitable Remote Learning: Emerging Lessons from COVID-19 Education Responses in 127 Countries." Innocenti Research Brief. Florence: UNICEF

11 Lockee, B.B. 2021. "Online education in the post-COVID era." *Nature Electronics* 4, 5–6 (2021). https://doi.org/10.1038/s41928-020-00534-0

12 Hawkins, et al. 2020. *Reimagining Human Connections: Technology and Innovation in Education at the World Bank*. Washington DC: World Bank

13 Saavedra, J. "Ending learning poverty: the call of our times." *World Bank*. October 11, 2019. Available at https://blogs.worldbank.org/education/ending-learning-poverty-call-our-times

14 The International Commission on Financing Global Education Opportunity. 2016. *The Learning Generation: Investing in Education for a Changing World*. New York: The Education Commission

15 UNICEF. 2020. *Reimagine Education: The Summary Case for Investment*. New York: UNICEF

16 Global Education Evidence Advisory Panel. 2020. *Cost-Effective Approaches to Improve Global Learning – what does recent evidence tell us are "Smart Buys" for improving in low- and middle-income countries? Recommendations of the Global Education Evidence Advisory Panel*. Washington DC: World Bank, Foreign, Commonwealth & Development Office, and Building Evidence in Education

17 Tobin, E. and Hieker, C. 2021. "What the EdTech Experience in Refugee Camps Can Teach Us in Times of School Closure. Blended Learning, Modular and Mobile Programs Are Key to Keeping Disadvantaged Learners in Education." *Challenges*. 12, 19. https://doi.org/10.3390/challe12020019

18 Vodafone. 2021. "Vodafone Foundation and UNHCR expand Connected Education programme for refugees and host communities into Mozambique." *Vodafone*. June 17, 2021. Available at https://www.vodafone.com/news/press-release/vodafone-foundation-and-unhcr-expand-connected-education-programme-refugees-and-host

19 Save our Future. 2020. *Averting an Education Catastrophe for the World's Children*. Save Our Future. Available at https://saveourfuture.world/wp-content/uploads/2020/10/Averting-an-Education-Catastrophe-for-the-Worlds-Children_SOF_White-Paper.pdf

20 Major, L., Francis, G. A. and Tsapali, M. 2021. "The effectiveness of technology-supported personalised learning in low- and middleincome countries : A meta-analysis." *British Journal of Educational Technology*. https://doi.org/10.1111/bjet.13116

21 Winthrop, R., Williams, T.P., and McGivney, E. 2016. *Innovating to unburden teachers*. Washington DC: Center for Universal Education at the Brookings Institution

22 Shrayber, M. 2017. "Is the African School for Excellence the Future of Education?" Available at https://uproxx.com/life/african-school-for-excellence-affordable-education/

23 The Education Commission. n.d. "Transforming Learning: High Touch High Tech." Available at https://educationcommission.org/wp-content/uploads/2020/12/Transforming-Learning-HTHT.pdf

24 Aneja, S. and Lalvani, J. 2021. "Role of the Private Sector and Technology for Future-Ready Education and Training." in *Powering a Learning Society During an Age of Disruption Education in the Asia-Pacific Region: Issues, Concerns and Prospects,* Volume 58, edited by Rupert Maclean and Lorraine Pe Symaco. Manila and New York: ADB and Springer Publishing

25 Piper, B. L., DeStefano, J., Kinyanjui, E., and Ong'ele, S. A. 2018. "Scaling up successfully: Lessons from Kenya's Tusome national literacy program." *Journal of Educational Change*, 19(3), 293-321. https://doi.org/10.1007/s10833-018-9325-4

26 Yao, H. et al. 2021. "How much will it cost to achieve universal digital learning?" Forthcoming

27 UNESCO. 2021. "One year into COVID-19 education disruption: Where do we stand?" *UNESCO*. March 19, 2021. Available at https://en.unesco.org/news/one-year-COVID-19-education-disruption-where-do-we-stand

28 ITU/UNESCO Broadband Commission for Sustainable Development. 2021. *The State of Broadband 2021: People-Centred Approaches for Universal Broadband*. Geneva: International Telecommunication Union and United Nations Educational, Scientific and Cultural Organization

29 Dreeseni, T. 2020. "Promising Practices for Equitable Remote Learning: Emerging Lessons from COVID-19 Education Responses in 127 Countries." Innocenti Research Brief. Florence: UNICEF

