CAN WE LEAPFROG?
The Potential of Education Innovations
to Rapidly Accelerate Progress

Rebecca Winthrop and Eileen McGivney
with Adam Barton

Rebecca Winthrop is a senior fellow and director of the Center for Universal Education at Brookings.
Eileen McGivney was a research associate at the Center for Universal Education at Brookings.
Adam Barton is a research assistant at the Center for Universal Education at Brookings.

Skills for a Changing World is a project of the Center for Universal Education at Brookings and the LEGO Foundation that seeks to ensure all children have high-quality learning opportunities, which build the breadth of skills needed to create vibrant, healthy societies in the face of changing social, technological, and economic demands.

Acknowledgments

Rebecca Winthrop and Eileen McGivney
with Adam Barton

CAN WE LEAPFROG?

The Potential of Education Innovations
to Rapidly Accelerate Progress

B | Center for
Universal Education
at BROOKINGS

SKILLS FOR A CHANGING WORLD

Contents

List of Figures

List of Tables

Overview

Surrounded by rice fields, the little, rural village of Bhaumau in Uttar Pradesh, India's most populous state, is tapping into new people and places to help educate its children for the 21st-century. Most children in the village are enrolled in the local schools and, with help from the nonprofit organization Pratham, are mastering basic reading and numeracy.

But outside school, in the late afternoons, children are complementing their school-based learning by honing a wide range of skills through a combination of play, peer learning, technology, and light-touch parental oversight.

Groups of five or six children between 8 and 14 years of age huddle together with offline tablet computers—loaded with educational content in Hindi and English, and updated manually every few months by Pratham field staff—developing their skills, from digital literacy to critical thinking to teamwork. They are not only consuming content but are also making it by filming short skits and interviewing visitors. They are constantly experimenting with new projects, and in the process they are practicing and applying language, math, and science knowledge. The main role of their parents is to ensure that the tablets are charged in the evening, using either the sporadic electricity provided by the government or generator power.

Since the children of Bhaumau have been playing with the tablets, their assessment scores on academic subjects have increased markedly, especially in English. But perhaps more importantly, they are developing powerful learning-to-learn skills that will help them innovate, create, and thrive in the future amid a fast-changing world. Indeed, within the first three months of the program, these children, who had

rarely encountered much more technology than a cell phone, outsmarted the Pratham field staff by hacking most of the tablets' passwords, which enabled the children to add their own content to the tablets' existing repository.[1]

This type of student-centered learning is rarely used inside the village's schools, where the average teacher relies on more traditional instruction-based approaches. Yet just these kinds of playful, dynamic learning experiences are needed if children are to master not only essential academic skills like literacy and numeracy but also broader, and equally crucial, skills like critical thinking, collaboration, empathy, communication, and problem solving. If the children in the modest village of Bhaumau, where most parents are day laborers and agriculture workers, can experience such a rich learning environment, with dramatic early results, in a few short months rather than the years or decades typical of education reform, why can't this happen elsewhere?

These children's experiences epitomize the underlying motivation for this report: to explore the possibility of harnessing innovations to leapfrog—to jump ahead, or move rapidly and nonlinearly—to make educational progress. We are less interested in the potential of one particular innovation over another to leapfrog, and we are agnostic about whether innovations are best driven by governments through schools, such as the Indian government's recent move to set up "tinkering labs" in public schools, or, as in the case in Bhaumau, whether the innovations are driven by civil society both in community and school settings, or whether they are driven by the private sector, such as the Indian adaptive learning product called Mindspark, which effectively supports students' learning. Instead, we are most interested in exploring globally what leapfrogging in education looks like—

and the potential for education innovations to help us leap ahead.

Our aim is to share insights that can inspire action-oriented governments, civil society organizations, educators, philanthropic investors, and members of the business community to seriously consider the prospect of rapid, nonlinear educational progress, and to reflect on what more needs to be done to make leapfrogging in education a reality. To do this, we have explored this topic in five main report sections.

Why Do We Need to Leapfrog?

The report's first section lays out the case for leapfrogging. It argues that there are two main global education challenges: skills inequality and skills uncertainty. First, in most countries around the world, schools serve some children well and some very poorly. This inequality in how formal education systems develop children's skills and abilities is found both within countries, between wealthy and poor children, and between countries, between the developed world's high-income countries and the developing world's low-income countries. What is more worrisome is that, with the current pace of change, it will take decades and centuries—what we call the "100-year gap"—for poor children to catch up with today's educational levels of wealthy children. Second, this 100-year gap only becomes more daunting when you realize that it is between what we consider to be a good and bad education today, and that it does not even take into account the type of education children will need for the future. Fast-paced social and economic change means that it is not clear exactly what skills children will need to thrive in the future world of work and to be constructive citizens. But we do know that children will need to be well equipped to face uncertainty

and to, among other things, work collaboratively with others to solve problems, something on which the average school does not focus.

What Do We Mean by Leapfrogging?

The next section defines leapfrogging, a concept not usually applied to education. It argues that the average schooling model used in most countries—what we call the persistent Prussian model, given its origins in mid-1700s Prussia—has brought many social and economic benefits to society. Thus we should think carefully about what needs to be transformed to meet the twin challenges of skills inequality and skills uncertainty. We ultimately argue that two of the most important transformations needed are in what children learn—namely, that schooling must focus on a breadth of skills, including but going beyond academics—and how children learn, specifically that schooling must put students' curiosity at the center of the teaching and learning process and make room for hands-on, playful, and experiential learning. Given these goals, we define leapfrogging as any practices, both new and old, that enable skills inequality to be much more quickly addressed than the current 100-year gap predicts, and also as any practices that enable us to meet the challenge of skills uncertainty in this rapidly changing world. Finally, we argue that leapfrogging should set its sights on helping all children develop a breadth of skills, no matter if they are currently in or out of school or are living in poor or rich communities. Although leapfrogging often connotes ideas of skipping over steps to advance along a particular path, we do not stick narrowly to this idea. We took inspiration from the overarching concept that rapid and nonlinear progress can be made without following the usual path, perhaps

skipping steps but also possibly ending up in a new place altogether.

Can We Leapfrog?

This section introduces the role of innovation in potentially helping education to leapfrog. It argues that one of the major questions the global education community faces—what we call the education paradox of our time—is whether it is possible to simultaneously address both skills inequality and skills uncertainty. This paradox, another prime motivation for this report, acknowledges that the current ways we help schools better teach the most marginalized, and hence address skills inequality, often are reinforcing the formal education structures that hold students back from developing the breadth of skills they need for 21st-century life, and hence are not preparing them for skills uncertainty. Citing the International Commission on Financing Global Education Opportunity, we argue that education innovation has a role to play in helping us find ways to leapfrog. Ultimately, innovation—which we define as an idea or technology that is a break from previous practice, and is often new in a particular context, even if not new to the world—can help countries that have a strong desire to prepare all children for a fast-changing world but are "hitting the limits" of what their education systems can provide.[2]

How to Leapfrog

In this section, we discuss our two major contributions to the effort to explore how education can leapfrog: a leapfrog pathway based on existing evidence about how to transform what and how children learn; and a global catalog of education

innovations that gives us insight into how to help education leap to different destinations along this pathway. The pathway charts a vision for leapfrogging that recognizes context and leaves room for multiple types of leaps. "Good" leap approaches are those found at the start of our pathway; they have the potential to address skills inequality even if not skills uncertainty, which is certainly an important leap for marginalized children. But the "best" leap is one that addresses both skills inequality and uncertainty at the same time; it can occur only when the core elements of innovations are aligned at the end of the pathway. In the catalog, we were interested in grounding the theory about leapfrogging in existing practice to demonstrate what is realistically possible in the here and now. To develop the catalog, we brought together the lists of fifteen organizations that we call Education Innovation Spotters—which are currently scanning the landscape of innovative programs, schools, policies, approaches, and tools; are collecting information about them; are highlighting them in publicly accessible formats; and may be funding or supporting them. This catalog consists of almost 3,000 education innovations that we have analyzed in relation to the four main elements of our leapfrog pathway, and this section gives illustrative examples from the catalog that showcase these elements in practice.

The Potential to Leapfrog

This fifth and final section of the report reflects on the current state of the education innovations community, which we define as the many actors around the globe who are engaged in supporting innovative education practices, and its collective potential to help education leapfrog. In many ways, the education innovations community is well positioned to advance leapfrogging; more than 85

percent of the world's countries host innovations included in our catalog, which focuses heavily on poor and marginalized children. The vast majority of innovations focus on changing the teaching and learning process by using more playful learning approaches, and they are frequently finding ways to cooperate with government, civil society groups, and the private sector to implement their new approaches. However, there are also noticeable gaps that could limit the ability of the education innovations to help fuel leapfrogging. For example, there is little priority put on teachers' professional development as a main aim of innovation, something that is essential for leaping ahead. Also, a relatively low priority is placed on finding new ways to recognize learning, to use technology to transform education, and to make effectiveness data publicly available. There are also significant gaps in the types of innovations that Innovation Spotters highlight: relatively few of the innovations they have captured are led by governments, are designed for children living in crisis and conflict, and are focused on children with disabilities. Undoubtedly, many actors around the world are pursuing innovative education approaches in each of these areas; making the effort to highlight such innovations would greatly enrich the community's knowledge.

Ultimately, we conclude that governments, funders, and practitioners—and all those interested in helping leapfrog education so all young people can learn the full range of skills they need to thrive in the future—should be optimistic about the potential to rapidly accelerate progress. The education innovations community is energetic, diverse, and widespread, and there is clearly a movement afoot to experiment with the persistent Prussian model of schooling. Children from poor and wealthy families alike are participating in new approaches that are changing, with impressive results, how schooling is delivered, what is taught, and how teaching is done. Ultimately, we argue that this richness of education innovations holds promise for leapfrogging—addressing skills inequality and skills uncertainty—especially if the education innovations community can do a better job of tackling current gaps and governments can provide a conducive environment for effective innovations to thrive and be scaled up.

1

Why Do We Need To Leapfrog?

The Persistent Prussian Model

It was not until 1763 that the idea of mass schooling began to take root. Prussia, in the wake of a military defeat, sought innovative ideas for to strengthen its position in the world—and specifically, the general capability of its men in uniform. Its solution was to establish the world's first system of compulsory and universal education.[3] A century later, this idea took root in the United States, when Horace Mann led the Common Schools movement in Massachusetts.[4] Mass schooling began to spread across Asia and Latin America, and at the end of the 1900s, especially after the United Nations Convention on the Rights of the Child, countries across Africa began to push for universal schooling.[5]

This spread of mass schooling around the globe is, in the words of the education sociologist David Baker, an "education revolution."[6] The idea that within four generations schooling would become a central feature of children's lives in all the world's countries was for most of human history virtually unimaginable. Indeed, during the past 200 years, the number of children enrolled in primary schooling globally soared from 2.3 million at the beginning of the 19th century to more than 700 million today, over 40 times the rate of population growth.[7]

This rapid growth in the idea and practice of mass schooling was shared across democratic and autocratic countries alike and was driven by multiple factors. The rise of the university in Europe, some 900 years ago, brought with it a radical belief for the time—that knowledge and truth are open to discovery by anybody and that education institutions, not other social institutions such as the church, are the arbiters of this information. Schools became the necessary extension of preparing to access this knowledge. Social demand for mass schooling was also driven by a need for new skills as economies, particularly in the West, shifted from agriculture to manufacturing. But mass schooling was by no means only of interest to industrializing economies. Especially after World War II, mass schooling spread around the globe, driven by a combination of nationalism and the powerful idea that education is a fundamental right for all children, which was taken up by families, activists, and aid agencies around the world.[8]

However, today's approach to schooling has plenty of critics. On December 10, 2006, *Time* magazine ran a story on education, which argued that if Rip van Winkle suddenly woke up from a century of slumber, he would be hard-pressed to recognize anything in the world around him, except a school. Though he would be dazzled by the whizzing automobiles and planes and confounded by hospitals, entering a school would give him a sense of familiarity. A building that children in the community go to at set times of the day and on specific days of the week, with classrooms and teachers at the front lecturing students seated in rows and taking notes, would, the article argues, look very much the same as a school 100 years ago.[9]

This, of course, is not entirely true. If Rip stepped into an average U.S. elementary school, there would be a richer diversity of children present than there were 100 years ago—not only girls and boys and white kids

and black kids but also kids from all socioeconomic classes and geographies. Children's lessons would feature more cognitively demanding content on subjects such as reading and mathematics, and the religion-infused values education would largely be missing, with some concepts having been repackaged as character education or social and emotional learning.[10] Instead of managing small classes with more fluid teaching styles, teachers would be instructing a larger number of students, and teaching itself would be more bureaucratic and rationalized.[11]

But despite this, the modern teaching and learning model would feel quite familiar to a newly awake Rip van Winkle. The "Prussian model," as education scholars call it, has been in its core elements remarkably stable over time. The rollout of mass schooling has been so closely tied to this model—that no matter in what corner of the globe you live, schools will closely resemble each other. Because of this, some scholars have characterized schools around the world as acting effectively as one "shared global institution."[12] Others point to the role that international institutions, especially those financing educational development in the Global South, have played in disseminating a "common blueprint for schools" during the past five decades.[13] There are of course many examples scattered across the globe of schools that do not follow this common blueprint but by and large the schooling experience of most children share many common characteristics.

In any given country, the average school today shares similar characteristics about where, when, and how children learn. Structurally, children go to school buildings during predetermined times of the day, week, and year—although the total number of hours children spend in school varies widely by country. In school, teachers lead children, who are grouped together by age, through a prescribed curriculum developed by adults with little input from students themselves. Teachers rarely enjoy observation, feedback, or support from their peers. A range of subjects are taught in discrete time periods throughout the day—and indeed, in the U.S., for example, subject times have remained more or less stable since 1920.[14] Students rely heavily on teacher instruction, with a particular focus on academic subjects, and they work to actively understand and retain the material presented, while frequently being incentivized to do so via examinations that the teacher administers. Recent research observing teaching in U.S. math classrooms demonstrates that many of the teaching techniques, particularly teacher led-instruction, are the same as those described by academics studying teaching in the 1900s.[15] Students progress through school based on their performance within predetermined time periods.

How much of a problem is the persistence of the Prussian model?

"The "Prussian model," as education scholars call it, has been in its core elements remarkably stable over time. The rollout of mass schooling has been so closely tied to this model—that no matter in what corner of the globe you live, schools will closely resemble each other."

The Twin Problems of Skills Inequality and Skills Uncertainty

The reality is that while mass schooling has spread around the globe in virtually the same form, it reaches and serves some children very well and others very poorly indeed. This is one of two main reasons to look critically at the Prussian model of schools. The second reason is how the model's rigidities are at risk of holding back students from developing necessary skills in a fast-changing world.

Skills Inequality and the 100-Year Gap

Both between and within countries, there are deep inequalities in what schools help children learn, know, and do. Many children are simply not making it to the schoolhouse door, and still others are not mastering the foundational skills they need for future work, learning, and life. Children from all socioeconomic backgrounds are affected, but the poorest children carry the heaviest burden. Worse yet, it will take approximately 100 years for those farthest behind to catch up.[16]

Inequality Between and Within Countries

This pressing problem has been well documented, most recently by the International Commission on Financing Global Education Opportunity (hereafter, the Education Commission). Through careful analysis of education data globally, the Education Commission

has projected that, by 2030, more than half the world's 2 billion children will not be on track to achieve basic skills at the secondary level, including literacy, numeracy, problem solving, and critical thinking.[17] As figure 1 shows, many of the children missing out on a quality education live in high-income countries, where nearly 1 in 3 children will be left behind. But by far it is in low-income countries where children are especially poorly served, with 9 out of every 10 children projected to reach adulthood without the skills they need to thrive.[18]

Additionally, most countries around the world, regardless of average education performance or country income level, struggle with deep education inequalities between their rich and poor students.[19] For example, globally the gap between rich and poor students is 57 percent on the secondary-school mathematics proficiency examination under the Program for International Student Assessment (PISA). The United States is home to the widest gap, of almost 40 percentage points, in students achieving high levels of math proficiency, with two-thirds of the richest children reaching levels 3 and 4 on proficiency, compared with only about a quarter of the poorest.[20] This inequality starts early; in the U.S., scholars find that "upon entering kindergarten, children from low-income families have weaker academic and attention skills, on average, and a higher probability of demonstrating antisocial behavior than children

from higher-income families. None of these gaps shrinks over the course of elementary school."[21] This entrenched disparity is also evident across the developing world. For example, at the primary level in Morocco, only 24 percent of low- and middle-income students meet basic math proficiency benchmarks, yet the richest children achieve these levels at nearly double this rate.[22]

Interestingly, there is some evidence to suggest that this skills gap may be smaller in the context of nonacademic skills. A 2012 PISA study on creative problem solving, for example, demonstrated that the socioeconomic status of learners had an impact on creative problem-solving scores to a lesser extent than it did for math, literacy, or science.[23] Overall, however, the education community simply does not yet have the tools to take summative and broadly comparable measures of nonacademic skills.[24]

The problem, however, is not simply one of magnitude. It is also one of gaps that asymmetrically persist over time. Pick a developed nation. Now imagine stepping back in time 100 years. As education observers, we might note that the average adult completed about 4.5 years of schooling and that just over a third of youth were in enrolled in secondary school. But these levels of access and attainment are not a relic of the past; studies of education in the developing world yield similar results today.

The 100-Year Gap

We argued in *Why Wait 100 Years? Bridging the Gap in Global Education* that, at the current pace of change, skills inequality is not going to be solved anytime soon. In fact, we found that it will take approximately a century for girls and boys in poor countries to catch up to today's education levels in rich countries.[25] This slow pace of change is just as evident between poor and rich communities within countries and regions. While all of the richest boys in the Sub-Saharan Africa are expected to achieve secondary school completion by 2041, it will

Figure 1

Projected Learning Outcomes in 2030

LOW-INCOME COUNTRIES — 8%, 92%
MIDDLE-INCOME COUNTRIES — 49%, 51%
HIGH-INCOME COUNTRIES — 30%, 70%

■ Will learn minimum secondary-level skills   ■ Will not learn minimum secondary-level skills
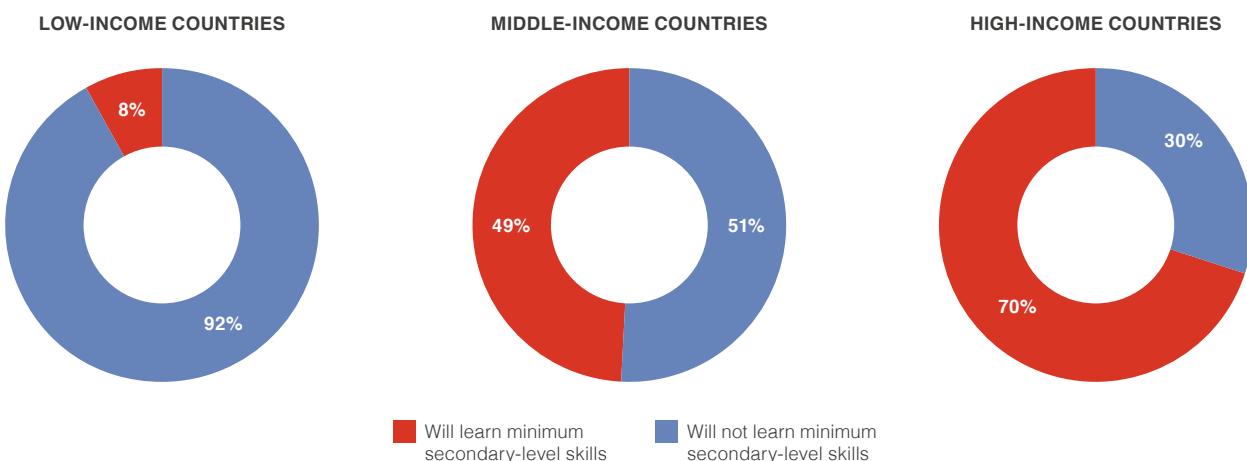
Source: Education Commission

"... at the current pace of change, skills inequality is not going to be solved anytime soon. In fact, we found that it will take approximately a century for girls and boys in poor countries to catch up to today's education levels in rich countries."

take the poorest girls 70 additional years to reach that milestone.[26] Extensive studies of educational inequality in the United States also highlight the alarmingly slow speed of closing the gap in achievement scores, social and emotional skills, and attainment in college completion.[27] Recent research shows that, at current rates, it will take another 60 to 110 years to close the gaps in the academic and behavioral competencies between high- and low-income children entering kindergarten.[28]

With our current pace of change, it is clear that deep inequalities in both access to and the quality of education will be with us for some time to come, and thus the promise of education as the equalizer, helping to compensate for social and economic differences, seems far from many children's reality.

The Problems of Access and Quality

There are many reasons why this inequality in skills development persists both within and between countries. Some of them are related to children's lives outside school, such as their nutritional status, the level of stress or support they experience on a daily basis, their family resources, the educational levels of their parents, and their health and emotional well-being. But many reasons stem from how well school systems themselves adapt to children's needs,

including reaching the hard to reach and consistently delivering a quality teaching and learning experience.

Many children around the world simply are not making it to the school door—or, if they do, they stay for only a few short years before they leave. Today, approximately 263 million youth aged 6 to 17 years are out of school, and this number has remained the same for the last decade. Reaching these "last mile" children will take different approaches.[29] They face multiple barriers to access, where poverty, gender, and their location intersect to exacerbate disadvantages. For the world's poorest families, sending their children to school means missing both labor and income on the days they need help farming.[30] It means forgoing child care when girls are not home to look after their younger siblings.[31] And though most countries have abolished school fees, poor families often face prohibitive, indirect costs, such as for uniforms and books.[32] Children living in regions affected by humanitarian emergencies represent half the world's out-of-school population.[33] Displacement, armed conflict, and insecurity can leave children without education for years and frequently decades.[34] Across Latin America, boys are dropping out of secondary school at the alarming rate of almost 50 percent, in part because the quality is so low.[35]

In fact, the majority of the world's youth are enrolled in and attending school but are learning little while there. For a number of countries, the economist Lant Pritchett has documented the flat "learning achievement profile" of students—meaning that for every year spent in school, the amount students have learned in subjects like literacy, numeracy, and science barely increases.[36] These flat or nearly flat learning achievement profiles are tragically widespread. The Education Commission estimates that, of all the children who will not be on track to achieve basic learning outcomes in 2030, roughly three-quarters are actually in school—they are simply not learning.[37] In addition, these estimates do not even include broader skills such as flexibility or collaboration where there is limited reliable cross-national data.

A diversity of reasons have led to this phenomenon of students' low learning levels. According to the Education Commission, in 2015 there were 2.7 million fewer teachers employed than were needed across the developing world. If this continues, more than 25 million new teachers will need to be recruited by 2030 just to ensure that every child can attend primary school.[38] In many countries, including some of the poorest in the world, for example, teachers are so overburdened that they are teaching classes of 60 or more students at a time, with 10 students for every book and children squeezed onto benches.[39] Classrooms are filled with students of widely varying levels that provide a challenge for teachers. Especially in the developing world, teachers, burdened with non-teaching duties including administration and event-planning, are often not in the classroom teaching.[40] In many African countries, for example, students receive just under three hours of instruction each day.[41] The language of instruction and pedagogical approaches used in the classroom also limit student's learning. Almost 40 percent of children in the world are not taught

in their native language, despite evidence showing that mother-tongue instruction is more effective for learning.[42] In India, while differentiated instruction (tailoring lessons to children's different levels of understanding) has been shown to be feasible and effective with the approach of teachers who are "teaching at the right level," most classrooms are not using it.[43] Additionally, many students have learning or physical disabilities that are not accommodated, and schools lack accessible materials and teachers trained to teach special needs students.[44]

Therefore, the problems of limited access to school and poor-quality schooling heavily hit our poorest young people. We must take seriously the need to rethink how education can help support these children, and not within the next 100 years but within the next decade.

Skills Uncertainty: Preparing Children for a Changing World

However, the magnitude of this 100-year gap only becomes more daunting when you consider that it is between what we consider to be a good and bad education today and does not even take into account the type of education children will need for the future. In addition to the limitations of weak schooling systems in effectively reaching and teaching all children essential academic skills, many are wondering if the Prussian model itself is limiting the relevance of a school-based education in a fast-changing world.

A Fast-Changing World

Today, people and ideas are flowing across borders at a greater speed than ever before in human history. Technology is becoming omnipresent. The gig economy is on the rise. And while today not every

child lives in a community where this is true, the pace of change is so rapid that they soon very well may be. Children struggling to learn their academic subjects in weak schools, and also children effectively mastering the curriculum in strong schools, both will need to face a future where they must be well equipped with a wide range of skills— from critically reading texts and collaboratively solving problems to quickly adapting to new forces affecting the economy, society, and the natural environment.

The pace of change in society—from technological innovation to global interconnectedness—stands in stark contrast to the pace of change in school systems. In the last decade, mobile phone service—and with it, access to information— has spread faster across most of Africa than the infrastructure supporting transportation, clean water, and sewerage put together.[45] Advances in artificial intelligence and robotics are happening faster than many scientists have predicted.[46] Social institutions, which take on average 10 to 15 years to adapt, are not keeping pace with the rapid pace of new innovations. Undoubtedly, societies have always faced changes, but the journalist Thomas Friedman provides a pithy comparison to illustrate the increasing speed at which change is happening: 100 years ago, new technologies like airplanes and automobiles took 20 years to significantly change our world, but today, new technologies, such as smart-phones, take approximately 5 to 7 years to transform our daily lives.[47]

New Skills for New Work

The effects of this rapid social change are especially evident in the changing world of work. Workers are being increasingly called upon to coexist with and complement machines that perform routine tasks by leveraging their interpersonal and complex

problem-solving competencies.[48] The Organization for Economic Cooperation and Development (OECD) estimates that, though few jobs are at risk of being completely automated, the bulk of workers will see 50 to 70 percent of their tasks lost to automation.[49] Nurse technicians, for example, might be stripped of routine tasks, such as taking vital signs; instead, they will be expected to engage with the patient, convey subtleties of the patient's expressions to a physician, and solve problems when machine errors occur.[50]

In a series of reports on skills in the workforce, the World Economic Forum stressed the magnitude of these changing skills demands, noting that "on average, by 2020, more than a third of the desired core skill sets of most occupations will be comprised of skills that are not yet considered crucial to the job today."[51] For example, in South Africa, 39 percent of core job skills across all industries will have completely changed by 2020—placing heavy demand on such skills as flexibility, knowledge related to information and communications technology (ICT), and emotional intelligence.[52] In the U.S., the jobs for which there has been the fastest-growing demand during the last 30 years are those requiring both high levels of math and social skills, such as physicians and management analysts.[53]

For the last decade, leaders around the globe have been especially vocal about their disappointment with how education systems are preparing youth for this changing world of work. In a recent study, only 53 percent of industry leaders said they are even reasonably confident in their companies' ability to recruit and train workers who match the diversity of future skills needs.[54] Automation has hollowed out the labor market, leaving many middle-skilled workers out of work or in low-wage jobs, a phenomenon documented in more than 30 countries across the developed and developing worlds.[55] Conversely, employers are struggling to find people with the skills

that are uniquely human and complement digital technologies, such as communication, teamwork, critical thinking, and flexibility. A 70-country study by the McKinsey Global Institute estimates that, by 2020, approximately 83 million high- and middle-skilled jobs will go unfilled because employers looking to hire in developed and developing countries will not be able to find people with the necessary academic and nonacademic skills.[56]

The academic Yong Zhao argues that for education to truly help students flourish in an increasingly fluid and fast-changing world of work, it should foster their entrepreneurial spirit, from curiosity to creativity to resilience. He argues that the structure of mass schooling rarely does this, pointing out that the better countries do on PISA, the worse they tend to score in entrepreneurial capacity, as measured by the annual global survey on entrepreneurship, the Global Entrepreneurship Monitor.[57] Building on his work, analysts at ATKearney found that top PISA scoring countries had an average perceived entrepreneurial capability score of 0.06, almost two-times below that of mid- and low-scoring countries on PISA, which had an average score of 0.13.[58]

Educating Global Citizens

It is not only employers who are looking for young people to come out of schooling with a diverse skill set—from academic abilities to a flexible mind-set to interpersonal and intrapersonal competencies. Civic leaders and policymakers regularly argue that young people must also be prepared to navigate an increasingly complex, interconnected, and fast-changing world. Their education experiences must prepare them to solve society's problems, which

increasingly cut across borders and range from climate change and migration to violent extremism.[59]

In *Teaching and Learning for the Twenty-First Century*, Fernando Reimers and Connie Chung of Harvard Graduate School of Education argue that, despite global ambitions, education systems are not creating sufficient opportunities for youth to learn these needed skills.[60] Case studies evaluating education planning in six nations reveal that education systems around the globe are largely unequipped to target 21st-century competencies and prepare children to be constructive global citizens.

Skills Uncertainty

All this and more are coming together to change how our children will live, work, and create.[61] And these changes also have deep implications for how we should educate them. Of course, it will remain important for all young people to develop a deep mastery of academic skills, from math and science to languages and history. But this is by no means the full range of capabilities that young people must develop to be successful in their adult lives. Children who are accessing good schools and mastering the basics, as well as children who are not, will need to be prepared to continue to learn, adapt, create, and innovate throughout their lives. Although this set of broad competencies has always been useful for young people, today, perhaps more than any other time in history, navigating uncertainty, complexity, and rapid change are becoming our children's central challenges. The question for education is whether it can enable our children to meet these challenges.

2

What Do We Mean by Leapfrogging?

Three Cheers for the Industrial Era's Model of Schooling

Given the radical changes afoot, does this mean that we should abandon the Prussian model of schooling all together? Indeed, a common refrain within education debates today is that there is an urgent need to depart from the industrial model of schooling. This call comes from all corners of the globe—from the United States to Brazil to Nigeria to India. Educators, nonprofit leaders, technologists, investors, academics and even some policymakers call for "reinventing," "reimaging," and "transforming" education.[62] The mass schooling model that is so globally pervasive is frequently heralded as broken, an artifact of the 19th century that privileged uniformity at scale and is no longer suitable in a fast-changing digital and globalized world.

But what exactly do educators mean when they argue that we need to shed our current schooling model for a new one—and is it a good idea? In fact, many characteristics of today's mass education approach were revolutionary when they were developed and continue to be worthwhile two centuries later. Taking stock of what those are, while also trying to understand and evaluate the possibilities for reinvention, is important to keep from throwing the proverbial baby out with the bathwater—a phenomenon not unknown in education.

At its core, the mass schooling movement is a radical enterprise in social equality. The commitment to every child being equally entitled to a quality education is a central principle that we should not lose in our effort to reimagine the industrial era's model of schooling. Today, virtually every society around the globe has a schooling system where governments and families accept that going to school should be a part of every young person's childhood. As the scholar Marcelo M. Suárez-Orozco puts it, "For the first time in human history, basic education in formal schools has become a normative ideal the world over."[63] Perhaps most important, this commitment to the right to education for all has led to significant social benefits.

This spread of schooling around the globe has had many positive outcomes, not only for the individuals who have been educated but also for societies overall. The world is healthier than it has ever been before. Two hundred years ago, people lived to be an average of less than 40 years old. Today, the average person lives to be 71.[64] Education—of girls and women in particular—has played an important role in improving our health. Health researchers have found that, since 1970, "of the 8.2 million more children who survived past age five, increases in women's educational attainment led to 4.2 million of them."[65] Increases in girls' education have also played an important role in combating HIV/AIDS and malaria; because of education's effectiveness

alongside medical interventions, it is often referred to as a "social vaccine" for these health epidemics.[66]

The world is also vastly wealthier, and for the first time in human history, experts estimate that extreme poverty can be nearly eliminated by 2030, having fallen below 10 percent of the world's population in recent years, which is an especially staggering prediction given that half the planet's population lived in extreme poverty only a few short decades ago.[67] Mass schooling has been a significant contributor to this rise in welfare. In the United States, for example, increasing education levels since the 19th century are estimated to account for between one-fifth and one-third of economic growth.[68] Globally, from 1950 to 2010, each additional year of schooling in the population increased economic growth by 5 to 12 percent.[69]

Today's educated populations are also driving the economic models of the future. Crowdsourcing, which taps into the time and talents of the many to accomplish quickly what previously was done slowly by the few, is changing everything from evaluating patents to tracking endangered species to designing T-shirts. Jeff Howe, who coined the term "crowdsourcing," argues that this online

phenomenon is only possible because of today's high education levels in many populations and their ability to connect with each other virtually.[70]

Women's ability to work outside the home has also been tied to the scaling up of mass education. Consider the systems that working parents, and especially mothers, would need to have in place to care for their children if schools did not exist. The child care that schooling provided, combined with expanded opportunity in the labor market, allowed increasing numbers of women to enter the workforce.[71] And as more women left home to seek employment, families became increasingly dependent on schools to care for their children—a self-perpetuating cycle that bolstered demand for and further cemented the place of mass schooling.[72] Indeed, schooling continues today in many countries around the world to be a backbone of child care that enables parents, especially women, to actively participate in the labor market.

But perhaps one of the most fundamental contributions of mass schooling has been to shift social identities from tribal to national lines. A common curriculum and shared sense of history, a shared language with which to communicate

"At its core, the mass schooling movement is a radical enterprise in social equality. The commitment to every child being equally entitled to a quality education is a central principle that we should not lose in our effort to reimagine the industrial era's model of schooling."

with each other, and a set of values that spreads across groups within a country are all aspects of how mass schooling has helped shape citizens' identities. The philosopher Benedict Anderson described this as developing "imagined communities"—"deep, horizontal comradeship" with others whom you may never meet within the national boundaries.[73] Depending on the content, values, and structures of mass schooling, this influence can either be a very good or very bad thing. Education can either reinforce social dynamics where civic discourse, inclusion, and diversity are all fostered or do just the opposite.[74]

There is, however, a strong argument to make that in many, if by no means all, parts of the world, mass schooling has helped foster more peaceful, democratic, and just societies.[75] Indeed, if the right to mass education is enjoyed equitably across a population, it has been shown to have a pacifying effect, meaning that a country's risk of civil strife and war is markedly reduced.[76]

Hence, there are many past and present reasons to admire the global project of mass schooling. The question then remains, what precisely is it that educators and innovators are so eager to reinvent?

Two Pillars for Transforming Education: What and How Children Learn

The answer is twofold. First, there is increasing concern that what children learn in school—the academic skills that are central in most schools around the globe—are only part of the skills that young people need to thrive in this fast-changing world. Second, there is an increasing recognition that how children are learning in school aligns very poorly with how they learn best and, crucially, how they develop the full range of skills they need to thrive in the future.

What Should Students Learn? The Breadth-of-Skills Movement

Many educators argue that the best way for schools to prepare young people for today's changing world is to help them develop a broad range of skills that they can nimbly deploy for learning, work, and life during their own lifetime, regardless of what the future entails.[77]

This does not mean jettisoning academic learning; but it does mean using teaching and learning approaches that enable students to deeply delve into subjects while also fostering a range of what some refer to as "21st-century skills."[77] In fact,

frameworks that set out a vision for 21st-century skills will often present a balanced vision, what we call a breadth of skills or broad range of skills, of academic subjects, globally relevant topics, and intrapersonal skills, which includes things like emotional intelligence, and interpersonal skills, which includes listening and interacting with others.

In 2008, Australia, for example, put forward a new national curriculum to better prepare its students for learning, work, and life. The curriculum sets out seven general capabilities that guide teaching and learning in the schools: literacy, numeracy, ICT capability, critical and creative thinking, personal and social responsibility, ethical understanding, and intercultural understanding. These general capabilities may not all reflect distinct subjects that are taught in the classroom, but they guide the teaching and learning process inside schools, in hopes that students will become "confident and creative individuals" and "active and informed citizens."[78] Today, hundreds of frameworks—developed by academics, practitioners, policymakers, and businesses—articulate different conceptualizations of how young people can cultivate this broad range of needed skills for work, learning, and life.[79]

At the Center for Universal Education at Brookings, we refer to this as the breadth-of-skills movement. Our colleagues Esther Care and Kate Anderson have described the concept of breadth of skills thus: "Skills are enablers—they provide us with the means to access a multiplicity of mental and physical activities. These skills rely not only on cognition, but also on the interdependencies of cognitive, social, and emotional characteristics. Shifts in skills, away from the narrow focus on literacy and numeracy and toward breadth of skills, are needed to navigate our changing societies and for individuals to function as responsible citizens."[80]

The recognition of the importance of the breadth of skills as an educational goal is long standing and today is now widespread. Twenty years ago, for example, the former president of the European Commission, Jacques Delors, chaired UNESCO's International Commission on Education for the 21st-century. The commission's seminal report, often referred to as the Delors Report, argued that education systems must focus on preparing students for lifelong learning. To do this, the report argued, young people not only need to learn to know, the focus of most education systems around

the globe, but also to learn to do, to live together, and to be.[81]

This vision of broad skills that included but built upon the traditional academic subjects taught in schools has long been supported in academia; for example, it was recently echoed by the educational researcher Howard Gartner, who 10 years ago published Five Minds for the Future. He argued that young people will need five minds, or sets of competencies, "to thrive in the world during the eras to come."[82] These include (1) the disciplined mind, which is able to fully master at least one particular scholarly discipline, craft, or profession; (2) the synthesizing mind, which is able to put disparate pieces of information together in a way that makes sense; (3) the creating mind, which develops fresh ways of thinking about things and unexpected answers; (4) the respectful mind, which seeks to understand and work effectively with others; and (5) the ethical mind, which questions the givens in society and considers how citizens can best improve society.[83]

Ultimately, this breadth-of-skills movement seeks, in the words of one practitioner, "to educate children not

Breadth of Skills

Refers to the expanded set of skills that education systems should help young people develop. Traditional skills, such as literacy and numeracy, must be complemented with skills such as collaboration, problem solving, and creativity. Children's cognitive, social, and emotional abilities must be brought to bear in developing their breadth of skills. "Breadth of skills" is used in this report interchangeably with terms such as "broad range of skills," "diverse skill set," or "21st-century skills."

for what is needed today but for where the ball will be in the future."[84] This movement has naturally led more and more people in society to ask if schools are up to the task, echoing a long-standing topic of debate in education circles about how children learn best.

How Should Students Learn? The Importance of Student-Centered Approaches

Long-standing educational traditions have thought deeply about how to align teaching with how children learn best. Many of these come out of the progressive education movement, from Montessori to Emilia Reggio to Waldorf to the democratic schools movement. They use different, and more student-centered, pedagogical approaches than most schools. Unfortunately, these approaches by and large remain the exception, not the rule. Indeed, a range of evidence shows that today most students in most countries learn in schools where very limited use of student-centered learning is the norm.

Classroom observations in the developing world point to pervasive use of teacher-centered pedagogies.[85] In Ethiopia, for example, one study found that student-centered activities account for only 11 percent of class time.[86] Another similar study in Cambodia found that 61 percent of class time is devoted to direct student instruction, and only 15 percent is used for student-led work.[87] A 2011 report by the UNESCO International Institute for Capacity Building in Africa echoes these findings when looking at how well teachers are supported in the use of student-centered strategies. Their meta-analysis of teacher training research concluded that African "teacher preparation programs have generally not adequately integrated [student-centered pedagogy] into the curriculum."[88]

This practice is also seen across the developed world, where teachers also rely heavily on teacher-led instruction. In all education systems across the OECD countries, for example, students report using memorization more frequently than learning strategies that involve making connections and finding new ways to solve a problem. Additionally, less than 30 percent of students reported experiencing even the most-used of student-centered teaching strategies: differentiated instruction.[89]

A number of studies, including recent work from the OECD and the *Cambridge Handbook on Learning Sciences*, emphasize that education and teaching broadly are not incorporating what we know from neuroscience and the learning sciences on how children best learn academic content, as well as cognitive and interpersonal and intrapersonal skills.[90] In the words of one expert, "perhaps the most solid finding to emerge from the learning sciences is that significant change can't be done by fiddling around at the edges of a system that remains instructionist at the core."[91] This is a prominent theme in the recent learning sciences research: that the common practice of teacher-led instruction runs counter to how children naturally learn best.[92]

This body of research provides additional weight and insight to many of the theories of teaching and learning put forth by leading progressive educators, such as John Dewey's work in the U.S. in the early 1900s and Paulo Friere's work in Brazil in the second half of the century. Supporting student inquiry, grounding learning in the experiences of everyday life, and fostering experimentation are hallmarks of progressive education approaches.[93] These approaches all share a commitment to putting the learner at the center of the teaching process, and many also focus on educational experiences that focus not only on what learners know but what they can do with what they know.[94]

Defining Leapfrogging in Education

Against this backdrop, what do we mean by leapfrogging in education? Leapfrogging, often described as the ability to jump ahead or make rapid and nonlinear progress, is not well defined in the education literature. Sometimes, in the business literature, it is associated with innovation that disrupts existing paradigms rather than sustains them in a different form.[95]

More frequently, leapfrogging is used colloquially to describe examples of rapid change. For example, the term "leapfrogging" is often used in relation to telecommunications or banking sectors in the developing world, where whole phases of infrastructure and institution building that other countries had to go through have been bypassed by nations that got a later start down that road. Many African countries never systematically invested in laying phone lines, for example, yet today access to cell phone service on the continent has grown so rapidly that in many cases communities are more likely to be connected to the outside world via cell phone service than to have access to electricity or running water.[96] And the situation is the same for banking: Instead of focusing on expanding physical branches to reach the many communities and families who lack access, people across the developing world are relying on mobile money—transfers and payments via text message—which grew out of innovations in Kenya.[97]

In one of the few previous explorations of leapfrogging in education, John Moravec and Arthur Harkins argue that a true leap is not merely adding new skills to an existing system but also rethinking education systems all together.[98] As a futurist, John Moravec draws on Peter Drucker's work on the rise of the knowledge worker and argues that we are moving into a new economic model that will privilege "nomadic knowledge workers," whom he defines as people who are "creative, imaginative, innovative," and "can work

"**We argue that leapfrogging means any practices, whether new or old, that enable skills inequality to be much more quickly addressed than the current 100-year gap predicts and any practices that enable us to meet the challenge of skills uncertainty in a rapidly changing world.**"

with almost anybody, anytime, anywhere."[99] While recognizing that this is not the current context everywhere, he argues that education should leapfrog to a new approach that prepares young people for what he sees as this eventual condition, and he spells out steps along a continuum of education transformation to do this.[100]

In this study, we took inspiration from the overarching idea that rapid and non-linear progress can be made without following the usual path. While leapfrogging often connotes ideas of skipping over steps to advance along a particular path, we do not stick narrowly to this idea. Rather for us leapfrogging is any approach that can rapidly accelerate educational progress, perhaps skipping steps but certainly ending up in a new place all together. Perhaps the most important part for us of defining leapfrogging was identifying the end goal to which we want to leap. Therefore, we argue that leapfrogging means any practices, whether new or old, that enable skills inequality to be much more quickly addressed than the current 100-year gap predicts and any practices that enable us to meet the challenge of skills uncertainty in a rapidly changing world. Ultimately we argue that leapfrogging should set its sights on helping all children develop breadth of skills no matter if they are currently in or out of school or living in poor or rich communities.