30 Alliance for Affordable Internet. 2020. "2020 Affordability Report." Available at https://a4ai.org/affordability-report/report/2020/

31 ITU/UNESCO Broadband Commission for Sustainable Development. 2021. *The State of Broadband 2021: People-Centred Approaches for Universal Broadband*. Geneva: International Telecommunication Union and United Nations Educational, Scientific and Cultural Organization

32 Alliance for Affordable Internet. 2019. "2019 Affordability Report." Available at https://a4ai.org/affordability-report/report/2019/

33 Webb, D. Barringer, K. Torrance, R. and Mitchell, J. 2020. "Girls' Education Rapid Evidence Review." EdTech Hub. 10.5281/zenodo.3958002

34 Lynch, P., Singal, N., and Francis, G. 2021. "EdTech for Learners with Disabilities in Primary School Settings in LMICs: A Systematic Literature Review." Working Paper. EdTech Hub. doi: 10.5281/zenodo.4348995

35 UNHCR. 2016. *Connecting Refugees: How Internet and Mobile Connectivity can Improve Refugee Well-Being and Transform Humanitarian Action*. Geneva: UNHCR

36 Omidyar Network. 2019. *Scaling Access & Impact Realizing the Power of EdTech – Executive Summary*. Redwood City: Omidyar Network. Available at https://omidyar.com/wp-content/uploads/2020/09/Scaling_Access_Impact_Realizing_Power_of_-EdTech.pdf

37 APEC Business Advisory Council. 2018. *Structural Reform and Digital Infrastructure*. Port Moresby, Papua New Guinea: APEC

38 OECD. 2019. *PISA 2018 Results (Volume 1): What Students Know and Can Do*. Paris: OECD Publishing; National Center on Education and the Economy. 2020. "A Step Ahead: Estonia Emerges as a Leader in Worldwide Distance Learning Experiment." *NCEE*. April 30, 2020. Available at https://ncee.org/quick-read/a-step-ahead-estonia/

39 World Bank Group/UNESCO/Global Education Monitoring Report. 2021. "Education Finance Watch 2021." Available at https://thedocs.worldbank.org/en/doc/507681613998942297-0090022021/original/EFWReport2021219.pdf

40 ITU/UNESCO Broadband Commission for Sustainable Development. 2021. *Connecting Learning Spaces: Possibilities for Hybrid Learning*. Geneva: International Telecommunication Union

41 Le Nestour, N. et al. 2020. "Unequal Burdens: The Impact of Shocks on Household Education Spending." *Center for Global Development*. December 3, 2020. Available at https://www.cgdev.org/blog/unequal-burdens-impact-shocks-household-education-spending

42 UNESCO. 2019. *Global Education Monitoring Report, 2019: Migration, Displacement and Education: Building Bridges, not Walls*. Paris: UNESCO

43 Carvalho, S. et al. 2020. "How Are International Donors Responding to Education Needs during the COVID Pandemic?" *Center for Global Development*. April 21, 2020. Available at https://www.cgdev.org/blog/how-are-international-donors-responding-education-needs-during-covid-pandemic

44 UNESCO. 2021b. "Scaling up digital learning and skills in the world's most populous countries to drive education recovery." *UNESCO*. April 4, 2021. Available at https://en.unesco.org/news/scaling-digital-learning-and-skills-worlds-most-populous-countries-drive-education-recovery

45 Yao, H. et al. 2021. "How much will it cost to achieve universal digital learning?" Forthcoming

46 ITU/UNESCO Broadband Commission for Sustainable Development. 2020. *The Digital Transformation of Education: Connecting Schools, Empowering Learners*. Geneva: International Telecommunication Union

47 Investopedia. 2021. "What's the Average Profit Margin for a Utility Company?" Available at https://www.investopedia.com/ask/answers/011915/what-average-profit-margin-utility-company.asp

48 Kojima, M. and Trimble, C. 2016. *Making Power Affordable for Africa and Viable for Its Utilities*. Washington DC: World Bank