3

Can We Leapfrog?

The Education Paradox of Our Time

Having defined leapfrogging, we now face several questions. Is it possible to address both skills inequality and skills uncertainty at the same time? Does focusing attention on one necessarily distract from the other?

This is the educational paradox for our time. As education systems around the world need to be strengthened to deliver their core services, they also simultaneously need to transform what and how children learn. The problem is that the current ways we know of helping schools better reach and teach the most marginalized often are reinforcing the education structures that hold students back from developing the breadth of skills they need for 21st-century life. Throughout human history, social institutions responsible for educating young people have always adapted to new eras, but never before on this scale or in such short periods of time. A central question for us all is how we can change schooling without losing the commitment to the principles of mass education.

Some argue that skills inequality and skills uncertainty cannot be addressed simultaneously.[101] Education systems need to walk before they can run, the argument goes, and thus they should tackle the problems of access, quality, and relevance in that order. Schooling that now leaves large numbers of children outside their doors or that keeps children in school year after year with little progress in developing central reading and math skills instead needs to focus on getting the basics right. Whether in poor countries or poor

communities, educators who advocate this strategy claim that there is a real danger in shifting the goal from access and quality to relevance. They worry that a focus on transforming the teaching and learning experience to help students develop a broader range of skills will, even if unintentionally, privilege those who are better served today by schools. The most marginalized will be forgotten, they argue, and thus will be less able to master life-changing academic skills such as reading or math. There is a clear rationale to this argument, and those who make it are often deeply committed to helping marginalized children.

But the problem with this approach is that there is a high degree of risk that it will maintain inequality in the long-term—just a different kind of inequality. At its core, this argument means that the Prussian model of schooling should be strengthened in areas where it is weak—in poor countries and poor communities—and should only be questioned in areas where it is strong—in rich countries and rich communities. As poor children increasingly gain access to schooling that helps them master basic skills, wealthy children will increasingly be participating in learning experiences that help them develop the breadth of skills they need thrive today and in the future.

This is not mere hypothetical conjecture; it is playing out in education policy around the globe. For example, in Madagascar, the government has recently developed an education sector plan to address the 30 percent of children who do not

finish primary school and the high numbers of children who are not mastering basic literacy and numeracy. With only 15 percent of teachers in the country being professionally trained, significant government effort will be needed to train teachers and place them in rural and hard-to-reach communities.[102] Meanwhile, in Finland, educators are taking seriously the prospects of educating children for a changing world. They are not content to rest on their laurels as one of the consistently top-scoring education systems in international measures such as PISA; instead, the government is ushering in reform that requires schools to increase the use of multidisciplinary themes in teaching and hence in some measure move away from traditional subjects as the organizing principle of learning. The Finnish educator Pasi Sahlberg notes that schools have some flexibility in how to integrate this phenomenon-based teaching approach, and thus will be able to draw on all the traditional school subjects to explore a topic such as the European Union or climate change. He also notes that what is potentially more forward thinking is the requirement that students have a voice in designing the topic and how their learning is assessed. Set subjects and control by teachers are making way for themes and opportunities for students to use their voices. The motivation for the reform, Sahlberg argues, is the recognition "that schools should teach what young people need in their lives."[103]

What will happen to the students entering school in Madagascar 20 years from now? Will they stand any hope of developing the broad range of skills that Finnish students will likely have in the future? Or, despite improved access and quality learning, will they again be woefully left behind, missing crucial skills they need to thrive? Most governments aspire to help young people develop the capabilities they will need to flourish regardless of their starting point. In the words of one former African Minister of Education, Dzingai Mutumbuka,

"I wanted the children in my country to develop the skills that will make them globally competitive; they are just as capable as children in other parts of the world."[104]

It would be foolish to argue that Madagascar can become like Finland in a decade; there are massive differences in their economies and available financial resources, for starters. But maybe Madagascar does not need to—it could chart its own course toward helping children get the full range of skills they need. After all, in every country in the world, children are natural-born learners—curious, creative, social, and persistent—and this is no less true in Madagascar than it is in Finland. Technology is advancing so quickly that expensive computer laboratories are being replaced by mobile phones, online and offline tablets, and solar-powered light weight projectors. If Indonesia can be one of the world leaders in startups, and India can do the same in biometric identification, why cannot Madagascar tackle skills inequality and skills uncertainty without following the same steps as Finland? The long, hard work of reforming education governance and resourcing would be important for this journey but is by no means enough. An essential part of the process would have to be identifying new ways of educating children—that is, strategies to engage young people in learning opportunities that will help them master academics at the same time as they build their skills for the 21st-century. Luckily, as we shall see later in this report, there are multiple examples of just these type of approaches being tried out, from the poorest parts of the world to the wealthiest. Being open to taking a different path is perhaps the first step toward leapfrogging. After all, breaking free from dominant logic—entrenched patterns of thought and action—and the resulting tendency to act in accord with past decisions, also known as path dependence, can be one of the biggest barriers to innovation.[105]

Can Innovation Help Education Leapfrog?

In fact, many countries around the globe—rich and poor alike— aspire to help their young people develop a broad range of skills. In a survey of more than 100 countries, our colleagues at the Center for Universal Education found this desire expressed in the policies of three-quarters of them.[106] However, most are long on aspiration and short on planning. Only 11 percent have evidence of any concrete plan for how to achieve this vision.[107] They are struggling with this very paradox of tackling skills inequality while addressing skills uncertainty, a complex task for virtually every government to address. Indeed, many countries are considering what steps they should take to help their young people develop the full range of academic, interpersonal, and intrapersonal skills they need.[108]

This paradox is the central motivation of this report. Can we address skills inequality and skills uncertainty at the same time? Are there new ideas and approaches that would enable us to

do that? What would a pathway for harnessing innovation for leapfrogging look like? We recognize that innovative practices are only one potential source of progress; certainly, improved delivery of existing education models will make an important contribution. However, in this report we focus solely on the universe of education innovation, which we argue must be an important part of the solution.

We first started exploring these questions through our Skills for a Changing World initiative and then accelerated our work on the topic through our research partnership with the International Commission on Financing Education Opportunity (Education Commission). The Education Commission—chaired by the UN secretary general's envoy for global education, Gordon Brown—was convened by several heads of state and launched in Oslo in 2015 with Norwegian prime minister Erna Solberg and UN secretary general Ban Ki Moon. It convened a group of

"'Education systems must innovate and change rather than just replicate past success,' especially in light of the evolving nature of skills young people need and because many countries are 'hitting the limits' of what their education systems can achieve."

global leaders who worked together for a year before putting forward an ambitious blueprint for accelerating global education progress, particularly in the developing world. The report calls for a major scaling up of global investment, to create a "learning generation" whereby all young people will have access to a quality education.[109]

The Education Commission argues that, to accomplish this, education systems must both be strengthened and be better at capitalizing on innovative approaches. Its report recommends improving access and quality by pursuing a series of "transformations," including making weak education systems stronger by following the effective policies of the top quarter of the fastest-improving countries as measured by learning outcomes on literacy as well as prioritizing inclusion and scaling up financing. The Education Commission also calls for a transformation in the use of innovative approaches to who, where,

and how education is delivered. Innovation, the Education Commission argues, is essential to any acceleration of progress: "Education systems must innovate and change rather than just replicate past success," especially in light of the evolving nature of skills young people need and because many countries are "hitting the limits" of what their education systems can achieve.[110]

The background paper we prepared for the Education Commission with our colleagues Timothy Williams and Priya Shankar was the precursor to this report. In it we defined innovation as an idea or technology that is a break from previous practice, often new in a particular context, even if not new to the world.[111] This continues to be how we conceive of innovations in education, although as we shall see in the next section we broadened the definition when scanning the landscape of education innovations to capture existing efforts to identify innovative education practices.

4

How to Leapfrog

Overview of the Leapfrog Pathway and the Global Catalog of Education Innovations

If the ultimate goal of leapfrogging as we define it is to transform what and how children learn so that all young people can develop the broad set of skills they need to thrive, then how can innovations help education do this? We have explored the answer to this question in two ways: by developing a leapfrog pathway based on existing evidence about how to transform what and how children learn; and by developing a global catalog of education innovations that gives us insight into how innovations are helping advance education to different destinations along the pathway.

Our interest is ultimately what insights this exploration can provide to action-oriented governments, civil society organizations, educators, philanthropic investors, and members of the business community who care about helping young people develop the breadth of skills they need to thrive in the future. We hope that, together, the leapfrog pathway and its corresponding catalog of innovations can illuminate the horizon, meaning what educational transformation may look like in the future, but also what practical action for advancing leapfrogging could look like today.

What follows is, first, a description of how we developed both the leapfrog pathway and the innovations catalog, and, second, a detailed description of the leapfrog pathway itself, which relies on examples from the catalog to illustrate its different elements.

In this exploratory study, we have focused specifically on the role of innovations in helping education leapfrog. In particular, we have focused on learning about what we are calling the "education innovation community," namely, the many actors around the globe who are engaged in supporting innovative education practices. The leapfrog pathway itself is based on existing evidence around how to transform what and how children learn. Although we developed the leapfrog pathway before finalizing the catalog both endeavors influenced each other; and many research activities—such as literature reviews, interviews, and consultations—informed both efforts.

The Leapfrog Pathway

We developed the leapfrog pathway to help identify how education could meet the vision of leapfrogging—accelerating progress to address both

skills inequality and skills uncertainty. We based the elements of the pathway on existing evidence about how to transform both what and how children learn, and we were informed by a number of sources—the existing literature on learning and education, as well as innovation and leapfrogging; more than 100 interviews with a wide range of thought leaders, innovators, and practitioners; and a series of consultations, including with decision makers across all levels of education, from ministers of education to teachers.[112]

Although many possible elements could have been included in the pathway—indeed, our initial draft had more than twelve—we chose to prioritize those that were most essential to addressing skills inequality and skills uncertainty, and thus to achieving the goal of leapfrogging as we have defined it above. The pathway has two main parts. First, it identifies strategies to improve learning and teaching, and the recognition of learning, as the core elements for leapfrogging. This means that education cannot leapfrog without attending to these essential elements; and it also means that in the pathway, the elements are closely aligned with each other. The pathway's second part identifies support elements: including more people and places, and leveraging technology

and data. These elements are not necessary for transformations in the core elements, but we argue they are very useful tools to consider, given the scope and scale of the challenges of skills inequality and skills uncertainty. Hence, unlike the core elements, the support elements are strategies that are not necessarily closely aligned with each other and may or may not be used, depending on the context.

We argue that what constitutes leapfrogging will depend heavily on the context from which you are starting. Though all nations should aspire to tackle both skills inequality and uncertainty, it is certainly a meaningful leap to close the current 100-year gap faster than predicted. For out-of-school children in South Sudan, for example, the Can't Wait to Learn program is a major advancement. This intervention, which provides literacy and numeracy training through games and exercises via offline tablets and a community facilitator, could certainly assist in addressing South Sudanese skills inequality. However, it would be unlikely to drastically accelerate progress for children in Argentina, most of whom are already in primary school and mastering basic literacy and numeracy. Nor would it enable learners to develop the breadth of skills needed to tackle skills uncertainty.

"**We hope that, together, the leapfrog pathway and its corresponding catalog of innovations can illuminate the horizon, meaning what educational transformation may look like in the future, but also what practical action for advancing leapfrogging could look like today.**"

Hence, we have visualized three possible destinations—good, better, best—within each element of the pathway. These are meant to illustrate the range of possible destinations to which innovations could help education leap and are not meant to be fixed categories. Though all leap approaches along our pathway have the potential to accelerate education progress in some form, only innovations that align their core elements with the end can effectively contribute to the "best" leap—addressing both skills inequality and skills uncertainty at the same time. Ultimately, across all the elements of the pathway, strategies build on each other rather than replace what has come before, and the pathway is characterized by an increasingly-diverse menu of actions.

The Global Catalog of Education Innovations

If the leapfrog pathway charts a vision for nonlinear progress, how do current education innovations stack up? What is the ultimate goal to which most innovations aspire, and how are they going about reaching this goal? We were interested in grounding the theory about leapfrogging in existing practice that demonstrates what is possible in the here and now.

From the outset, we were aware that multiple organizations are already working on scanning the landscape of education innovations. These ranged from Ashoka, which seeks social innovators and schools that develop young people's skills for social entrepreneurship; to the Results for Development (R4D) Center for Education Innovations, which looks for programs in low- and middle-income countries; to EdSurge, a U.S.-based education technology product index. We call these organizations the Education Innovation

Spotters—those that are currently scanning the landscape of innovative programs, schools, policies, approaches, and tools; are collecting information about them; are highlighting them; and are sometimes funding or supporting them. We had hoped there might be an existing catalog that combined the insights of these different organizations in one place. Upon finding that none existed, we decided to create our own.

Our method for studying the landscape of education innovation—or, as we refer to it, the education innovation community—was to bring together the lists of these Innovation Spotters into one central catalog, and analyze them in relation to our leapfrog pathway. Ultimately, we had to relax our own definition of innovation and be open to the different definitions used by the Innovation Spotters. In the end, we cataloged all innovations that the Innovation Spotters had deemed innovative, deferring to their definitions and criteria. This ranged from thorough and specific classifications of innovation, such as that used by the OECD, to more fluid definitions by those who sought to cast a wide net, like the R4D Center for Education Innovations and the HundrED Finland list.

The catalog has almost 3,000 innovations spread across developed and developing countries and includes programs run by non-profits, government initiatives, and private sector interventions; individual schools as well as chains of schools; and specific products and tools. The majority are focused on K-12 schooling, although youth workforce development and early childhood also are included in a significant way. The innovations included nascent innovations that have just begun but have no data on their effectiveness as well as longer-serving innovations that have external evaluations of effectiveness and evidence of the ability to scale up. We searched for Innovation Spotters working in different languages,

including Spanish, Portuguese, and Mandarin. However, we primarily worked in English, as this was the language used by most of the Innovation Spotters we encountered used. As this was an exploratory study, we specifically sought to capture a diversity of perspectives and so included diverse lists, some of which are focused on technology, others focused on breadth of skills, and others on specific target populations.

Although this global catalog gives us good insight into what the education innovation community is doing, it is by no means comprehensive of all innovation happening in education. There are most certainly other Innovation Spotters working in languages outside the scope of our study; but perhaps more significantly, there are many innovations that are not featured on the various lists of the Innovation Spotters, and hence our catalog.

Good, Better, Best: A Leapfrog Pathway for Education

We now turn to the leapfrog pathway itself (figure 2). After presenting the full pathway, we discuss each of the core and support elements, illustrating features of innovations that could support a good, better, or best leap with examples of innovations from the catalog.

"Education Innovation Spotters are those organizations that are currently scanning the landscape of innovative programs, schools, policies, approaches, and tools; are collecting information about them; are highlighting them; and are sometimes funding or supporting them. Our method for studying the landscape of education innovation—or, as we refer to it, the education innovation community—was to bring together the lists of these Innovation Spotters into one central catalog, and analyze them in relation to our leapfrog pathway."

Four Things to Know About the Leapfrog Pathway

1 ## Elements

The pathway includes two core elements—learning and teaching, and recognizing learning—and two support elements—people and places, and technology and data. The core elements are essential for transforming what and how children learn. In contrast, the support elements are important, but not essential, tools for supporting the core elements. Each element presents an expanding menu of actions building off of and adding to the practices that have come before it.

2 ## Evidence

The pathway has been developed based in large part on existing evidence on how to transform what and how children learn.

3 ## Context

Leapfrogging can take many forms depending on the context. In what we call a "good" leap, innovations could, for example, support new ways for out-of-school children to master core academic content, essentially more rapidly addressing skills inequality than the current pace of change predicts. The "best" leap, however, is one that addresses skills inequality and skills uncertainty at the same time. We describe three anchor points in the leapfrog pathway—good, better, best—to illustrate, not prescribe, the range of destinations included in the leapfrog pathway.

4 ## Purpose

The pathway was developed not as a tool to evaluate individual innovations but rather to help understand the collective effort of the education innovation community. For example, it is possible that, separately, two innovations do not have the potential to help leapfrog education, but when working alongside each other, they could.

Five Things to Know About the Global Catalog of Education Innovations

1   Who, what, where

The catalog has almost 3,000 innovations spread across developed and developing countries and includes programs run by non-profits, government initiatives, and private sector interventions; individual schools as well as chains of schools; and specific products and tools. The majority are focused on K-12 schooling, although youth workforce development and early childhood also are included in a significant way.

2   Source of data

In analyzing each of the innovations in the catalog, which includes examining them in relation to our leapfrog pathway, we have relied on publicly available information. Hence our information on each innovation is only as current or complete as their website or external information sources allow.

3   Innovation Spotters

To scan the landscape of education innovations, we relied on 15 organizations that we are calling Innovation Spotters. These Innovation Spotters maintain lists of education innovations and collectively their innovations come from 166 countries. Together these innovations provide insight into what we are calling the education innovation community, namely the constellation of actors around the globe who are involved in supporting innovative education practices.

4   Defining innovation

In developing the catalog, we relied entirely on the definitions of innovation that the 15 Innovation Spotters used to develop their lists. The result is that there is a wide diversity of innovations in the catalog, from promising to proven and from small scale to large scale.

5   A snapshot of the universe

The catalog provides a diverse and useful picture of the education innovation community. But it is a partial one and by no means represents the whole universe of education innovations that exist.

Figure 2

Leapfrog Pathway for Education - Core Elements

LEARNING AND TEACHING: INCREASINGLY STUDENT-CENTERED

Remember and understand:
Students recall facts and basic concepts and explain ideas or concepts.

Remember and understand

Apply and analyze:
Students apply information in new situations and draw connections among ideas.

Remember and understand

Apply and analyze

Evaluate and create:
Students evaluate, design, and create original work, and question and criticize existing work.

LEARNING

TEACHING

Playful:
Learning is driven by students' inquiry and needs, meaningfully connected to their lives, and fosters experimentation and social interaction. Teachers often act as facilitators and guides.

Interactive:
Teacher is in charge, and sometimes engages students in discussion, activities, or group-based work.

Interactive

Lecture-based:
Teacher is in charge; students passively receive information.

Lecture-based

Lecture-based

RECOGNITION OF LEARNING: INCREASINGLY INDIVIDUALIZED

Predetermined:
Learners progress based on time and age in a linear fashion.

Predetermined

Group-based:
Learners progress based on ability, to a limited extent. They can sometimes move between groups of similarly-leveled peers.

Predetermined

Group-based

Individual-based:
Learners progress individually as they demonstrate mastery of content. They move fluidly between learning groups and may have the option of designing their own assessments and pathways.

PROGRESSION

VERIFICATION

Hybrid-led:
Educational institutions mediate the verification process, in collaboration with employers and postsecondary institutions. Employers and postsecondary institutions recognize diplomas and other certifications with the knowledge that they have contributed to students' educational programming in some capacity.

Education-led

Industry-led:
Employers and postsecondary institutions mediate the verification process. Employers and postsecondary institutions find ways to directly recognize learners' knowledge and skills that are of particular relevance to their job or further course of study.

Hybrid-led

Education-led

Education-led:
Educational institutions mediate the verification process. Employers and postsecondary institutions recognize diplomas and other certifications from formal institutions.

Leapfrog Pathway for Education - Support Elements

PEOPLE AND PLACES: INCREASINGLY DIVERSE

Licensed teachers:
Licensed teachers bear the entire responsibility of teaching.

Licensed teachers

Teachers team with others:
Licensed teachers sometimes team with parents, students, and others.

Licensed teachers

Teachers team with others

Everyone:
Learning regularly involves community members, peers, parents, siblings, employers, and others, along with educators.

PEOPLE

PLACES

In a diversity of contexts:
Formal, organized learning that significantly uses multiple spaces, including schools, community spaces, and workplaces. In some cases, these may be informal learning spaces where the environments are transformed for learning.

Connected to outside school:
Learning is primarily organized in a formal setting, but may sometimes occur outside the school building and hours—online or in person.

In school

In school:
Learning is formal, organized, and occurs inside a defined space and time (school day).

Connected to outside school

In school

TECHNOLOGY AND DATA: INCREASINGLY RESULTS ORIENTED

Substitution:
Technology acts as a direct tool substitute, with no functional change.

Substitution

Augmentation:
Technology acts as a direct tool substitute, with functional improvement.

Substitution

Augmentation

Modification and redefinition:
Technology allows for significant task redesign, or allows for the creation of new tasks that were previously inconceivable. Technology is integrated and embedded into learning.

TECHNOLOGY

DATA

Data for transforming learning experiences:
Collection and analysis of data in real time; data are used to evolve programs, increase transparency, and/or improve educational experiences and outcomes; data are less compliance oriented and may be less standardized.

Data for program improvement:
Infrequent collection and analysis of data. Data may be used to improve programming; limited use of data for improving learner outcomes.

Data for compliance

Data for compliance:
Infrequent collection and analysis of data. Data is used for routine compliance.

Data for program improvement

Data for compliance

Core Elements: Increasingly Student-Centered and Individualized

As discussed above, central to addressing skills inequality and skills uncertainty is transforming what and how children learn. This cannot be done without focusing on how students learn and how teachers teach in conjunction with how students' learning is recognized, both within schools and outside them. These core elements of the leapfrog pathway are closely related, and hence leaping forward in one element often means a similar shift in another element. We examine both in turn.

Learning and Teaching: Increasingly Student-Centered

How students learn and how teachers teach are at the core of an education system's ability to develop student skills. Studies across the world have demonstrated time and again that changes in teaching practice improve student learning to a greater extent than any other school-based interventions. In the developing world, studies show the most effective educational programming is focused on promoting evidence-based pedagogies.[113] And in the developed world, John Hattie combined over 1,200 meta-analyses and found that, compared with other interventions, changes in teaching and learning most positively influenced

student achievement.[114] Additionally, the International Initiative for Impact Evaluation's review of educational programming identified structured pedagogy—which integrates evidence-based instructional approaches—as having the largest and most consistent impact on learning outcomes.[115]

We also know that teaching and learning experiences that lead with students' interests and needs both are more effective and enable a greater range of skill development.[116] Underpinning this finding from the learning sciences is the idea that how teachers teach ultimately helps shape what skills students are able to develop. While some important 21st-century skills—such as digital literacy—can be taught through teacher-directed instruction, many others cannot. To hone their ability to collaboratively solve problems, for example, children need teaching and learning experiences that give them space to lead, experiment, fail, and try again. Supporting teachers' capacity to guide children's learning is an important part of transforming the teaching and learning process.

Indeed, leapfrogging in education requires being open to new ways of teaching and learning that may look quite different from what characterizes

Figure 3

Learning and Teaching: Increasingly Student-Centered

Remember and understand:

Students recall facts and basic concepts and explain ideas or concepts.

Remember and understand

Apply and analyze:

Students apply information in new situations and draw connections among ideas.

Remember and understand

Apply and analyze

Evaluate and create:

Students evaluate, design, and create original work, and question and criticize existing work.

LEARNING

TEACHING

Playful:

Learning is driven by students' inquiry and needs, meaningfully connected to their lives, and fosters experimentation and social interaction. Teachers often act as facilitators and guides.

Interactive:

Teacher is in charge, and sometimes engages students in discussion, activities, or group-based work.

Interactive

Lecture-based:

Teacher is in charge; students passively receive information.

Lecture-based

Lecture-based

the average classroom. This is why learning and teaching experiences that put students at the center, fostering their natural inquisitiveness and exposing them to important topics that will shape their lives, are important for transforming education. In the words of John Dewey: "If we teach students the same way as yesterday, we rob them of tomorrow."[117]

Learning

In 1956, Benjamin Bloom developed a framework for student learning behaviors in order to promote higher forms of thinking in education. The revised version of this framework, known simply as Bloom's Taxonomy, describes a range of increasingly sophisticated learning objectives and behaviors. At its core, the taxonomy is about how learners

interact with knowledge—how they think. It is a continuum that builds from the simple and concrete to the complex and abstract. As learners move from "lower-order" to "higher-order" skills, they are able to accomplish increasingly sophisticated learning objectives.[118] This movement requires students to demonstrate increasing levels of agency in the learning process. Take, for example, a lesson on the fairytale Little Red Riding Hood. The first level of thinking might require learners to describe where Little Red Riding Hood was walking, remembering information from the book. The final level could ask learners to create a poem or song that conveys Little Red's story in a new way. We rely on this taxonomy to describe a shift in what we expect of students: moving from what they know to what they can do with what they know.

A range of studies justify this focus on both knowledge and application. For example, in *How Teachers Teach and How Student's Learn*, an OECD Education Working Paper, researchers using the PISA study compared the mathematic abilities of students from around the world who rely on memorization with those who use higher-order cognitive strategies, including consciously connecting tasks with prior knowledge or planning and setting goals.[119] They find that, on the most basic math questions, students using memorization strategies perform similar to others. However, these students are much less likely to succeed at more complex questions.

Of course, higher-order cognitive skills not only build on lower-order ones but also help to strengthen them. In a recent review of dozens of studies on cognitive development and literacy, researchers underscore the fact that complex skills are deeply intertwined with lower-order skills. For readers and writers to thrive, they need to learn both the cognitive basics, such as decoding words, and higher-order skills, such as inference.[120] One study showed that training fourth graders in making inferences helped improve learning outcomes for poor readers; researchers posited that

these readers likely struggled because they lacked the higher-order ability to draw connections between ideas, not because they lacked basic word-decoding abilities.[121] This skills interdependence is reflected by the additive nature of our leapfrog pathway, in which the creative capacities of learners are supported by their ability to remember and understand knowledge.

This is equally relevant in the context of 21st-century skills, which can be developed by allowing students the opportunity to utilize diverse skills while learning specific academic content.[122] For example, students could hone their ability to collaborate with others in science class by working in teams to investigate the habitats of different animals. Integrating the development of 21st-century skills into traditional classroom subjects—or, as we call it, teaching "skills through subjects"—is an important strategy for cultivating the breadth of skills.

As we move along the leapfrog pathway, education increasingly requires learners to create and evaluate original work using a broad range of skills—from academic to inter- and intrapersonal. A detailed look at case examples for each main topic follows.

Remember and Understand:

Learners are largely tasked with remembering information and making meaning from it. Learning activities require skills such as recognizing, identifying, recalling, summarizing, explaining, and clarifying relevant knowledge.

ALGEBRATOR
by Softmath, Inc.

Organization Type: Private sector company
Location: U.S.
Innovation Spotter: EdSurge

Algebrator is a for-fee software program that helps students solve and understand high school- and college-level math problems. Students input problems from their textbooks or classroom notes into Algebrator, and the platform shows step-by-step instructions on how to solve it. The application includes an "explain" function that details why specific algebra rules are to be applied.

Apply and Analyze:

Learners are tasked with using, reorganizing, and reflecting upon pieces of information. Learning activities require skills such as solving problems and comparing evidence.

PREPARATION FOR SOCIAL ACTION (PSA)
by Kimanya-Ngeyo Foundation for Science and Education

Organization Type: Nongovernmental organization (NGO)
Location: Uganda
Innovation Spotter: R4D

PSA is a tutorial-based program for in- and out-of-school youth in rural areas that teaches learners to apply math, science, technology, and language concepts to community development activities in agriculture, health, early childhood development, and environmental sustainability. Trained community tutors facilitate three-hour learning sessions five times per week that unite academic learning with social action. Students might use math concepts to help local businesses analyze their cash flows, or learn biology by studying local agricultural activities. Since its inception in 2007, 420 learners have successfully completed the 18-unit curriculum in 30 study centers across Uganda.

Evaluate and Create:

Learners are tasked with adapting, transforming, and creating information. Learning activities require higher-order cognitive skills, such as contrasting, designing, judging, and producing relevant knowledge.

NÚCLEO AVANÇADO EM EDUCAÇÃO - NAVE ("ADVANCED EDUCATION CENTER")
by the Rio de Janeiro State Government and Oi Futuro Institute

Organization Type: Government and private sector company, Chain of schools
Location: Brazil
Innovation Spotter: Graduate XXI, InnoveEdu, WISE

NAVE is a chain of free, government-run secondary schools with two campuses across Brazil. They are run by the governments of two Brazilian states in collaboration with the social responsibility arm of Oi, a Brazilian telecom company. Students specialize in one of three technical areas: video game design, multimedia design, or digital scriptwriting. The school's focus is on creativity, innovation, and entrepreneurship in digital spaces, and students are challenged to regularly design, develop, and publish apps, games, and other tech solutions. For example, video game design students might work in a biology class to create an app that allows users to explore the different parts of the circulatory system. To date, students' apps and games have been downloaded more than 600,000 times from online stores. The results of this creative learning model have been impressive: NAVE schools scored first place among all public schools in the states of Recife and Rio de Janeiro on the national secondary leaving exam.

Teaching

Effective teaching puts student inquiry at the center and actively engages students in "doing things and thinking about the things they are doing."[123] A collection of diverse pedagogical approaches are motivated by this over-arching principle. These teaching strategies frequently recognize that children are natural-born learners, often citing the important role active student inquiry has in developing a wide range of skills and capacities. Some pedagogical approaches entail harnessing children's innate ability to play as a way of helpings students "actively [engage] in meaningful discovery" and allowing them the freedom to experiment and explore problems.[124] Others focus on connecting classroom learning to the everyday lives of students, including pedagogies in which learners participate in real-life activities, such as internships and community projects, and learn through reflecting on those experiences.[125] Educators use a range of terms to describe these various approaches—including active learning, experiential learning, and problem-based learning—and each emphasizes a slightly different piece of the teaching and learning process. One term that we have found useful in describing these types of pedagogical approaches is playful learning because recent definitions have attempted to draw together different elements and bodies of evidence around student-centered learning. For example, in one recent definition, playful learning is described as learning experiences that allow for active student engagement, experimentation and iteration, social interaction, curiosity and joy, and meaningful connection to student experience.[126] Of course, at any given moment, students may not

experience all of these characteristics as they work through tough problems or master challenging skills. And educators have an important role to play in fostering this type of learning experience. Pedagogical practices that foster playful learning range from project-based learning—where children work on an extended project through which they master not only academic skills but also get the chance to develop intra- and inter-personal skills—to more personal learning experiences where students set their own goals and their learning journey is facilitated through interactions with teachers and peers.

Playful learning goes one step beyond simply making learning interactive, which might focus solely on involving students in activities without requiring conscious engagement or reflection or room for experimentation and iteration. Additionally, playful learning pedagogies regularly tap into student curiosity and interest to drive learning—affording students increased agency over what and how they learn, and structuring curricula so that they can discover and produce knowledge for themselves.[127] Learning skills through subjects, as previously mentioned, is also a classroom practice that can be done in a way that advances student-led inquiry. Take, for instance, the concrete example of a biology class that allows learners to explore diabetes in their communities. Here, students might develop their analytical writing abilities by drafting a policy brief, practice scientific thinking by designing an experiment, learn communication skills through interacting with community members, and practice taking another person's perspective when talking with patients—all the while gaining expertise on the function of human kidneys.[128]

"**Pedagogical practices that foster playful learning range from project-based learning—where children work on an extended project through which they master not only academic skills but also get the chance to develop intra- and inter-personal skills—to more personal learning experiences where students set their own goals and their learning journey is facilitated through interactions with teachers and peers.**"

Pedagogical approaches that characterize playful learning enjoy wide empirical support, with studies consistently demonstrating that they result in better student outcomes than do traditional pedagogies.[129] Research has shown, too, that these types of pedagogical approaches can effectively foster important noncognitive skills. In an extensive review of evidence on learning, Hilton and Pellegrino's 2012 report to the National Research Council finds that practices similar to those we detail above support both content knowledge acquisition and the development of interpersonal and intrapersonal skills.[130] They also point out that, more broadly, what works in fostering cognitive skills, such as problem-solving, aligns well with best practices in developing social and emotional skills.

Even in this exceedingly hands-on environment, however, teachers maintain a crucial role: they facilitate student learning. The psychologist Richard Mayer, an expert in the learning sciences and how to apply them in education, has conducted and reviewed many studies that compare the outcomes of students learning entirely on their own or with teacher facilitation. He consistently finds that children who have a teacher to guide their learning perform better in all areas—from problem solving to computer programming—showing that students need both enough freedom and "enough guidance so that their cognitive activity results in the construction of useful knowledge."[131] Ultimately, teachers need to substantially complement lecture-focused teaching with pedagogical practices that characterize playful learning experiences.

As we move from good to best in the leapfrog pathway, learning is increasingly driven by student interest and need, and teachers increasingly assume the role of facilitator.

Lecture-Based:

Students play virtually no role in deciding what and how they learn. Instruction largely involves the transmission of knowledge from teacher to student, where a teacher presents information for students to remember as fact. Teachers are valued as the sole source of knowledge in the classroom.

EL MAESTRO EN CASA ("TEACHER AT HOME")
by El Maestro en Casa

Organization Type: NGO
Location: Costa Rica, Dominican Republic, Guatemala, Honduras, Panama
Innovation Spotter: Graduate XXI/IDB

El Maestro en Casa is an NGO-led distance education program designed to provide primary and secondary education opportunities to youth and adults in rural zones who were unable to start or finish their studies. Central to this model are radio-based lectures, which are accessible anywhere learners have a radio signal. These lectures are supplemented by self-paced textbooks and optional tutoring hours at central learning centers.

Interactive:

Students play little role in deciding what and how they learn, though they may sometimes be able to choose among a predetermined set of learning activities. Instruction might involve student participation in discussions, activities, or group-based work. Teachers are usually the source of knowledge in the classroom, though students sometimes share their own knowledge and experiences.

CLAY INTERNATIONAL SECONDARY SCHOOL (CISS)
by Project Education Inc. (PEI)

Organization Type: NGO, Individual school
Location: Kenya
Innovation Spotter: R4D

CISS is a free secondary school that infuses the Kenyan national curriculum with lessons on character development, citizenship, and emotional well-being. Classes emphasize active student participation, with frequent group-based activities and discussions. The school has served nearly 130 low-income learners, boasting a 98 percent graduation rate and a 47 percent college matriculation rate.

Playful:

Students play an active role in deciding what and how they learn. Instruction regularly involves a wide array of hands-on pedagogies that allow students to explore, hypothesize, argue, collaborate, and create. Teachers guide students as they discover and create meaning for themselves. Learning is more and more experiential, social, and based on students' own reality. At the same time, students have the opportunity to abstract and imagine others' realities.

INNOVA SCHOOLS
by Innova Schools

Organization Type: Private sector company, Chain of schools
Location: Peru
Innovation Spotter: Graduate XXI/IDB

Innova Schools is a chain of low-cost private schools that focus on blended learning (online and in-class learning). Students spend 70 percent of the day in classrooms of 30 students; the other 30 percent is spent in a computer lab working at their own pace on individual learning plans. During the group instruction portion of the day, students work in small teams to tackle challenges related to curricular topics. When they move to the computer labs, students use online learning tools like Khan Academy and develop individual projects focused on their interests and learning needs, with teachers circulating throughout the labs to facilitate and provide occasional support. Additionally, the school teaches design thinking to learners: once each year, students work in groups to apply their content knowledge to community social problems and design human-centered innovations. Reaching a total of 9,000 learners, Innova Schools have promising evidence of success. On average, schools in the Innova network score 34 percentage points higher on mathematics and 38 on reading than national averages on Peru's government assessments.

## Recognition of Learning: Increasingly Individualized

How learning is recognized often frames how teachers teach inside their classrooms, what schools measure, and how institutions such as employers and universities select which young people to accept. Hence any attempt to leapfrog teaching and learning practices needs to go hand-in-hand with shifting practices in how to assess and certify learning. We have identified two elements of recognizing student learning, both of which concern authentically aligning student classroom experiences with the real-world contexts in which they will be expected to use their skills.

Although most employers intend to hire employees based on what they can do, to date most have relied on proxy measures of candidates' competencies—namely, degrees and diplomas. In schools, students' progress is often based on how long they spend in their classes, combined with whether they met at least a minimum level of content mastery. In the end, they are awarded a diploma that signifies the time they spent learning and, to some extent, the knowledge they acquired. But it rarely captures the full range of their competencies. New models for recognizing student learning are emerging today, such as expanding the types of skills and abilities against which teachers track student growth, allowing for progression once a skill is developed, and demonstrating competence directly to employers—in other words, approaches that increasingly recognize individual differences in students' learning and skills.

Figure 4

Recognition of Learning: Increasingly Individualized

Predetermined:
Learners progress based on time and age in a linear fashion.

Predetermined

Group-based:
Learners progress based on ability, to a limited extent. They can sometimes move between groups of similarly-leveled peers.

Predetermined

Group-based

Individual-based:
Learners progress individually as they demonstrate mastery of content. They move fluidly between learning groups and may have the option of designing their own assessments and pathways.

PROGRESSION

VERIFICATION

Education-led:
Educational institutions mediate the verification process. Employers and postsecondary institutions recognize diplomas and other certifications from formal institutions.

Hybrid-led:
Educational institutions mediate the verification process, in collaboration with employers and postsecondary institutions. Employers and postsecondary institutions recognize diplomas and other certifications with the knowledge that they have contributed to students' educational programming in some capacity.

Education-led

Industry-led:
Employers and postsecondary institutions mediate the verification process. Employers and postsecondary institutions find ways to directly recognize learners' knowledge and skills that are of particular relevance to their job or further course of study.

Hybrid-led

Education-led

"However, [age-graded progression] largely treats age as one of the most important determinants of student ability. By providing limited flexibility in how we recognize learners' abilities, we erase individual difference between learners—both struggles and strengths."

Progression

In most learning environments, students are grouped into age grades, where they learn together and at the same pace. There is a linear progression from one grade to the next, and students move together through their classes and onto the next grade. Within this context, assessments are frequently used to determine whether a student can move to the next age grade—for example, students may be required to repeat a grade if they do not achieve passing marks in their courses. However, this system largely treats age as one of the most important determinants of student ability. By providing limited flexibility in how we recognize learners' abilities, we erase individual difference between learners—both struggles and strengths.

Research from learning sciences consistently shows that one of the most impactful teaching practices is continuously assessing student ability in order to appropriately tailor academic content.[132] Matching teaching with student needs is equally important for fostering social and emotional skills.[133]

Proponents of ability-based progression often talk about "mastery-learning" or "competency-based" learning, which are pedagogical approaches widely examined in contemporary research.[134] Broadly defined, these efforts focus on providing differentiated supports to ensure that learners master needed skills, developing novel assessments that can capture this mastery across both academic and interpersonal and intrapersonal skills, and devising progression mechanisms that give students the time they each need to master a skill.[135] Useful assessment practices that can help more authentically reflect students' competencies across a broad range of skills include things such as self-assessments and peer assessments, computerized adaptive quizzes, and student portfolios. Preliminary evidence suggests that these approaches to assessment, which focus on what a learner can do with her knowledge, lead to improved learning outcomes.[136]

As we move across our leapfrog pathway, programming increasingly allows learners to progress based on individual knowledge and need.

Predetermined:

Time and age primarily determine what students learn and how they move through the learning environment, with students' skills and abilities playing a secondary role.

KIBERA SCHOOL FOR GIRLS
by Shining Hope for Communities

Organization Type: NGO, Chain of schools
Location: Kenya
Innovation Spotter: R4D

Kibera School for Girls offers tuition-free primary education for the most vulnerable girls in the slums of Kibera, Kenya. The two NGO-led schools seek to foster both the academic and social development of disadvantaged girls, with a particular emphasis placed on mentorship and psychosocial support networks. The schools utilize hands-on pedagogies and small, age-graded classes. Learners enter the program in pre-K, at age 4, and graduate when they reach the 6th grade. The schools have served 279 learners, and boast that every 2nd grader can read a grade-appropriate English paragraph – compared with just 15 percent of 2nd graders nationwide.

Group-Based:

Teachers sometimes address individual differences by allowing learners to infrequently move between ability groups in an age-graded setting. To a limited extent, ability determines what students learn and how they move through the learning environment.