49 USAID. 2020. *Barriers to Investing in Last-Mile Connectivity*. Research Report. Washington DC: USAID

50 Yao, H. et al. 2021. "How much will it cost to achieve universal digital learning?" Forthcoming; Abdul-Hamid, H. 2014. *What Matters Most for Education Management Information Systems: A Framework Paper*. SABER Working Paper Series Number 7. June, 2014. Washington DC: World Bank. Available at http://wbgfiles.worldbank.org/documents/hdn/ed/saber/supporting_doc/Background/EMIS/Framework_SABER-EMIS.pdf

51 International Telecommunication Union. 2019. *The Economic Contribution of Broadband, Digitization and ICT Regulation Econometric Modelling for the Americas*. Geneva: International Telecommunication Union

52 UNCTAD. n.d. "Digitalization offers great potential for development, but also risks." Accessed October 20, 2021. Available at https://sdgpulse.unctad.org/ict-development/

53 Yao, H. et al. 2021. "How much will it cost to achieve universal digital learning?" Forthcoming

54 Sustainable Energy for All. 2020. *Energizing Finance: Understanding the Landscape 2020*. Vienna: Sustainable Energy for All

55 Sustainable Energy for All. 2020. *Energizing Finance: Understanding the Landscape 2020*. Vienna: Sustainable Energy for All

56 Sustainable Energy for All. 2018. *Energizing Finance: Understanding the Landscape 2018*. Vienna: Sustainable Energy for All

57 International Energy Agency. 2020. "World Energy Investment 2020: Power Sector." Available at https://www.iea.org/reports/world-energy-investment-2020/power-sector

58 World Bank. 2018. "Access to Energy is at the Heart of Development." *World Bank*. April 18, 2018. Available at https://www.worldbank.org/en/news/feature/2018/04/18/access-energy-sustainable-development-goal-7

59 World-Energy. 2021. "Creating a Global Energy Alliance for People and Planet." November 3, 2021. Available at https://www.world-energy.org/article/20913.html; IKEA Foundation. 2021. "Historic alliance launches at COP26 to accelerate renewable energy, climate solutions, and jobs." November 2, 2021. Available at https://ikeafoundation.org/press-release/historic-alliance-launches-at-cop26-to-accelerate-renewable-energy-climate-solutions-and-jobs/

60 UNCTAD. 2017. *The Least Development Countries Report*. Geneva: UNCTAD

61 Probst, B. et al. 2021. "Leveraging private investment to expand renewable power generation: Evidence on financial additionality and productivity gains from Uganda." *World Development*. Issue 140. Amsterdam: Elsevier

62 International Telecommunication Union. 2020. *Measuring Digital Development: Facts and Figures*. Geneva: International Telecommunication Union

63 Yao, H. et al. 2021. "How much will it cost to achieve universal digital learning?" Forthcoming

64 International Telecommunication Union. 2020. *Measuring Digital Development: Facts and Figures*. Geneva: International Telecommunication Union

65 USAID. 2020. *Barriers to Investing in Last-Mile Connectivity*. Research Report. Washington DC: USAID

66 International Telecommunication Union. 2020. *Measuring Digital Development: Facts and Figures*. Geneva: International Telecommunication Union

67 Yao, H. et al. 2021. "How much will it cost to achieve universal digital learning?" Forthcoming

68 Giangola, N. 2001. *What Works: Educ.ar's Strategy for a Nation Connected and Learning*. Washington DC: World Resources Institute; Canuelas Al Dia. 2015. "The President Delivered the 5 Million Netbook from Connect Equality." *Canuelas Al Dia*. July 2, 2015. Available at https://canuelasaldia-com-ar.translate.goog/nota/4574/la-presidenta-entrego-la-netbook-5-millones-de-conectar-igualdad/; Gutierrez, P. 2021. "Argentina: The UN awarded the Connect Equality Program." *Fayerwayer*. December 4, 2012. Available at https://www.fayerwayer.com/2012/12/argentina-la-onu-premio-al-programa-conectar-igualdad/; Tejada, N. 2021. "TeleSemana. Digital divide in Argentina: the Juana Manso Plan advances." *TeleSemana*. July 20, 2021. Available at https://www.telesemana.com/blog/2021/07/20/brecha-digital-en-argentina-avanza-el-plan-juana-manso/

69 Data Quest India. 2004. "ICT Leasing." *Data Quest India*. June 22, 2004. Available at https://www.dqindia.com/ict-leasing/

70 Levine, S. 2001. "H-P helps Third World, and itself." *San Francisco Business Times*. March 19, 2001. Available at https://www.bizjournals.com/sanfrancisco/stories/2001/03/19/story6.html