READ INDIA
by Pratham Education Foundation

Organization Type: NGO
Location: India
Innovation Spotter: InnoveEdu, R4D, WISE

Read India is an NGO-led program that provides remedial literacy and numeracy education to primary-aged children. Trained volunteers support full-time staff members in "learning camps" across India, where learners are grouped by ability rather than age. Read India pioneered this ability-level approach in Indian remedial education, known as "teaching at the right level." Teachers provide learning activities and materials tailored to each group's reading and mathematics abilities. In total, more than 400,000 learners have been reached, and randomized control trials demonstrated that children in Read India programming gain between 0.9 and 1.3 levels in reading and mathematics, compared with control groups.

Individualized:

Teachers address individual differences by allowing learners to progress as they demonstrate mastery, regardless of the time it takes. Ability largely determines what students learn and how they move through the learning environment. Learners may be able to design their own assessments to prove that they have mastered a given topic and are ready to progress.

ALBERTON PRIMARY SCHOOL
by the South Australian Department of Education and Children's Services

Organization Type: Government, Individual school
Location: Australia
Innovation Spotter: OECD

Australia's Alberton Primary School focuses on promoting empathy, grit, inquiry, and independence through highly personalized learning experiences. Through the "Discovery" program, students collaborate on personal learning plans that allow them to determine what and how they want to learn. They identify topics of interest and propose learning projects that can be completed individually or in groups, where older learners develop leadership and empathy skills by mentoring younger learners with similar interests. As students' needs and interests evolve, they are able to design new learning pathways, identify new learning goals, and move between diverse interest and ability groups. Alberton serves 290 learners yearly, and its students consistently receive above-average results on state and national standardized tests.

Verification

However, it will not be sufficient to change how learning is recognized within the formal education system alone. At the end of the day, we seek to equip youth with the skills they need to thrive outside schools. In considering how we determine when students have learned what they need to know, then, our attention necessarily turns to employers and postsecondary institutions—those who ultimately need to determine whether youth are prepared for what comes after school. Currently, employers rely on the skills information they can glean from diplomas and credentials, accredited by formal systems of education, which may provide an indication of some of the skills graduates have but rarely showcase all the skills for which an individual employer is searching. Likewise, many universities depend on standardized test scores and grades, which can illuminate only a small slice of what students can do. In the end, educational qualifications act essentially as a proxy measure for individuals' skills, painting a broad picture of what students should be able to do for employers and postsecondary institutions.

There is increasing experimentation with how external actors recognize and verify students' learning, particularly vis-à-vis tools that will allow institutions and employers to verify the specific competencies they seek. These tools include badges, which are digital "representations of skills" that are issued and shared by a variety of organizations and individuals, and portfolios— physical or digital collections of student creations.

Other approaches make use of formal linkages with employers and postsecondary institutions, allowing these actors to have a voice in what students learn and how they are assessed. Through these connections with individual educational programs, employer and postsecondary institutions can screen candidates with greater confidence in the specific skills their diplomas represent.

A focus on competency is certainly not a novel concept in all sectors. Take the arts, for example. The world's top ballerina would not be barred from auditioning for the Royal Ballet in London if she did not have a degree in dance; nor do great painters need a master's degree in fine arts before they can be exhibited in top museums. Technology industries have begun to make this approach quite visible, as well; where one would usually need a computer science degree to demonstrate that he or she has the skills required for a coding job, code storage platforms like GitHub and badge-enabled coding games like CodeFights are allowing learners to directly demonstrate their skills to employers. In both these sectors, we see what education will have to emulate across the board: systems in which education institutions no longer serve as proxies for the labor market or postsecondary education. This ultimately opens up multiple pathways for students to demonstrate their individual abilities.

As we move across our leapfrog pathway, educational programming increasingly forms partnerships with actors from outside the formal system to determine if students have the particular skills and abilities for which they are looking.

Education-Led:

Educational institutions decide what skills and competencies will be taught and how they will be assessed. They determine when learners have acquired these skills and competencies. Employers and postsecondary institutions recognize diplomas and other certifications from formal institutions. Diplomas and other certifications serve as proxy measures of student competencies, and verification is mediated by educational institutions.

ENVIRONMENTAL CHARTER HIGH SCHOOL (EHCS)
by Environmental Charter Schools

Organization Type: NGO, Chain of schools
Location: U.S.
Innovation Spotter: Ashoka Changemaker Schools

ECHS is a free, public secondary school that teaches academic and 21st-century skills through a focus on environmental problem solving. Students learn by designing solutions to environmental, social, economic, and cultural challenges around the globe. Classes place special emphasis on college readiness, and content is aligned with the government-designed Common Core State Standards. Students receive diplomas accredited by the California Department of Education and the ACS Western Association of Schools and Colleges – the same bodies that accredit traditional California public schools. ECHS consistently ranks in the top 10% of California schools based on annual test scores.

Hybrid-Led:

Employers and postsecondary institutions provide some input on the skills and competencies that will be taught and how they will be assessed. Educational institutions ultimately determine when learners have acquired these skills and competencies. Employers and postsecondary facilities recognize diplomas and other certifications with a good understanding of the exact competencies that learners should have developed. Diplomas and other certifications serve as proxy measures of student competencies, and verification is mediated by educational institutions.

SCHOOL-BUSINESS PARTNERSHIPS
by Al Jisir and INJAZ Al Maghrib

Organization Type: NGO
Location: Morocco
Innovation Spotter: Ashoka Fellows, WISE

Dreamed up by a former banker, the School-Business Partnerships program links private sector companies with individual schools to improve the quality and relevance of Moroccan education. Companies are invited to "adopt" schools, providing both financial and technical support through School Support Committees composed of business leaders, administrators, teachers, students, and parents. These committees conduct collaborative, in-school needs assessments, and they develop three-year action plans for school improvement. Business leaders lend their strategic and managerial expertise to school administrators, fund school improvement projects, participate in classroom and extracurricular activities, and offer advice on incorporating business skills into the curricula at the national, municipal, and school levels. Additionally, through INJAZ Al-Maghrib, businesspeople advise students as they develop and pilot small businesses and facilitate workshops on entrepreneurship, financial literacy, and life skills. Students at these schools receive a regular diploma accredited by the Moroccan government, but they study a curriculum developed in collaboration with employers. The program has served more than 150,000 students across 300 public schools.

Industry-Led:

Employers and postsecondary institutions decide what skills and competencies are needed and how they will be assessed. They directly determine if learners have acquired these skills and competencies. They may form partnerships with educational institutions or leverage online platforms to plan and execute this verification process.

GO FOR GOLD
by Go for Gold

Organization Type: NGO
Location: South Africa
Innovation Spotter: R4D

Go for Gold is a youth development program that pairs disadvantaged high schoolers with construction industry professionals for mentorship, work experience, life skills training, and employment. In their last year of high school, students interview with partner companies to secure an internship between secondary and post-secondary education. Participants then complete year-long internships while taking industry-designed professional and life skills classes. Employers evaluate interns according to on-the-job performance and demonstration of workplace competencies; if they are satisfied, they sponsor interns for post-secondary education. Upon completion of post-secondary education, partner companies hire the sponsored learner. Of the 330 learners who have participated, all have secured internship placements and 95 percent have successfully completed post-secondary programs.

Support Elements: Increasingly Diverse and Results Oriented

Providing assistance to the core elements to transform what and how children learn are support elements, which leverage more people and places and the power offered by technology and data. These support elements are fundamentally different, in that they are not necessary for educational transformation but often are very helpful, especially when considering the scale of educational challenges.

For example, it is quite possible for an innovation to support transformed teaching and learning through technology without leveraging more people—in addition to teachers—to assist in the learning process.

People and Places: Increasingly Diverse

Throughout history, education for young people has always taken place in a diversity of contexts: within the home, in artisans' workshops, and inside places of worship, to name a few. Children regularly rely on a wide array of people to prepare them with the skills they needed. Older siblings pass down knowledge, parents contribute their expertise inside schools, community members work with youth to solve community problems, and local businesses provide hands-on learning opportunities related to their industries. Education has intentionally utilized diverse contexts that include schools and online communities, but also community spaces, workplaces, and the

natural environment. In a world facing teacher shortages alongside a growing youth population, solving our twin problems will continue to be an all-hands-on-deck endeavor. Though leveraging more people and places is not required for transforming what and how children learn, we argue that the scale of our twin problems is so vast that leapfrogging will draw heavily on these supports.

People

Successfully leapfrogging in teaching, learning, and recognition depends a great deal on helping to unburden teachers and unleash their creativity. Arguments against tackling skills inequality and skills uncertainty together often include the feasibility of asking overwhelmed educators and school personnel to make large changes. This is certainly a valid concern, given that teachers in almost every country face a long list of responsibilities—from administrative duties to assisting with school-wide functions—that have little to do with helping ignite meaningful learning in their classrooms.[138] In one extreme example, the Pakistani government requires teachers to spend approximately 50 days per year on nonteaching duties, such as staffing vaccination drives and voting centers.[139] It is perhaps unsurprising, then, that the report *Millions Learning: Scaling Up Quality Learning in Developing Countries*, from the Center for Universal Education, found unburdening and

People and Places: Increasingly Diverse

Licensed teachers:
Licensed teachers bear the entire responsibility of teaching.

Licensed teachers

Teachers team with others:
Licensed teachers sometimes team with parents, students, and others.

Licensed teachers

Teachers team with others

Everyone:
Learning regularly involves community members, peers, parents, siblings, employers, and others, along with educators.

PEOPLE

PLACES

In a diversity of contexts:
Formal, organized learning that significantly uses multiple spaces, including schools, community spaces, and workplaces. In some cases, these may be informal learning spaces where the environments are transformed for learning.

Connected to outside school:
Learning is primarily organized in a formal setting, but may sometimes occur outside the school building and hours—online or in person.

Connected to outside school

In school:
Learning is formal, organized, and occurs inside a defined space and time (school day).

In school

In school

empowering teachers to be one of the key ingredients of successfully scaling up effective approaches to improving learning.[140]

For this reason, leapfrogging will require us to consider new ways to unburden teachers. This idea is reinforced by the Education Commission, which used the example of Chile to point out that teachers have an average of less than half a person supporting them in their work, compared with the five medical personnel supporting doctors.[141] Indeed, with its community health worker approach, the global health community provides a prime example of the power of tapping a diversity of people. Community health workers are community members who are

trained to take on various tasks previously carried out by physicians, such as administering vaccines or providing prenatal support. Supervised by a medical expert, they leverage their community knowledge and geographical flexibility to unburden doctors and scale up effective medical interventions—in effect, bringing the clinic to people rather than the people to the clinic.[142] In our pathway, we illustrate a similar effort in education to unburden teachers, bolster the education workforce, and ultimately facilitate leapfrogging.

As we move across our leapfrog pathway, educational programming increasingly leverages nonteacher actors to help unburden teachers and support learning.

Licensed Teachers:

Education relies on licensed teachers as the central figures facilitating children's learning.

PUDAMI NEIGHBORHOOD SCHOOLS
by Dr. Reddy's Foundation

Organization Type: NGO, Chain of schools
Location: India
Innovation Spotter: R4D

Pudami Neighborhood Schools enroll out-of-school children in English-medium basic education programs. Teachers are trained twice yearly to support students in transitioning to academic English from the students' native language, Telugu. Pudami schools emphasize teacher professional development with the belief that educators are ultimately responsible for student achievement. More than 10,000 learners have been served across over 30 neighborhood schools.

Teachers Team with Others:

Education sometimes includes nonteacher actors in facilitating children's learning. This could involve infrequent peer teaching, use of outside content experts, or community members leading learning groups.

AFLATOUN
by Aflatoun International

Organization Type: NGO
Location: Global – 109 countries
Innovation Spotter: Harvard GEII, R4D

Aflatoun is a financial and social education program developed by the Dutch NGO Aflatoun International. It offers highly flexible curricula for pre-school to teenaged learners, usually in formal education settings. The curricula, which focus on children's rights, money management, and enterprise, are adapted to local contexts by community partners. Aflatoun trains local teachers to deliver these curricula in formal settings, using active learning methodologies to develop youth skills for employability and entrepreneurship, including team work, creativity, and citizenship. Central to the Aflatoun model is the development of "children's clubs," which focus on peer-to-peer collaboration, problem-solving, and democratic leadership. Through these clubs, students teach and learn from each other as they start small businesses and lead community development projects. More than 4.5 million learners benefit from Aflatoun programming annually, and randomized control trial evidence found that the program's positive effect on financial habits was more than double that of the 25 other financial education interventions studied.

Everyone:

Education leverages a range of actors to unburden teachers and help support students' learning. This could involve learning projects facilitated by outside content experts or parent volunteers taking charge of administrative tasks.

THE LEARNER GUIDE PROGRAM
by Camfed International

Organization Type: NGO
Location: Ghana, Malawi, Tanzania, Zambia, Zimbabwe
Innovation Spotter: Harvard GEII

The Learner Guide Program trains young women who have participated in Camfed programming to serve as mentors and peer teachers in rural African schools. These women, known as Learner Guides, deliver a curriculum on self-awareness, resilience, discernment, and wellbeing. Additionally, these guides provide tutoring and informal mentorship support to local learners. Upon completion of the program, Learner guides receive access to low-risk, interest-free loans and qualify for fast-track teacher certifications. So far, 4,660 Learner Guides have served more than 250,000 students. An independent evaluation found that 91% of students surveyed reported that the Learner Guide Program positively affected their attitude towards school. Additionally, academic outcomes in Learner Guide schools improved by the equivalent of 0.5 effect size in English and 1.0 in mathematics.

Places

Classrooms are by no means the only place where children can develop the broad range of skills they need to thrive in an uncertain future. The OECD, in its detailed report *Innovative Learning Environments,* argues that "'school' and 'classroom' do not offer a satisfactory architecture for framing learning environments as they are essentially institutional and partial."[143] Instead, they prefer the concept of the "learning environment" to illuminate the types of educational approaches systems should use to effectively prepare students for the 21st-century. A learning environment can draw on experiences both in and out of school, with a range of content and people from whom to learn. In their analysis, the pedagogical core of a learning environment has four core components: learners; content; educators, from licensed teachers to others; and resources, from learning spaces such as buildings to digital resources and organized learning is carried out depending on the dynamics within that core from how time is used to how learners and teachers are grouped to what pedagogy used.[144]

Seamlessly finding ways for children to learn important skills both in and out of school is often referred to as "life-wide" learning. The literature on this concept emphasizes the small proportion of waking hours that children typically spend inside school. For example, in the United States, from birth to 18 years of age, children spend 20 percent of their waking hours in school.[145] Life-wide learning is defined by the OECD's Center for Educational Research and Innovation as learning that takes place "in multiple contexts, such as work, at home and in our social lives."[146] Proponents of life-wide learning use this information to argue that there is ample opportunity to creatively and thoughtfully expand the spaces in which children can learn. Indeed, opening up to new people and places for learning is one important way to quickly enrich young people's learning experiences that develop the broad range of skills they need to thrive in the future.

There is substantial evidence demonstrating how leveraging diverse settings to offer a wide range of extracurricular activities can help children learn, with special promise for interpersonal and intrapersonal skills. University College London's Centre for Longitudinal Studies recently published a report highlighting the strong association between participation in activities outside of school and positive outcomes in school attainment and social and emotional skills development—for rich and disadvantaged youth alike.[147] Their study emphasized the skills-building potential of activities occurring beyond school walls—both formal activities, such as music lessons in community centers, and informal activities, such as playing

"Indeed, opening up to new people and places for learning is one important way to quickly enrich young people's learning experiences that develop the broad range of skills they need to thrive in the future."

sports in a park. And a 2013 study from the German Socio-Economic Panel provides evidence that, controlling for an array of family variables, music training outside of school improves cognitive and noncognitive skills development and leads to higher performance in and engagement with school.[148] Analyses of non-formal education in the developing world have yielded similarly positive results; in Nicaragua, for example, researchers have shown that participation in academic programming outside of schools leads to higher learning outcomes and greater civic and social engagement.[149]

There is increasing interest in finding scalable ways in which children can learn academic and interpersonal and intrapersonal skills outside the classroom. This exploration has been largely driven by recent technological advancements. It can include everything from the tens of millions of people around the world taking open courses on Khan Academy or Ed-X to Sudan's Can't Wait to Learn program, which relies on gamified literacy courses, tablets, and community facilitators to teach out-of-school children. And using new applications of augmented reality, the same software that powers Pokemon Go can be used to turn any environment into an educational experience in which students can explore and learn from their surroundings.[150] But out-of-school learning is not limited to technology-enabled environments; for example, our colleague Kathy Hirsh-Pasek has designed physical spaces in supermarkets that boost children's language acquisition dramatically.[151]

As we move across the leapfrog pathway, educational programming increasingly leverages the potential of nonformal learning spaces to supplement classroom instruction.

In school:

Educational learning activities occur exclusively inside of formal education institutions, meaning schools or other locations that offer long-term, credential-based education. Learning is synchronous, occurring within a defined space and time.

KOPILA VALLEY CHILDREN'S HOME & SCHOOL
by BlinkNow

Organization Type: NGO, Individual school
Location: Nepal
Innovation Spotter: R4D

Kopila Valley Children's Home & School is a school and shelter for rural Nepali children, serving as a permanent home for over 45 youth. It offers a diverse, Montessori-inspired curriculum emphasizing creativity and critical thinking for students, nursery through 10th grade. The school has served 350 learners, and boasts impressive achievement figures: all 8th grade students scored in the top 10 percent of Nepal's nationwide exam.

Connected to Outside Schools:

Educational learning activities largely occur inside formal education institutions, but may include limited nonformal components. Learning may sometimes be asynchronous, occurring online and when the student chooses, or taken into nonformal spaces, such as community centers or museums.

UDAY COMMUNITY SCHOOL
by Gramin Shiksha Kendra

Organization Type: NGO, Chain of schools
Location: India
Innovation Spotter: Ashoka Changemaker Schools

Uday Community Schools are free, primary-level laboratory schools that seek to effect positive change in Indian education by modeling evidence-based pedagogies for low-income youth. The three schools serve 200 learners yearly and teach the Rajasthan state curriculum through a multi-grade teaching methodology that allows students to learn in small groups and at their own pace. Creative problem solving is at the heart of the Uday model, and students have the chance to apply their knowledge outside of classroom spaces through social projects in their villages. For example, learners have conducted surveys on local tobacco habits and shared the results on tobacco expenditures with village leaders. They have also traveled to government schools to teach other students the importance of sports for health and wellbeing. All Uday children pass Indian public assessments, as compared to 82% of students in other schools, and none drop out—a major accomplishment, considering that approximately 50% of Indian youth discontinue their studies after 10th grade.

In a Diversity of Contexts:

Educational learning activities occur in a range of places. Learning may sometimes be asynchronous, making meaningful and frequent use of nonformal environments, including online spaces, community spaces, or places of employment.

PEADS: PROGRAMA EDUCACIONAL DE APOIO AO DESENVOLVIMENTO SUSTENTÁVEL ("EDUCATIONAL SUPPORT PROGRAM FOR SUSTAINABLE DEVELOPMENT SUPPORT,")
by SERTA

Organization Type: NGO
Location: Brazil
Innovation Spotter: Ashoka Fellows

Peads is an NGO program operating in formal and non-formal education programs in rural Brazil to make learning more applicable to students and families in agricultural areas. Peads links classroom work with rural development needs by facilitating student-led research on issues related to agriculture, including innovative farming techniques and agricultural technology. Students venture out into their communities both during and after school to identify community needs and develop community-based projects that put academic skills into practice in local contexts. For example, students might research soil erosion on coffee farms, analyze the impact it has on coffee production, develop a plan to train farmers on soil conservation, and then evaluate the success of their intervention. Peads has reached over 130,000 learners across Brazil, and won 5th place in the Itaú UNICEF Education and Participation Awards – one of the highest distinctions for NGOs in Brazil.

Technology and Data: Increasingly Results Oriented

Technology and data are both important tools that can help education leapfrog to a breadth of skills for all learners. In both cases, however, more is not necessarily the answer. The potential of technology and data to support new learning experiences has progressively grown in recent years, with features such as real-time student feedback or augmented reality beginning to enter the mainstream. But both have also suffered from a legacy of getting in the way of intended outcomes rather than unleashing the potential of students, educators, and community members to achieve the desired results. As was the case with people and places, technology and data may not be required to transform what and how children learn. However, given the scope of our educational challenge, both can serve as powerful supports if deployed in meaningful ways.

Figure 6

Technology and Data: Increasingly Results Oriented

Substitution:
Technology acts as a direct tool substitute, with no functional change.

Substitution

Augmentation:
Technology acts as a direct tool substitute, with functional improvement.

Substitution

Augmentation

Modification and redefinition:
Technology allows for significant task redesign, or allows for the creation of new tasks that were previously inconceivable. Technology is integrated and embedded into learning.

TECHNOLOGY

DATA

Data for transforming learning experiences:
Collection and analysis of data in real time; data are used to evolve programs, increase transparency, and/or improve educational experiences and outcomes; data are less compliance oriented and may be less standardized.

Data for program improvement:
Infrequent collection and analysis of data. Data may be used to improve programming; limited use of data for improving learner outcomes.

Data for program improvement

Data for compliance:
Infrequent collection and analysis of data. Data is used for routine compliance.

Data for compliance

Data for compliance

Technology

One well-known framework for understanding how to effectively use technology in education is the SAMR model developed by Ruben R. Puentedura in 2006.[152] As a graduate student at Harvard University in the 1980s, working to redesign the undergraduate science curriculum, Puentedura began to reflect on the role of technology in education transformation.[153] His research seeking to understand whether technology practices or tech tools themselves mattered more for learning eventually led to the creation of SAMR, now widely used by education practitioners. The SAMR model focuses on four types of technology use in education: substitution, augmentation, modification, and redefinition.

The first two types of technology use, Puentedura argues, enhance the education currently being provided. In the first type, technology simply substitutes for the function of some other technology without changing what is fundamentally possible—for example, having students fill in digital versions of traditional worksheets. In the second type of use, technology becomes better integrated, augmenting a function. This might mean utilizing online worksheets that are automatically graded, freeing up teachers' time.

Puentedura argues that the last two types of use are fundamentally different: they move beyond tweaking the current educational model to truly enable educational transformation. For example, the third type of use, modification, could mean students using geographic information system mapping technology to transform and display census data in a social studies class. The fourth and final type of use is redefinition, where technology can do something previously inconceivable, such as expanding access to educational opportunities, amplifying active learning and allowing teachers and students to create and innovate themselves.

A number of recent studies of education technology highlight the importance of using technology for transforming learning; unfortunately, this does not characterize much of the impact of digital technologies on education to date.[154] The education and technology expert Michael Trucano argues that far too frequently, the approach to ICT in education has been "dump hardware in schools [and] hope for magic to happen."[155] In a detailed review of digital education technology in Latin America, he argues that while much of the rhetoric focuses on technology doing something that previously was inconceivable, "in actual practice technology has largely been used to support traditional teaching and learning practices."[156]

Recent research has shown that, when technology is used to enable playful learning experiences, it is much more effective in improving learning outcomes—especially for marginalized children. In a review of studies looking at technology for at-risk students in the U.S., Linda Darling-Hammond and her colleagues found that technology is generally not used productively for disadvantaged students. For these students, the focus is on improving core academic knowledge, and programs use approaches that only aspire for students to remember or understand content. Rather than the "drill-and-kill" computer exercises currently used, the authors find technology is successful when it is interactive, includes real-time feedback, and allows students to creatively apply what they learned.[157] Other academics argue that new technologies, such as virtual reality, have the potential to empower even more playful learning activities—allowing for more sophisticated opportunities for application, collaboration, and creation.[158] Using technology in this way can help drive student learning experiences toward what is needed if we are to leapfrog education: applying, evaluating, and creating knowledge.

As we move across our leapfrog pathway, educational programming increasingly uses technology to redefine and reimagine teaching and learning tasks.

Substitution:

Technology simply replaces existing tools without changing teaching or learning tasks in any significant way.

While a number of cataloged innovations appear to rely on technology as a substitute, their publically available program descriptions are too limited to accurately determine the technology practices in which they engage. For example, Girls' Improved Learning Outcomes (GILO) by KnowledgeBeat equips Egyptian classrooms with computers, but does not appear to train teachers to use this technology for any novel learning activities. But, lacking sufficient information, we have decided not to feature an innovation that may use technology for simple substitution.

Augmentation:

Technology replaces existing tools and makes teaching or learning tasks more significantly more effective, efficient, or meaningful.

MINDTAP
by CENGAGE

Organization Type:	Private sector company
Location:	Global – 125 countries
Innovation Spotter:	Graduate XXI

MindTap is a for-fee learning management system used by teachers across the globe. MindTap helps teachers lesson plan with a repository of adjustable readings, assignments, interactive multimedia, and quizzes. Teachers can also use the platform to monitor their students with real-time analytics on engagement, achievement, and satisfaction. It is a helpful administrative tool that augments classroom practices without redesigning existing tasks. It enables teachers to streamline assignments, organize class information, and identify topics that need additional instruction in order to address individual student needs. Internal reports indicate that MindTap can lead to increases in math (37 percent) and literacy (19 percent) achievement.

Modification and Redefinition:

Technology transforms existing limitations of current educational practice.

MINDSPARK CENTERS
by Educational Initiatives (EI)

Organization Type:	NGO
Location:	India
Innovation Spotter:	R4D

Mindspark Centers are technology-based remedial centers for underprivileged students who struggle with mathematics or Hindi. Students come daily for 90 minute sessions, spending half their time working on homework in small groups and the other half playing Mindspark—a computer-based adaptive learning game used in more than 100 elite Indian private schools. The program tailors content to students' language and mathematics levels and allows them to progress at their own speed. Through continuous assessment, it targets students' needs and automatically transitions learners between levels. Gamification and real-time content adaptation significantly modifies how students learn math and reading. Five learning centers serve 3,700 students. Experiments have demonstrated that Mindspark Centers produce gains in student learning equivalent to a 1.04 effect size in math and 1.23 in Hindi over six months.

Data

For data and evidence to support leapfrogging education, we need to move past a culture of collecting data without making it useful for improving systems, programs, and learning. Learners can certainly flourish even when data are not collected at all; but without data, it is hard to know if they are or not. This, however, leaves a large piece of data's potential untapped: it is ultimately best if programs continuously collect and apply data to drive student learning, evolve programming, and create transparent systems. Ultimately, to support leapfrogging, strategies that makes data increasingly integrated, meaningful, and transparent—empowering rather than distracting stakeholders, as they focus on student learning—is important. In *Millions Learning: Scaling Quality Education in Developing Countries*, our colleagues at the Center for Universal Education highlighted this dynamic in learning at scale. Examples of successfully-scaled education initiatives invariably made use of continuous feedback loops, in which data were not only collected but also frequently used to design, inform, and sustain programming.[159]

Digital technology has also influenced how we collect, analyze, and use data. Typically, education systems have collected data on school enrollment, expenditures, and other basic measures of inputs and outputs. More recently, education systems have also focused on measuring student learning to hold schools and systems accountable for ensuring their students master the basics.[160] Typically, however, most education data are not made public, are not disaggregated, and are not in a usable format.[161] Simply put, the promise of data and evidence have been limited; education has not yet made the shift from "data for compliance" to "data for learning."[162]

However, we are living amid what many have termed a "data revolution."[163] New technologies are allowing for vast amounts of data to be collected on everything from miniscule changes in atmospheric pressure to what you ate for dinner last night. They allow for ever advanced analysis techniques that can gauge public opinion as well as detect flu outbreaks.[164] The excitement around the potential for data to improve our lives and transform services has made its way to education, with many asking how we can better use data to track what is working, and hold our systems accountable.

Data and evidence can provide valuable support to leapfrogging education, empowering politicians, parents, and educators with information to transform student experiences. But this entails more than simply ramping up data collection efforts. As the UNESCO Institute for Statistics reports, data collection is counterproductive to the goal of supporting learning when the process leaves educators feeling overburdened.[165] The social accountability scholars Jonathan Fox and Joy Aceron take this one step further, noting that data are not useful when collected and disseminated exclusively in an upward direction, never to be seen by the collectors again.[166] In additional papers, Fox showed that behavior change only results from data that are explained or packaged so as to be understandable and actionable;[167] data collection and dissemination alone do not empower stakeholder action.[168] This concept of usability demands that interventions using data pay attention to form in addition to process, with a particular emphasis on data format, presentation, and comparability.[169]

In the vision of data and evidence that we set forth, these processes create a sort of self-driving machine that enables systems of all sizes to make decisions and continuously improve performance. The World Bank education specialist Husein Abdul-Hamid refers to this dynamic power of data to inform and transform systems as the "information cycle."[170]

As we move across the leapfrog pathway, educational programming increasingly integrates data to improve education experiences and outcomes.

Data for Compliance:

Data on educational inputs and outcomes are infrequently collected—these might include end-of-year assessments or annual financial reporting. They are used to determine if educational programs are meeting goals, but are not acted upon in a significant or timely manner.

Similar to our findings in the technology dimension, we note that innovations that do not make meaningful use of data do not tend to include detailed descriptions of their data practices online. For example, we might infer that Lighthouse Community Public Schools, an American charter school network, uses data only for reporting to regulatory bodies because we do not see any mention of data-driven practices in online descriptions. But we have chosen not to feature such innovations for lack of available information.

Data for Program Improvement:

Data on education inputs and outcomes are collected a bit more frequently—these might include end-of-semester assessments or quarterly attendance logs. They are used somewhat regularly to inform high-level decisions and make program improvements. Though data on individual learners may be collected, they are rarely used to adjust teaching practices.

INTERNATIONAL VILLAGE SCHOOL (IVS)
by ConnectSwiss

Organization Type:	NGO, Individual school
Location:	Kenya
Innovation Spotter:	R4D

IVS is a low-cost private secondary school that offers high quality, participatory education to underprivileged Kenyan students. IVS monitors student performance on the Kenyan Certificate of Secondary Education to gauge how many students can apply for college and how many students are eligible for scholarships. In order to improve student results, IVS also gathers data on teachers through annual performance reviews focused on teaching style, student interaction, and accommodating individual needs. End-of-year data on IVS's 95 learners are collected annually to both measure success and improve programming. They show that IVS students score, on average, 26 percentage points higher on leaving exams than other students in the region.

Data for Learning:

Data on education inputs and outcomes are frequently collected—these might include end-of-unit assessments, daily uploads of attendance data to a parent information portal, or even technology-enabled, real-time assessments. These types of data are regularly used to adjust teaching practices, improve transparency, increase program efficiency, and better serve individual learners.

THE OPEN LEARNING INITIATIVE (OLI)
by Carnegie Mellon University

Organization Type: NGO
Location: Global – 214 countries
Innovation Spotter: WISE

OLI is an online learning platform for a wide range of courses that can be used either by students outside of formal education contexts, or by teachers for blended learning (online and in-class learning). OLI uses automatic tutoring, virtual laboratories, activity-embedded assessments, and continuous feedback to tailor content to meet student needs. As students complete learning activities, OLI collects real-time data to determine what material to present next, as well as the personalized corrections, suggestions, or cues that will be offered to the student. These data are continuously provided to the instructor and used to tailor teaching materials and alter teaching methodologies. More than 300,000 users have accessed OLI. Randomized control trial research confirm that self-directed OLI courses are as effective as traditional courses. When students use OLI materials in blended learning, they learn the same content twice as fast as they would in traditional classrooms.

The Role of Government Amid Expanding Options

Ultimately, the leapfrog pathway sets out a vision of expanding options for how to transform what and how children learn. Leapfrogging will of course look very different in different contexts. Although this pathway charts a course for forward-looking educators, we recognize that certain elements will be more relevant than others, depending on the situation young people face. One thing, however, that should remain an important feature across all contexts is the role of government. As previously discussed, leapfrogging will not be achieved if we undermine, un-intentionally or intentionally, governments' commitment to ensuring all children have a right to education. By adding an expanding set of options for how to approach education, governments can open up fruitful avenues for leaping ahead

that perhaps were closed before. However, an expanded menu of options should not be interpreted as a shift in the ultimate responsibility for educating all children. To achieve mass education, where every child in society has the opportunity to learn, governments must bear the ultimate responsibility. Mass education is, after all, a social project the purpose of which is not only to help individual children develop to their full potential but also to advance broader aims across society. Currently, nation-states remain the way in which society is organized, and until a time when that is no longer the case, governments are the only actors in society that have the duty to care for and protect every single young person, something neither civil society or the business community is currently bound to do.

5

The Potential to Leapfrog

What We Learned About the Education Innovations Community

Where is the education innovation community focusing its energy? We have illustrated the boundaries of the leapfrog pathway above with some examples of our cataloged innovations. However, it is also useful to examine the innovations collectively to give us insight into the scope and scale of the innovation efforts, how the education innovation community is treating the various elements of the leapfrog pathway, and how it is doing this work. Ultimately, this begins to help us understand the potential of the education innovations community to contribute to leapfrogging.

As previously discussed, we began our research by uniting 15 existing lists of education innovations to create a catalog of nearly 3,000 projects, programs, and schools. The lists we utilized come from actors we refer to as Innovation Spotters— organizations that are actively working to identify, highlight, and sometimes support education innovations throughout the world. We did not selectively choose which innovations to include in our catalog. Instead, we inputted and analyzed every intervention that these Spotters deemed to be innovative—that is, every intervention included on these 15 lists. Our only requirement was that the Spotter organization explicitly stated that they were identifying what they believed to be innovations. Figure 7 provides an overview of the information that we collected on each innovation and table 1 profiles the 15 Spotters included in our catalog.

Snapshot: Global Education Innovations Catalog

15
Sources

Innovation Spotter organizations with active lists of education innovations in 2016 and early 2017

166
Countries

From across the developed and developing world

4
Languages

Searched for lists in English, Spanish, Mandarin, and Portuguese
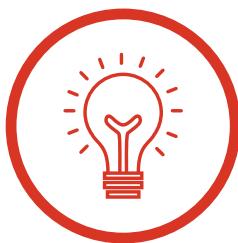
2,855
Innovations

Including NGO projects, for-profit products, government initiatives, and schools

Information collected on each innovation

DESCRIPTORS	Name of primary actor(s) and innovation | Country/countries and region(s) | Year established | Innovation goal(s) | Age(s)/schooling level(s) targeted | Skill(s) or subject(s) targeted | Population(s) targeted | Source list(s) | Whether currently active | Website link
IMPLEMENTATION DETAILS	Type(s) of implementer | Type(s) of funding | Effectiveness data | Scale | Cost
LEAPFROG PATHWAY CHARACTERISTICS	Learning | Teaching | Progression | Veri ication | People | Places | Technology | Data

Table 1

INNOVATION SPOTTERS CATALOGED

Innovation Spotter	Number of innovations	Focus	Geography	Collaboration with Other Spotters
Ashoka Fellows[1] and Changemaker Schools	881	Supporting and highlighting social innovators working in education and schools that promote changemaker skills	Global	R4D, WISE, Harvard, OECD
R4D–CEI Program Database	756	Highlighting pro-poor innovations in developing countries	Low- and middle-income countries	Harvard, WISE, Ashoka, OECD, UNICEF
EdSurge Curriculum Products[2]	518	U.S.-based education technology organization that highlights EdTech products for teachers, parents, and school leaders	United States and global	InnoveEdu
WISE–ed.hub, awards, and prizes	249	Providing a platform to highlight innovations through the hub, funding proven models through awards and prizes	Global	R4D, InnoveEdu, Harvard, Ashoka
OECD Innovative Learning Environments	127	Studying and highlighting innovative school models from OECD member countries	OECD (high-income) countries	R4D, Harvard
Graduate XXI/IDB	122	Initiative to identify technology projects to improve education and graduation in Latin America	Latin America	
HundrED Finnish 100	100	Highlighting and studying 100 innovations currently taking place in Finnish schools	Finland	Ashoka
InnoveEdu	98	Highlighting initiatives and classifying their approaches, including technology products and low-tech programs	Global	WISE, EdSurge
USAID and mEducation 2016	65	Supporting innovations in literacy through the All Children Reading grand challenge, and highlighting practices through the mEducation Alliance	Low- and middle-income countries	
UNICEF–Innovation Fund and Mapping	61	Highlighting innovations through its mapping, and funding programs through its fund	Low- and middle-income countries	R4D
Harvard Global Education Innovations Initiative	56	Identifying and highlighting best practices for 21st-century learning	Global	WISE, OECD, R4D, Teach for All
Teach for All–Alumni Incubator	47	Supporting alumni from the Teach for All partner countries to create and scale up innovations	Global	Harvard
Development Innovation Ventures[1]	10	Invests in innovations that solve challenges in developing countries	Low- and middle-income countries	
Humanitarian Education Accelerator	8	Financing, mentoring, and providing evaluation support to humanitarian innovators with the goal of scaling up effective education solutions for youth in emergencies	Education in emergencies	
Global Innovation Fund[1]	2	Invests in innovations that meet challenges in developing countries through grants	Low- and middle-income countries	

[1] These lists included innovations from other sectors. We cataloged only those entries relevant to education.

[2] We chose to catalog only the curriculum products from EdSurge's larger index, which consists of over 2,300 products, so as not to dilute the contributions of other Innovation Spotters and also due to the time it would take to include all of the innovations in the EdSurge list.

Scope and Scale

Innovations in the catalog range widely in their scale, from tiny schools that have served only a dozen learners to massive online platforms like Duolingo, which has more than 150 million registered users. Roughly one-third of cataloged innovations report data on the total number of learners they have served. Of these, more than three-quarters have reached at least 1,000 learners, and 30 percent—320 innovations—have served 50,000 or more. These data reveal that the Spotters' criteria for scale in innovation are quite diverse; their focus is not limited to small pilots, and they are not only seeking large-scale and established interventions.

There Is a Strong Desire for Innovation in Rich and Poor Countries Alike

One of the most striking features of the innovations in the catalog is how geographically diverse they are. With 166 countries represented in our catalog, education innovation is clearly taking root almost everywhere—in poor and rich countries alike.

There are 41 countries with 20 or more education innovations featured in the catalog, and they hail from some of the poorest countries in the world— such as Afghanistan and Nepal—to some of the wealthiest—such as Canada and Australia—and everywhere in between. Of the 15 countries with 50 or more innovations, there is also a wide mix of levels of economic development, ranging from Uganda to Finland. The two countries with the most innovations are India and the United States (figure 8).

The nations that appear most frequently in our catalog highlight a Spotter focus on large countries with widespread inequality in education and other contexts. But their appearance is also due, in part, to the geographical biases of some of our sources. For example, 76 percent of EdSurge's 518-item curriculum and product index is U.S.-based. And R4D's Center for Education Innovations, whose database accounts for 26 percent of our catalog, collaborated extensively with regional hubs in India, South Africa, Kenya, and Uganda. Despite this relative over-representation, however, we still note the sweeping geographic reach of our Innovation Spotters.

Figure 8

Where Are Innovations Occurring?
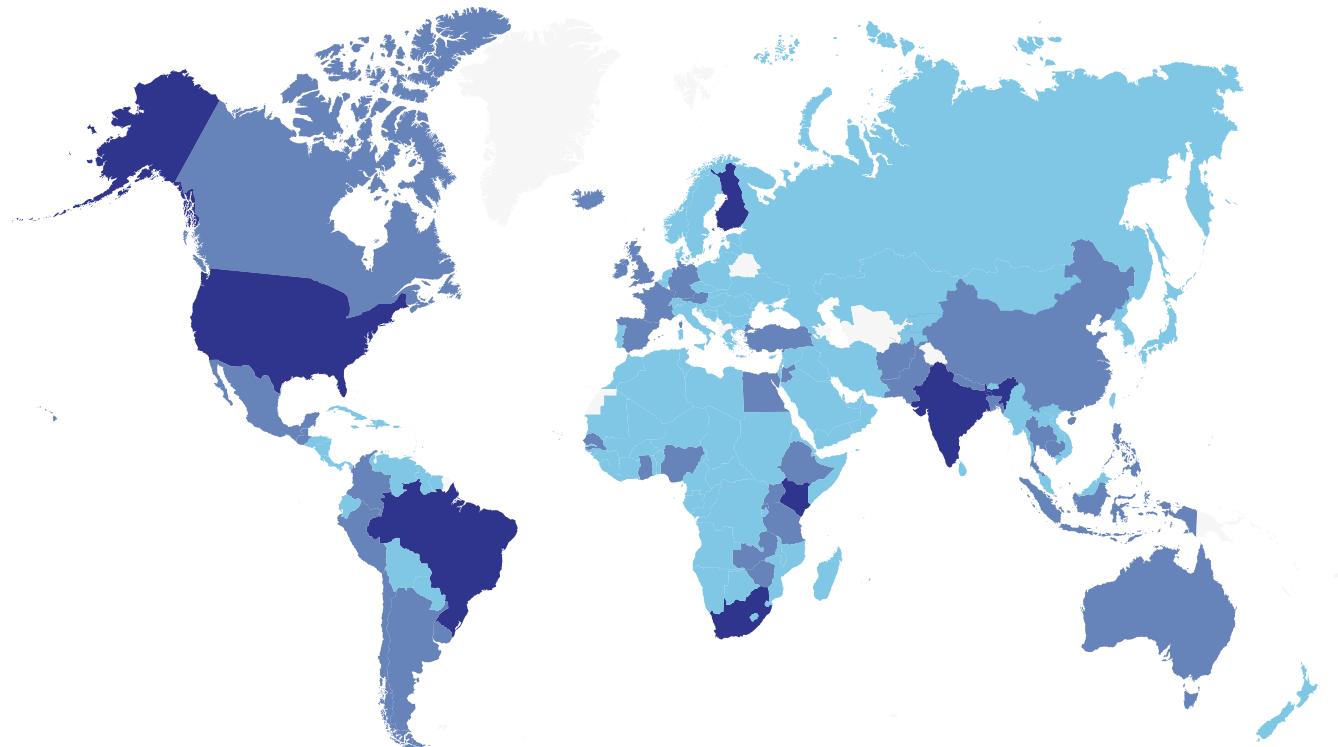
Countries with 20+ innovations

618 United States	**88** Mexico	**51** Australia	**38** Peru	**27** Nepal	**22** Senegal
320 India	**80** United Kingdom	**49** Tanzania	**38** Indonesia	**26** Jordan	**22** Afghanistan
187 South Africa	**74** Nigeria	**46** Rwanda	**38** Germany	**26** Austria	**21** Zimbabwe
167 Kenya	**66** Colombia	**46** Argentina	**37** Spain	**25** Turkey	**20** Uruguay
130 Brazil	**65** Canada	**45** Ghana	**36** Bangladesh	**24** Ireland	**20** Guatemala
120 Finland	**57** Pakistan	**42** China	**34** France	**24** Ethiopia	**20** Cambodia
94 Uganda	**55** Chile	**38** Thailand	**27** Zambia	**24** Egypt	

■ Countries with 100+ innovations　　■ Countries with 20-99 innovations　　■ Countries with 1-19 innovations　　□ Countries with 0 innovations

It is interesting to note that education innovators are searching for better approaches not only across poor and rich countries but also across those with strong and weak education systems. Looking to the countries that top the list, a number of them are considered underperformers. The United States is one example, because it consistently scores below the average of other OECD countries on the international PISA examination, particularly in math and science.[171] India, the second-most-highlighted country, performed so poorly on the 2009 PISA exam that it backed out of future participation.[172] Assessments of younger children in India's rural areas shows that fewer than half in fifth grade can read and about one quarter can do simple division.[173] Brazil is another underperformer, with PISA results that place 15-year-olds on par with middle-income countries in the region, such as Peru and Colombia, but far below the OECD average and middle-income countries elsewhere, such as Indonesia, Thailand, and Vietnam.[174] Similarly South Africa performs poorly on international assessments, and only 50 to 60 percent of primary students meet basic reading and math proficiency.[175] However, high-performers top the list as well. Kenya's per-capita income level is about a quarter of South Africa's, yet nearly all primary school children are proficient in literacy and numeracy.[176] Finland, sixth in our catalog, has embarked on a country-wide effort to identify and promote innovation while consistently topping international rankings. Kenya and Finland also show levels of equity in learning outcomes that are significantly higher than those of the U.S., South Africa, Brazil, and India.