71 Hanover Research. 2014. *Practices for Leasing Educational Technology*. Arlington, VA: Hanover Research

72 Yao, H. et al. 2021. "How much will it cost to achieve universal digital learning?" Forthcoming

73 OECD. 2020. *Teaching in Focus #35: Teachers' training and use of information and communications technology in the face of the COVID-19 crisis*. Paris: OECD

74 Varkey Foundation. n.d. "System failure: Why EdTech Policy Needs a Critical Update." *Varkey Foundation*. Accessed October 19, 2021. Available at https://www.varkeyfoundation.org/what-we-do/atlantis-group/system-failure/edtech-today

75 Roger Federer Foundation. 2016. "Interactive learning and teaching: Zonal in-service coordinators facilitation guide." Available at http://iact.info/pdfs/iActFacilitator-Guide.pdf

76 Save our Future. 2020. *Averting an Education Catastrophe for the World's Children*. Save Our Future. Available at https://saveourfuture.world/wp-content/uploads/2020/10/Averting-an-Education-Catastrophe-for-the-Worlds-Children_SOF_White-Paper.pdf

77 McAleavy, T. et al. 2018. *Technology supported professional development for teachers: lessons from developing countries*. Reading: Education Development Trust

78 Krelja Kurelovic, E. 2016. "Advantages and limitations of usage of open educational resources in small countries." *International Journal of Research in Education and Science* (IJRES), 2(1), 136-142.

79 Hennessy, S., Haßler, B., Blair, J., Duggal, N., Shin Leong, W., Makonga, A., and Tembo, A. 2014. "OER4Schools: Participants book." *The Centre for Commonwealth Education*. Available at http://oer.educ.cam.ac.uk/w/images/6/61/OER4Schools_Participants_book.pdf

80 Hennessy, S., Haßler, B., and Hofmann, R. 2016. "Pedagogic change by Zambian primary school teachers participating in the OER4Schools professional development programme for one year." *Research Papers in Education*, 31:4, 399-427. https://doi.org/10.1080/02671522.2015.1073343

81 T-TEL. 2017. "Midline survey: Transforming teacher education and learning." Available at https://www.t-tel.org/files/docs/Learning%20Hub/Research%20 and%20evidence%20-%20teacher%20education%20in%20Ghana/T-TEL%20MIDLINE%20REPORT.pdf

82 Yao, H. et al. 2021. "How much will it cost to achieve universal digital learning?" Forthcoming

83 The Education Commission. 2019. *Transforming the Education Workforce: Learning Teams for a Learning Generation.* New York: The Education Commission

84 Stuart, E. et al. 2021. "How Data and Digital Technologies Can Transform Education Systems." *In Powering a Learning Society During an Age of Disruption Education in the Asia-Pacific Region: Issues, Concerns and Prospects,* Volume 58, edited by Rupert Maclean and Lorraine Pe Symaco. Manila and New York: ADB and Springer Publishing

85 Save our Future. 2020. *Averting an Education Catastrophe for the World's Children*. Save Our Future. Available at https://saveourfuture.world/wp-content/uploads/2020/10/Averting-an-Education-Catastrophe-for-the-Worlds-Children_SOF_White-Paper.pdf

86 Mackintosh, A. et al. 2020. *Workforce Management in Sierra Leone Research and Policy Paper*. New York: The Education Commission

87 Adam, T., El-Serafy, Y., Podea, M., and Haßler, B. 2021. "The use of 'building blocks' to develop digital platforms for education in sub-Saharan Africa." EdTech Hub. Available at https://doi.org/10.53832/edtechhub.0049

88 World Bank. n.d. "Innovative Finance for Development Solutions: Initiatives of the World Bank Group." Available at https://olc.worldbank.org/system/files/Innovative_Finance_for_Development_Solutions.pdf

89 Steer, L. et al. 2015. *Non-state Actors in Education in Developing Countries*. Washington DC: Brookings Institution

90 Vaughan, N., Faure, R. and Steer, L. "Innovative finance options for a green and equitable recovery." Forthcoming

91 UNESCO. 2021. "Building resilient education systems in the COVID-19 era." *UNESCO*. April 15, 2021. Available at https://en.unesco.org/news/building-resilient-education-systems-COVID-19-era