There Is an Emphasis on Marginalized Communities

Interestingly, within the wide range of countries captured, there is a particular focus on the poorest children (figure 9). A majority of innovations, 57 percent, target marginalized populations—including low-income children, out-of-school children, orphans, girls, students with disabilities, ethnic minorities, child laborers, and children in crisis. Interestingly, the next greatest share of innovations in the catalog, at 33 percent, has no target population at all; these innovations are generally technology products that are released for general consumption, though a smaller piece of this category includes schools that do not seek to serve a specific type of learner.

Regardless of ascertaining their individual effectiveness, the innovations collectively point to the potential to be relevant in a wide range of contexts, including for those that are farthest behind.

Figure 9

Majority of Education Innovations Focus on Marginalized Students

- Marginalized Target Population
- No Target Population
- Other Target Population

57%
33%
10%
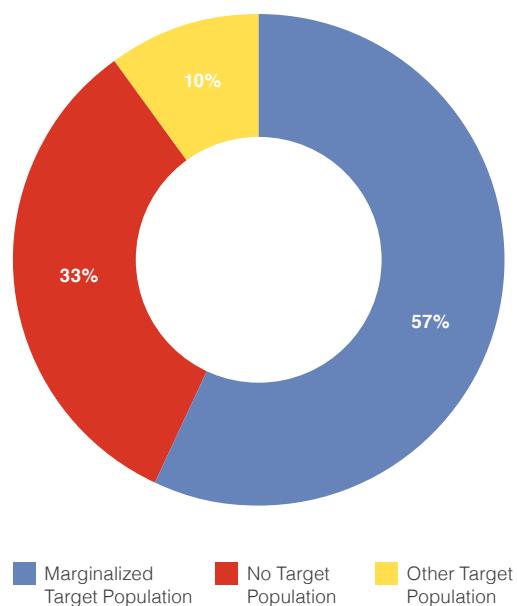
The Leapfrog Pathway

We cataloged such a large number of policies, programs, schools, and tools because we sought to gain insight into what potential current innovations hold for leapfrogging. What innovations are transforming teaching, learning and recognition, and are they reaching poor children? How do innovations creatively use people, places, technology, and data? Or, are the Innovation Spotters focused elsewhere, not illuminating the dimensions we see as critical to make the ultimate leap forward and solve the twin problems of skills inequality and uncertainty?

We found that the education innovation community is focused much more on some elements of the leapfrog pathway than others. The overwhelming focus of innovators is on transforming teaching and learning experiences, particularly by leveraging pedagogical approaches that involve playful learning. Despite this focus on teaching and learning, however, few innovations explicitly seek to develop teachers' skills. Instead, many seek to unburden teachers, relying on a range of strategies, including leveraging the power of technology and crowding in content experts from the community. There are also similar gaps in recognizing student learning and leveraging the power of technology and data. Very few innovations transform how students progress through and receive verification from educational programs. And technology is deployed largely as a support that substitutes or merely augments existing tools. Data, too, are rarely used; when they are, they do not significantly support transformation.

Most Innovations Focus on Improving Student Learning

The vast majority of innovations, approximately 81 percent, aim to improve learners' skills, and a much smaller number focus on improving educational access or teachers' abilities (figure 10). The predominant goal of innovations is to improve 21st-century skills—like critical thinking, confidence, and global awareness—and academic skills—like literacy, numeracy, and science (figures 11 and 12). A smaller number focus on improving vocational skills, including business skills or those associated with specific trades. Indeed, half of all innovations in the catalog have a goal of jointly improving both academic and 21st-century skills. Not surprisingly, the vast majority of innovations focus on helping students to not only remember information but also to understand it and ultimately use it to evaluate information and create new knowledge.

Innovations are taking many approaches to improve student learning, but one of the most popular, which is used in nearly three-quarters of all innovations, is to support pedagogical approaches that involve playful learning (figure 13). For example, the Indian company FunDa Labz sells building kits that teach math and science concepts through playful creation. Instead of learning about the human ear from a textbook, students might use a FunDa Labz activity kit to build and test a working model of an ear. Other innovations are individual schools identified for their hands-on and experiential practices, including Marla de Socorro

Figure 10

Primary Goal of Innovations

81% Improve skills
29% Improve access, attendance, completion, enrollment
23% Improve teaching

Figure 11

Skill Types Targeted by Innovations

62% 21st-century skills
61% Academic skills
21% Vocational skills

Rocha de Castro in Brazil. This municipal primary school is based on a "contextualized learning" model, in which students identify local phenomena they want to study and collaborate with teachers to develop multidisciplinary learning plans. Students might, for example, discuss the cultivation of a local plant, measure and calculate its average height, research and write about its history, and design an irrigation system to increase production. Still other innovations offer playful learning curricula to improve student skills. One such example is the nonprofit JASON, which provides a supplemental science curriculum that targets middle school science lessons. Learners who have access to a computer and a good internet connection go on science "missions," working with practicing scientists on projects, and doing tasks where they must apply their science knowledge to help solve a real-life problem, such as hurricane path prediction.

It is interesting to note that innovations aiming to improve learners' vocational skills use playful learning approaches more frequently than those that target academic skills. Certainly, vocational education has always had project-based learning at its heart, so perhaps this is not surprising. For example, Guatemala's Ak' Tenamit Internship Program is an NGO-led secondary education program for rural, indigenous Mayan youth that involves splitting time between the classroom and a series of internships, where learners apply the concepts learned in class. Unlike other technical schools in the country, where students have an average of between 200 and 250 hours of work experience, young people in Ak' Tenamit spend 3,000 hours working with numerous employers, a strategy that not only hones their skills but also helps them find the area in which they most want to work.

Specific Skills Targeted by Innovations

21ST-CENTURY SKILLS

32% Inter/Intrapersonal skills

26% Citizenship/Global Citizenship

18% Digital Literacy

ACADEMIC SKILLS

44% Literacy

41% Numeracy

32% Science
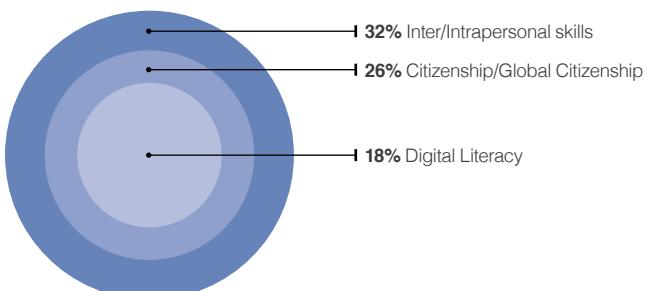
26% Other Academic Subjects*
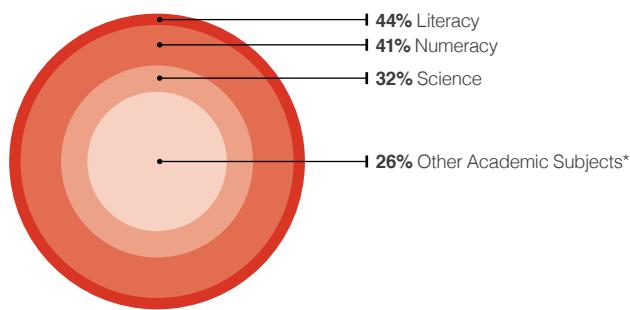
* Including social studies, foreign languages, etc.

Figure 13

Innovations that Use Playful Learning Approaches
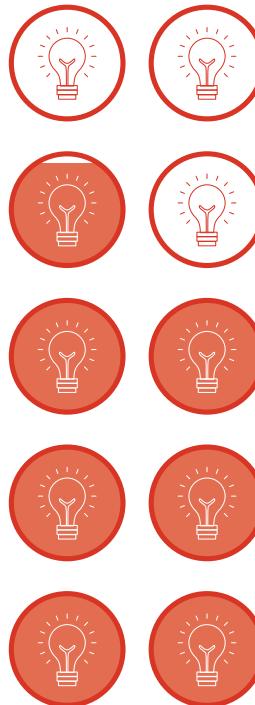
69%

OF INNOVATIONS USE PLAYFUL LEARNING APPROACHES

Little Focus on Recognizing Student Learning

Although many innovations are focused on transforming students' learning experience, very few are focused on transforming the flip side of the process: how learning is recognized. A very small number of innovations are experimenting with either progression through students' learning careers or means of verifying learners' skills and abilities. Only 15 percent have moved toward more individualized and flexible methods of progression. These generally rely on the power of technology to provide real-time feedback and adapt content to learners' needs. Some of these innovations are supplemental digital curricula delivered by for-profit companies, such

as Reading Plus. This reading intervention offers flexible assessments and adaptive instruction that adjust to a student's reading level and interest. Others are learning applications based on mobile phones or tablet computers that create flexibility through gamification. For example, BuzzMath allows learners to create an avatar and progress through various math concepts as they complete competency-based "missions."

An exceedingly small share of innovations—2 percent—complement education-led credentialing with skills verification by employers or postsecondary institutions. Unsurprisingly, these interventions largely focus on employability skills, including basic academic knowledge, industry-specific competencies, and interpersonal

and intrapersonal skills like collaboration and grit. For example, Enactus Senegal offers Senegalese university students the opportunity to collaboratively design and lead community development projects. Teams of students have developed products like solar ovens and designed management handbooks for farm cooperatives. As students initiate their projects, they participate in life-skills workshops and receive feedback and career guidance from industry professionals. In order to combat youth unemployment, Enactus Senegal established linkages with corporations and local businesses. These partners closely monitor student projects and the skills they develop, offering job interviews to promising candidates.

However, few interventions transforming verification are actually providing education within the formal system. Instead, they are often for-profit programs that collaborate with employers, largely in the technology space, to train learners of any age. A prime example of this model is CodeFights— an online coding game that allows any user to complete challenges based on particular programming concepts. As the user wins challenges of increasing difficulty, he or she is invited to apply to top technology companies that are looking for coders with those specific skills.

This begs the question of how far innovations in teaching and learning can go without the requisite shifts in how students' learning is recognized. As previously discussed, our catalog relies entirely on publicly available program documents and descriptions. It is possible that some innovative models are, in fact, working to change how learning is recognized but are simply choosing not to highlight this piece of their efforts.

Many Innovations Help Unburden Teachers, but Far Fewer Support Their Professional Development

Almost 40 percent of innovations are employing various creative strategies to unburden teachers. One tool in this arsenal is reaching out to new people and places to help transform students' learning experiences. Teachers are actively incorporating community members—from employers to artists— into their classrooms to serve as content specialists, aides, or other sources of support. Through the Educurious Expert Network, for example, teachers can set up virtual lessons with experts working in fields related to students' projects and interests. And the global Getting Ready for School program trains older children to help younger learners successfully transition to primary school in areas where a formal preschool is not available. A teacher trains these older students, who then use planned playful activities to develop children's school readiness skills.

A more common approach, however, is using technology to remove administrative tasks from teachers' plates. In fact, more than 80 percent of innovations that seek to unburden teachers in some way make use of technology. These include interventions such as classroom management tools, online lesson repositories, and even adaptive games. For example, LDC Core Tools, developed by an American nonprofit, offers frameworks and templates for lesson planning and assessing in line with Common Core State Standards. And in Chile, the nonprofit eMat offers online, interactive mathematics games and activities aligned with national curricular standards. Teachers serve as facilitators, assigning learning units to individual students and tracking performance using an online dashboard.

One of the most common types of unburdening tools featured in our catalog are learning management systems. These software tools support teachers in delivering and tracking lessons, and often facilitate communication between teachers, students, and parents. One such example is Fuel Education, which enables teachers to curate online curricula from an open-source resource library. Teachers can then assign customized lessons to individual learners and receive real-time analytics on student learning. Most of the cataloged learning management systems are being used in developed nations— and particularly the U.S. This mirrors a broader trend in unburdening teachers: the vast majority of unburdening innovations are used in developed countries, and nearly half are used in the U.S.

However, despite the multitude of approaches to unburdening teachers, a surprisingly small percentage of innovations have the explicit goal of supporting the professional development of teachers. In making this claim, we considered any innovation that mentioned in its program language that it provided professional development opportunities or otherwise sought to improve teachers' skills. As noted above, only 23 percent of innovations focus on teacher development. One such effort is the Fabretto Children's Foundation's Early Education Program from Nicaragua, which trains public preschool teachers to use play-based pedagogies. The foundation also shows teachers on how to use locally available supplies to develop their own creative teaching resources. Another is the Rwandan Teacher Training Colleges, which offer an online training courses for secondary school teachers. Training modules focus on preparing educators to integrate new teaching practices and technologies into their classrooms.

Most Innovations Using Technology and Data Do Not Focus on Transformation

Surprisingly, given the rhetoric about technological innovation, leveraging technology and data to help transform education is of relatively limited focus within the innovations cataloged. Just over half the innovations use technology at all, and most of them do so in a way that aims to either substitute or augment existing practice. For example, the online library CommonLit offers free educational content, including books, short stories, poems, and news clippings. The site offers convenient access to reading materials classified by ability level, but it does not allow learners to interact with these texts in any new ways.

Only 20 percent of the innovations using technology aim to do so in a transformative way that redefines and extends what is currently possible in standard education practice. For example, the INQuiry Intelligent Tutoring System relies on real-time assessment and artificial intelligence technology to develop students' inquiry skills. Through its online science learning environment, students complete virtual labs that challenge them to lead the inquiry process, from hypothesis generation to communicating their findings. The platform automatically collects data on student progression and inquiry skill development—using algorithms to identify, for example, if a student has designed a controlled experiment. These data are continuously fed into an online teacher portal, which provides class-wide and individual performance metrics. Teachers receive real-time mobile alerts on student skills progression, coded by urgency and level of support needed, to allow them to target and

assist individual students while they learn. An artificial intelligence inquiry coach named Rex the Dinosaur uses these student performance data to provide real-time tutoring, scaffolding student learning as needed if a teacher is not available. Another intervention is iCivics, a nonprofit civic education platform that houses role-playing games and interactive digital tools that place students in the shoes of public servants. And the Swedish company WriteReader seeks to help young learners improve their literacy skills by creating a platform where they can write and post their own digital books. Readers, usually parents or teachers, can help correct mistakes using the online story hub.

Innovation is similarly scarce in the context of data; only 16 percent of cataloged interventions regularly use data to drive learning and program outcomes. In fact, most innovations share no information about their data practices. The few that are using data to transform student learning rely heavily on novel technologies, with a particular focus on real-time assessment through gamification. A good example of this sort of intervention is Dragon Box, an award-winning series of math applications. In role-playing games like Big Numbers and Elements, students learn and practice mathematic concepts while data, collected in real time, are used to determine information presented to learners and how they advance through the story. Another is Sokikom, a collaborative math game that allows learners to progress at their own pace as they demonstrate understanding. Teachers can use an online platform to track students' achievement in real time and assign specific modules to meet learners' needs.

A selected number of innovations working on large-scale data transparency were highlighted, including the LINK School Performance Review and the Karnataka Learning Partnership. The former is a community-driven process, implemented in Sub-Saharan Africa, that helps district education officials collect data on teaching and learning, school leadership, and other education metrics. It then collaborates with educators and community members to develop data-based school and district improvement plans. The latter is a Web-based platform that allows stakeholders in India's Karnataka state to share information about their public schools to galvanize systems change.

How Innovations Are Implemented

Leverage Expertise of Nonprofits and the Business Community

The innovations are implemented by a mix of education actors. As figure 14 shows, the smallest share of the innovations, 12 percent, are the result of government policy or initiatives and implemented by ministries of education, including government schools. For-profit companies, largely those in the edtech space, lead the next largest share of innovations, at 26 percent of the catalog. However, nonprofits in civil society are by far the most common type of actor, implementing more than 60 percent of the innovations in the catalog.

Mixed Sources of Financing

Many innovations are financed by multiple sources (figure 15). Philanthropic foundations, governments, for-profit investments, and user fees each support between 25 and 30 percent of the innovations in the catalog. Donations, largely from individuals or communities, support 20 percent of the innovations, and by far the smallest contributor is international aid dollars, which only support 11 percent of the innovations. Each of these financing sources support a wide variety of innovations—from funding schools to afterschool music enrichment to in-school robotics labs. The exception is user fees, which are largely charged by technology-enabled programs delivered by for-profit companies. In fact, more than half of innovations that charge fees are software products such as mathematics applications or course management platforms. In contrast, we note that few of these fee-charging innovations are private schools.

Public-Private Partnerships Are Being Used by Many

It is interesting to note that roughly one-fifth of the catalog is some type of public-private partnership (PPP). Broadly defined, PPPs are collaborations between government and nongovernment actors involving the provision and financing of education services. In the case of our catalog, these are almost exclusively nongovernment programs that engage with government actors for little more than funding. More specifically, 78 percent of the 554 cataloged PPPs all over the world are financed by governments and are delivered by nonprofits (figure 16). These include many charter schools and online teacher support tools.

A much smaller share of these PPPs are privately-financed government programs (17 percent), though the smallest share belongs to for-profit interventions (15 percent). The latter of these two PPP models—delivered by for-profits—is most common in the U.S., where various federal agencies provide funding support to companies developing education technology products through the Small Business Innovation Research program.