92 Trucano, M. 2015. "Universal Service Funds Connecting Schools to the Internet Around the World." *World Bank*. February 26, 2015. Available at https://blogs.worldbank.org/edutech/universal-service-funds-connecting-schools-internet-around-world

93 Mattey, C. 2021. "US Forward: FCC Must Reform USF Contributions Now - An Analysis of the Options." *Benton Institute*. September 14, 2021. Available at https://www.benton.org/headlines/usforward-fcc-must-reform-usf-contributions-now-analysis-options

94 ITU/UNESCO Broadband Commission for Sustainable Development. 2021. *Connecting Learning Spaces: Possibilities for Hybrid Learning*. Geneva: International Telecommunication Union

95 Thakur, D. and Potter, L. 2018. *Universal Service and Access Funds: An Untapped Resource to Close the Gender Digital Divide*. Washington DC: Web Foundation

96 International Institute for Sustainable Development. 2020. "Mexico Issues Sovereign SDG Bond for Most Vulnerable Municipalities." *SDG Knowledge Hub*. September 22, 2020. Available at https://sdg.iisd.org/news/mexico-issues-sovereign-sdg-bond-for-most-vulnerable-municipalities/

97 World Economic Forum. 2021. *Guidebook to Digital Inclusion Bond Financing*. White Paper. Cologny: World Economic Forum

98 Global Business Coalition for Education and the Education Commission. 2019. "Engaging the Investment Community in Education - the case for education bonds to raise new resources for Sustainable Development Goal 4." Discussion Memo 2019. Available at https://gbc-education.org/wp-content/uploads/2019/04/EducationBonds_GBC-Education.pdf

99 African Development Bank. 2012. "AfDB Offers Education Support Bond to Japanese Investors." *AfDB*. February 29, 2012. Available at https://www.afdb.org/en/news-and-events/afdb-offers-education-support-bond-to-japanese-investors-8877

100 Asian Development Bank. 2021. "ADB Issues Inaugural Education Bond." *ADB*. February 9, 2021. Available at https://www.adb.org/news/adb-issues-inaugural-education-bond

101 Alba, P. and Mathiasen, K. 2020. "The International Finance Facility for Education: A vital instrument to mitigate the impact of the pandemic." *Brookings Institution*. July 9, 2020. Available at https://www.brookings.edu/blog/future-development/2020/07/09/the-international-finance-facility-for-education-a-vital-instrument-to-mitigate-the-impact-of-the-pandemic/

102 Lam-Frendo, M. and Landy, M. 2021. "If you issue it, they will come: Lessons from recent infrastructure bonds." *IFC online*. September 23, 2021. Available at https://blogs.worldbank.org/ppps/if-you-issue-it-they-will-come-lessons-recent-infrastructure-bonds

103 Africa News. 2021. "Liquid Telecommunications bond offering is fourth recent digital and telecommunications financing by PIDG company Emerging Africa Infrastructure Fund." *Africa News*. February 2, 2021. Available at https://www.africanews.com/2021/02/22/liquid-telecommunications-bond-offering-is-fourth-recent-digital-and-telecommunications-financing-by-pidg-company-emerging-africa-infrastructure-fund/

104 Patrinos, H. et al. 2009. *Public Private Partnerships in Education*. Washington DC: World Bank

105 Government of India. 2010. "Overview of PPP in Infrastructure." Available at https://www.pppinindia.gov.in/toolkit/urban-transport/module1-oopi-infra-wup.php?links=oopii1b

106 ITU/UNESCO Broadband Commission for Sustainable Development. 2021. *Connecting Learning Spaces: Possibilities for Hybrid Learning*. Geneva: International Telecommunication Union

107 Consortium for School Networking. 2014. "Reinventing Learning in Portugal: An Ecosystem Approach." Available at https://www.cosn.org/sites/default/files/pdf/ReinventingLearning_Portugal_April14.pdf; Trucano, M. 2014. "Checking in with Portugal's big projects to support technology use in education." *World Bank*. April 29, 2014. Available at https://blogs.worldbank.org/edutech/portugal-2

108 Burnfield, W. 2015. *Public-Private Partnerships in São Tomé & Principe: Improving Connectivity, Fostering Competition & Reducing Prices*. Washington DC: Alliance for Affordable Internet; World Bank. 2018. *Cameroon, Chad, Central African Republic, São Tomé & Principe: Internet and Mobile Connectivity. Project Performance Report No. 126034*. Washington DC: World Bank

109 Escueta, M. and Holloway, S. 2016. "Investment in Education Technology Across the Globe: Where Profit Meets Purpose." Entrepreneurship and Public Policy Working Paper Series. New York: Columbia University School of International and Public Affairs. Available at https://sipa.columbia.edu/sites/default/files/25222_SIPA-White-Paper-Global-Ed-Tech-web.pdf

110 Li, C. and Lalani, F. 2020. "The COVID-19 pandemic has changed education forever. This is how." *World Economic Forum*. April 29, 2020. Available at https://www.weforum.org/agenda/2020/04/coronavirus-education-global-COVID19-online-digital-learning/

111 Edventures GBA. 2021. "Market Opportunities: Asia and Greater Bay Area." *Edventures GBA*. Accessed November 3, 2021. Available at https://www.edventuresgba.com/en/market.html

112 Renner, B. 2021. "EdTech Giants are Poised for Ascension." *Latin America Business Stories*. September 23, 2021. Available at https://labsnews.com/en/articles/business/edtech-giants-are-poised-for-ascension/

113 Christian, A. 2020. "Internet Connectivity is not the biggest barrier to e-learning in Africa." *Weetracker*. April 12, 2020. Available at https://weetracker.com/2020/04/12/internet-connectivity-is-not-the-biggest-barrier-to-e-learning-in-africa

114 Bouhaj, K. n.d. "EdTech in Africa: A Landscape." *Medium*. August 9, 2021. Accessed November 4, 2021. Available at https://kenza-bouhaj.medium.com/edtech-in-africa-a-landscape-6bb03c299b33

115 PR Newswire. 2019. "The Global Crowdfunding Market was Valued at 10.2 Billion US$ in 2018 and is Expected to Reach 28.8 Billion US$ with a CAGR of 16% by 2025 - Valuates Reports." *Cision PR Newswire*. June 17, 2019. Available at https://www.prnewswire.com/in/news-releases/the-global-crowdfunding-market-was-valued-at-10-2-billion-us-in-2018-and-is-expected-to-reach-28-8-billion-us-with-a-cagr-of-16-by-2025-valuates-reports-888819175.html

116 Candid Learning. 2021. "What is a Foundation?" *Candid*. Available at https://learning.candid.org/resources/knowledge-base/what-is-a-foundation/

117 Petersen, J. and Poulson, S. 2016. "New Approaches to Ed-Tech Funding." *Philanthropy News Digest*. April 27, 2016. Available at https://philanthropynewsdigest.org/columns/ssir-pnd/new-approaches-to-ed-tech-funding

Abbreviations

ACE	Africa Coast to Europe Optical Fiber Submarine Cable
ADB	Asian Development Bank
AfDB	African Development Bank
ANSES	National Social Security Administration
BMGF	Bill & Melinda Gates Foundation
CAGR	Compound annual growth rate
CMS	Content management systems
DEG	Deutsche Investitions-und Entwicklungsgesellschaft mbH
DFI	Development finance institution
DFID	Department for International Development
EAIF	Emerging Africa Infrastructure Fund
EMIS	Education management information system
GDP	Gross domestic product
GIS	Geographic information systems
HICs	High-income countries
HNIs	High net-worth individuals
IBRD	International Bank for Reconstruction and Development
ICT	Information and communications technology
IFC	International Finance Corporation
IFFEd	International Finance Facility for Education
IFFIm	International Finance Facility for Immunisation
INS	Instant Network Schools
ITU	International Telecommunication Union
JPY	Japanese Yen
LICs	Low-income countries
LIT	Liquid Intelligent Technologies

LMICs	Lower-middle-income countries
MDB	Multilateral development bank
MICs	Middle-income countries
MoE	Ministry of Education
NGOs	Non-governmental organizations
ODA	Official development assistance
OECD	Organisation for Economic Co-operation and Development
OER	Open educational resources
PE	Private equity
PISA	Programme for International Student Assessment
PPPs	Public private partnerships
RCTs	Randomized controlled trials
SDGs	Sustainable Development Goals
SIGs	Social impact guarantees
TVET	Technical and vocational training
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USFs	Universal service funds
UMICs	Upper-middle-income countries
VC	Venture capital
YMCA	Young Men's Christian Association

the
Education
Commission