Figure 14

Types of Organizations Delivering Innovations
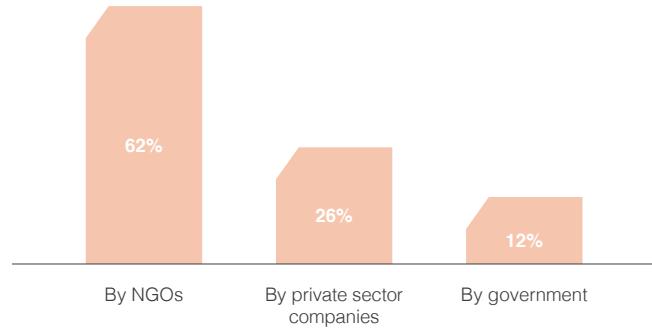
Figure 15

Innovation Financing Sources

62% By NGOs

26% By private sector companies

12% By government

29% Foundations

27% Fees

26% Governments

23% Private sector investment

20% Donations

11% Aid
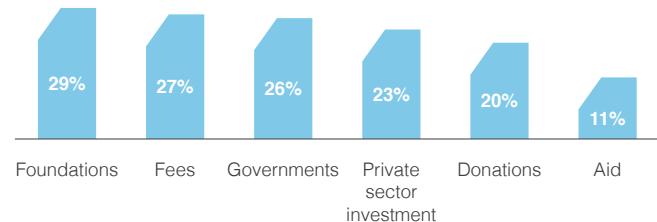
Figure 16

Types of Organizations Delivering Innovations through PPPs

77% Delivered by NGO

17% Delivered by government

15% Delivered by private sector companies
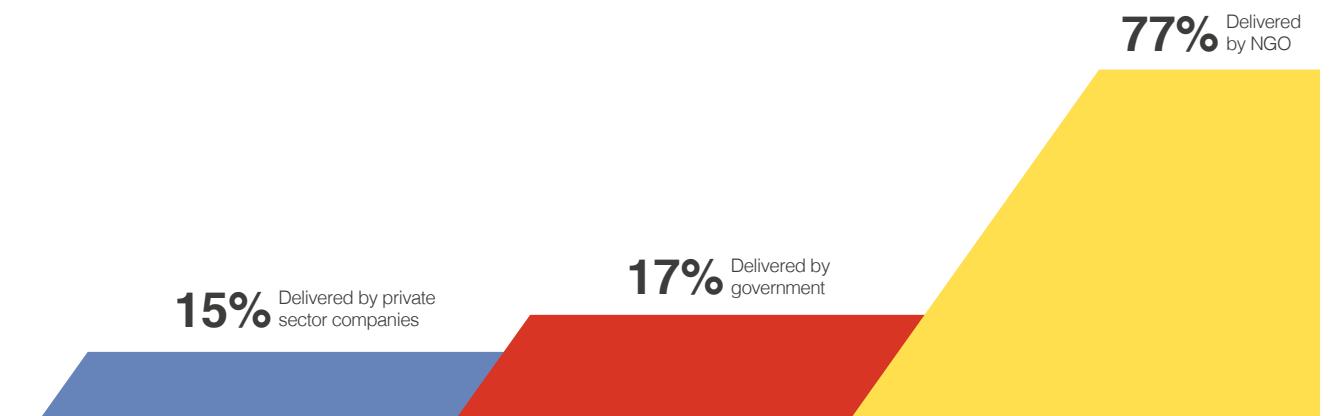
Publicly Available Data

Just over 900 innovations in the catalog, approximately one-third, make evidence on the effectiveness of their innovations publicly available. However, the question arises as to why the other two-thirds of the innovations do not. For this analysis, we used an extremely generous definition of evidence, counting randomized control trials, external evaluations, and internally reported data—even qualitative statements on program efficacy. Of the innovations that publicly present effectiveness data, roughly 57 percent do so based on internal monitoring and evaluation data.

We may be able to frame this gap as an issue of transparency or prioritization, rather than one of program efficacy. Five of our Innovations Spotters required some level of impact evidence before including an innovation on their lists. These five sources, which constitute almost one-third of the catalog, are Development Innovation Ventures, Global Innovation Fund, Humanitarian Education Accelerator, USAID and mEducation, and R4D's Center for Education Innovations. Additionally, 140 innovations appear on Spotter sublists that require evidence of success—the WISE awards finalists and winners, as well as the UNICEF Innovations Fund projects. All told, roughly 34 percent of the catalog comes from Spotters who required impact evidence. But of these innovations that clearly have evidence of impact, less than 40 percent of them actually make their data public (figure 17).

In total numbers, many innovations in the catalog have effectiveness data available. However, this reluctance by most of the innovations we cataloged to either share publicly their existing data on impact or perhaps to not collect effectiveness data at all poses a serious limitation for the potential of innovations to help leapfrog education. Educators and students, as well as governments and investors, need to have a clear idea of how innovations are having an impact to be able to further leverage their programs.

Innovation Spotters

This cataloging exercise revealed much about Innovation Spotters' priorities—as well as their blind spots. Chief among these findings is that these innovation-spotting efforts are largely not overlapping. All told, 10 of the 15 cataloged lists collaborated in some capacity with at least one of the others. Yet only 207 innovations—just under 10 percent of the entire catalog—appear on more than one list. Only a handful of innovations appear on more than three of the lists, with some of the well-known favorites, including Read India, Escuela Nueva, Educate! Experience, and Can't Wait to Learn. Indeed, these innovations are some of the most well-studied interventions in our catalog. On average, however, Innovation Spotters are seeking to highlight newcomers: nearly half of all cataloged innovations were established within the last 10 years. Mostly, however, each Innovation Spotter seems to capture a distinct piece of the education innovation community.

Just as important as what our catalog highlights is what it misses. Conspicuously absent from the surveyed innovations are efforts targeting displaced children and youth, and those affected by armed conflict. Fewer than 4 percent, only 119 innovations, explicitly target conflict-affected or displaced young people. Looking at innovations'

Figure 17

Few Innovations Make Effectiveness Evidence Publicly Available

Global Innovation Fund
Humanitarian Education Accelerator*
Development Innovation Ventures*
Tech for All
Harvard GEII
UNICEF
USAID-mEducation*
InnoveEdu
HundrED
Graduate XXI / IDB
OECD
Ashoka Schools
WISE
EdSurge
Ashoka Fellows
R4D CEI*

33%

**With publicly
available evidence**

67%

**Without publicly
available evidence**

* Spotter Requires Evidence
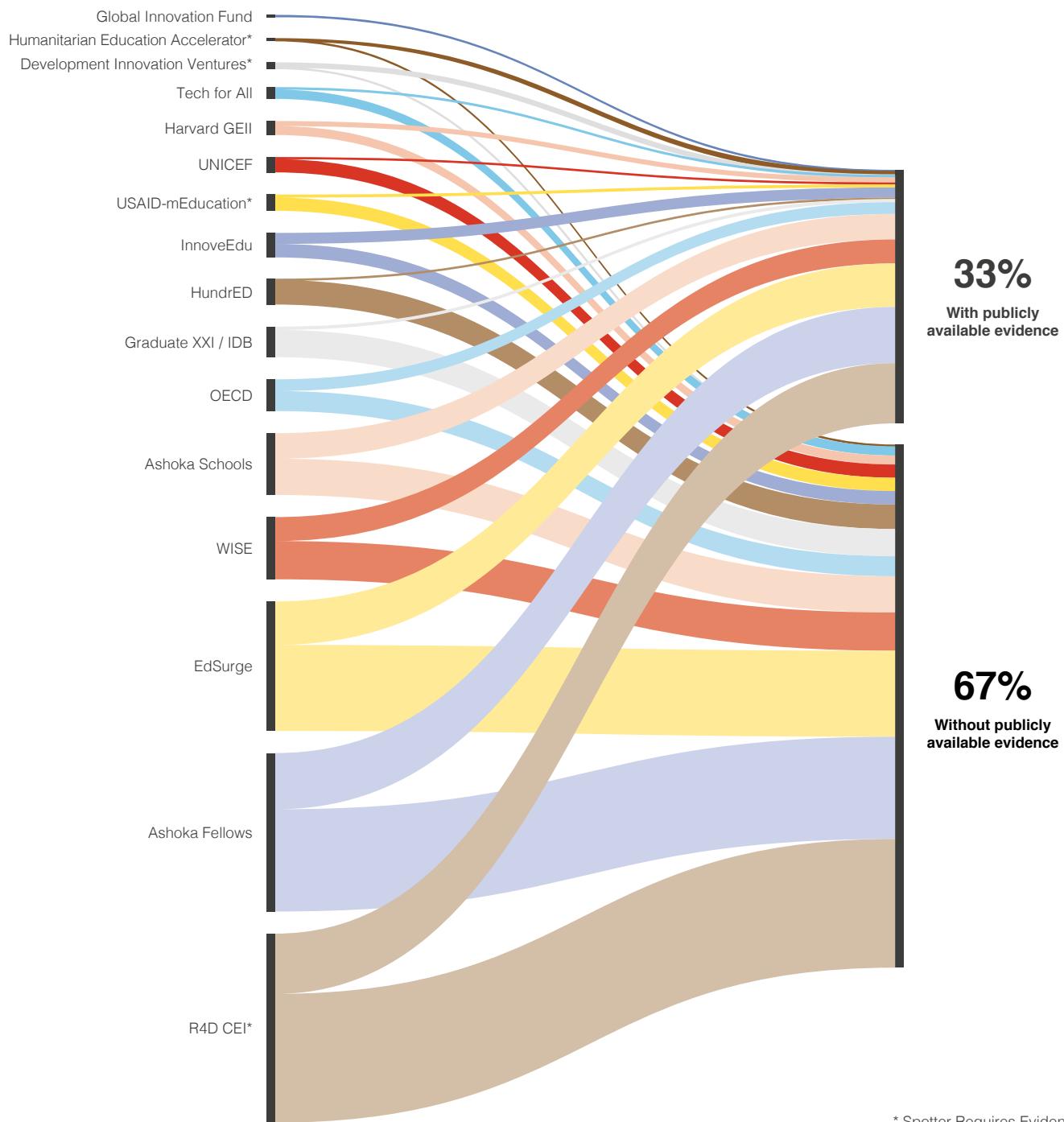
geographies reveals more of the same: 21 of the 35 countries on the World Bank's Fragile Situations list appear fewer than five times in our catalog, and seven do not appear at all.[179] The sole cataloged list focusing on education in emergencies, the Humanitarian Education Accelerator, highlights a total of just eight innovations. Undoubtedly, many education innovations do exist in these contexts. But for whatever reason, Innovations Spotters do not seem amenable to including them on their lists. We might consider that this has to do with the word "innovation" itself, which is used less in these more chaotic contexts. At a time when the world is facing the largest refugee crisis since World War II, the Innovation Spotters seem to be focused elsewhere.

Not to say that no innovation is happening in education in emergencies, but there is perhaps a disconnect between those looking at education in conflict and those looking at education innovations. In fact, the INEE Minimum Standards for Education: Preparedness, Response, Recovery, and the INEE Toolkit were recently recognized as one of 12 "Innovative Policies 2016" at the UN office in Vienna.[180] Further, many educational practices utilized in conflict align with the vision of innovative and holistic education that many in the community are working toward. For example, education in emergencies has long focused on psychosocial support in their education programs, which overlaps with and encompasses many areas of social and emotional learning that innovators are working toward in a variety of contexts.[181] The INEE, in fact, has created a resource list that includes more than 1,000 interventions, tools, and resources—many of which could be innovative and informative for innovators. However, they do not describe their list as a collection of innovations, instead framing their work as an effort to inform and empower governments and humanitarian workers as they provide education in emergency contexts.[182]

Learners with disabilities are also rarely the focus of interventions in the catalog. Fewer than 7 percent of interventions are intended for this population. This is quite notable when considering both technology's potential to level the playing field in learning and the relative prevalence of technology-based interventions in our catalog.[183] Yet we rarely see innovations that leverage the power of technology to improve disabled learners' experiences. In fact, only 75 of the 1,363 innovations that use technology to augment, modify, or redefine practices target children with disabilities.

Innovations developed and implemented by governments also seem to play a modest role in the lists of the Innovation Spotters. Only 12 percent of the innovations in the catalog are implemented by governments, even though one of the Innovation Spotters, the OECD, was solely dedicated to capturing government innovations. This, too, likely underrepresents the wide range of ways governments attempt to innovate in education. Similar to our hypothesis about children and youth in conflict, it could again be the case that governments are less prone to using the language of innovation to describe their interventions. Or it might be that the ways in which they innovate are simply not on the Innovation Spotters' radar screens. For example, the Japanese peer learning model for teachers, Lesson Study, did not make it on to any Spotter list. The model encourages teachers to share knowledge and skills with their peers as they collaboratively plan, observe, and critique each other's lessons each month. The absence of Lesson Study from Spotters' lists is quite surprising, given both the extent to which it has spread across the world and the robustness of its effectiveness evidence. A case study on implementation by the Zambian government, for example, demonstrated that students learning from Lesson Study teachers passed national science examinations at a rate 12.4 percent higher than their peers. In any case, it seems that Spotters' sights are not set on government-led innovations.

Conclusion

The education innovations community is energetic, diverse, and widespread. With the innovations profiled in our catalog taking root in more than 85 percent of the world's countries, there is clearly a movement afoot to experiment with the persistent Prussian model of schooling. Children from poor and wealthy families alike are participating in new approaches that are changing, with impressive results, how schooling is delivered, what is taught, and how teaching is done. Ultimately, we argue that this richness of education innovations holds promise for leapfrogging, and with it, addressing skills inequality and skills uncertainty, especially if the education innovations community can do a better job of tackling current gaps and governments can scale up effective innovations to help transform systems. In conclusion, we make three broad observations for how to help harness innovation to leapfrog education progress so that all children can develop the skills they need to thrive not only today but also in the changing world to come.

Innovations Hold Promise for Leapfrogging, but...

Numerous innovations have demonstrated, at small and large scales, that new approaches are not only possible but also effective, including in low-resource environments. For example, by providing a hands-on learning experience and an alternative pathway to crowd-in young, female talent to education, Camfed's Learner Guide program is not only building a pipeline of women teachers but also improving the academic learning outcomes of marginalized children and helping them develop important social-emotional and leadership skills for their future. Creative approaches to tackling skills inequality and skills uncertainty are not only flourishing in Tanzania, where the Learner Guide

program is in full swing, but also across Sub-Saharan Africa and around the globe.

These innovations hold great promise for leapfrogging. They demonstrate the numerous ways in which education can transform what and how children learn. The particular leap will depend on the context from which one starts, and there are ample examples of innovations that help improve skills inequality—especially for the most marginalized—and, separately, those that help improve skills uncertainty. However, perhaps what holds the most promise for education's ability to leapfrog are the numerous examples of innovations that enable marginalized children to simultaneously do both, namely, new approaches that help young people both improve their mastery of school subjects and develop the broader set of skills, such as learning to learn and teamwork skills, they need to thrive in an uncertain future.[184]

At their core, the sheer diversity of these innovations demonstrates that new ways of thinking about education are possible and are catching on. After all, mind-sets can stand in the way of leapfrogging as much as any other physical, legal, or financial barriers. In *Schools for 21st-century Learners*, Andreas Schleicher of the OECD argues that to help children learn, schools need to break free from long-held beliefs of how "things work best." Often, he claims, these beliefs are rooted in past behavior and experiences, and are deeply held and widely shared. What can be most difficult is that they are often accepted as indisputably correct. We argue that taken together, the leapfrog pathway and the innovations catalog have demonstrated that there is a viable set of expanded options that can enable us to collectively advance education—in particular, options that do not need to be limited by dominant logic or path dependence.

Key Gaps Will Need to Be Addressed, and...

The potential of the education innovations community to help leapfrog progress is limited, however, by several gaps. These gaps reflect a lower level of collective focus and prioritization in areas important for leapfrogging. We are particularly concerned with three main gaps:

- **Teachers and their professional development.** Supporting teachers' capacity to shift how they teach will be central to any successful attempts to leapfrog education. Any serious efforts to add playful learning approaches to classrooms and to foster breadth of skills will require teachers to develop and be comfortable with new strategies and approaches. Currently, less than one-quarter of the innovations in our catalog have an explicit aim of developing teachers' own skills and capacity, reflecting limited prioritization of this crucial piece of the leapfrog puzzle. In-depth discussions involving members of the education innovations community, along with teachers and teacher organizations, could help uncover why there is currently such a surprisingly limited focus on teachers, as well as steps that could help innovations do more to support teacher professional development in the future.

- **Recognizing learning.** In addition to helping teachers cultivate new sets of skills, shifting how learning is recognized also plays an important role in transforming the teaching and learning experience. How learning is recognized exerts powerful incentives on the learning experience and shapes how students progress through education as well as what types of educational experiences students and their parents, in particular

seek out. Given the strong focus of innovations on transforming the teaching and learning process and their comparatively limited focus on the recognition of learning, we argue that, collectively, the education innovations community may be missing a trick. Ramping up new approaches to recognizing learning, in line with the leapfrog pathway, could help support the changes aspired to by innovations working to transform teaching and learning.

- **Technology.** The promise of technology to be a tool to help transform what is possible in education is falling short in the innovations in our catalog. With most of the innovations that do use technology focused on using the tool to either substitute for or augment traditional practice, the education innovations community is not sufficiently leveraging technology to leapfrog education in a way that could help address skills inequality and skills uncertainty at the same time. Deeper discussions with the technology and education innovations communities could help highlight where the barriers are, why they exist, and what can be done

A Focus on Scaling Up Is Urgently Needed

The innovations we have canvassed demonstrate education's potential to leapfrog. But leapfrogging will not happen without a concerted focus on scaling up effective approaches. We will not achieve the transformational change needed to address both skills inequality and skills uncertainty with small islands of innovation. To do this, governments need to be much more engaged in how and when to bring innovative approaches into their ongoing efforts to encourage education system reform and improved management. Governments have an important role to play, as the

ultimate duty-bearer of children's right to education, in creating an enabling environment for new approaches to be tried and tested and, if effective, to be shared and scaled. With governments implementing only 12 percent of the innovations in our catalog, collaboration across government, civil society, and the private sector will play an important role in helping to scale up innovations with leapfrog potential.

To help foster this type of collaboration, the education innovations community needs to get serious about data. It needs to be businesslike about evaluating the effectiveness of its approaches and transparently sharing these data publicly. This effort must include collecting and sharing information on the cost-effectiveness of innovations—a crucial piece of information needed by governments, without which they can rarely act. It also includes committing to the ongoing use of data during their implementation efforts, thus seeing data as an asset to help continuously improve and, when needed, adjust course. This approach to data will support not only the effectiveness of the innovation but also the ability to understand and articulate to others how it works and under what conditions, which are pertinent to any conversation about scaling up. Although a number of innovations in our catalog are serious about data and share this information publicly, it is not a strong focus across the education innovations community. Only one-third of the innovations in our catalog collect effectiveness data and share them publicly, two percent do so for cost-effectiveness data, and 22 percent describe continuously using data to improve the implementation and results of their innovation. For governments, along with other scaling actors, to understand the different types of innovative approaches that could, in their context, be the best options for leapfrogging—whether in teaching and learning practices or in how to recognize learning— good and accessible data are essential.

Activities to support scaling up include helping governments, as well as other decision makers that play a role in scaling up—such as foreign aid donors, which are the least involved in the education innovations community—understand the vision of leapfrogging, the principles underlying the leapfrog pathway, how existing innovations could help provide an expanded menu of options for leapfrogging education progress, and where in a given context gaps remain. A useful first step here could be to form a partnership with our Millions Learning efforts to develop real-time scaling-up labs from which to learn from, and to document and support the process of scaling up through continuous, collective learning approaches, along with other scaling up initiatives. Finding mechanisms and approaches that connect those innovating in education with those designing and implementing policies is needed to ultimately effect broad systems change. Likewise, any catalog of innovations that seeks to provide constructive ideas and insights for leapfrogging to policymakers requires sifting through information to select what is most relevant, identifying ways to adapt effective approaches to the local context, and enabling timely and open conversations with a diversity of actors about approaches that have the potential to transform children's educational experiences.

After all, we know from previous Millions Learning research that two of the key ingredients for successful scaling in education are using data effectively and collaborating across government, civil society, and the private sector. Harnessing the potential of innovations to scale up new ways of tackling skills inequality and skills uncertainty deserves our collective attention and action. Leapfrogging in education ultimately may hold the best promise for rapidly improving children's chances to develop a breadth of skills and thrive in their future lives.

Bibliography

Abdul-Hamid, Husein, Sarah Mintz, and Namrata Saraogi. "From Compliance to Learning: A System for Harnessing the Power of Data in the State of Maryland." World Bank Studies. Washington, D.C.: World Bank, 2017. doi:10.1596/978-1-4648-1058-9.

Abdul-Hamid, Husein. "What Matters Most for Education Management Information Systems: A Framework Paper." Systems Approach for Better Education Results (SABER) Working Paper Series, Number 7. Washington, D.C.: World Bank, 2014. http://wbgfiles.worldbank.org/documents/hdn/ed/saber/supporting_doc/Background/EMIS/Framework_SABER-EMIS.pdf.

"About Us." Leap Innovations. Accessed June 02, 2017. http://www.leapinnovations.org/about-us.

Anderson, Benedict. Imagined Communities: Reflections on the Origin and Spread of Nationalism. London: Verso, 2016.

Anderson, Lorin W., Benjamin Samuel Bloom, and David R. Krathwohl. A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. New York: Longman, 2001.

Ansari, D., J. König, M. Leaskand T. Tokuhama-Espinosa. "Developmental Cognitive Neuroscience: Implications for Teachers' Pedagogical Knowledge." In Pedagogical Knowledge and the Changing Nature of ohe Teaching Profession, edited by S. Guerrero. Paris: OECD, 2017. http://dx.doi.org/10.1787/9789264270695-en.

Arntz, M., T. Gregory and U. Zierahn, "The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis." OECD Social, Employment and Migration Working Papers, No. 189. Paris: OECD Publishing, 2016. http://dx.doi.org/10.1787/5jlz9h56dvq7-en.

ASER. "Annual Status of Education Report (Rural) 2016." New Delhi: ASER, January 2017. http://img.asercentre.org/docs/Publications/ASER%20Reports/ASER%202016/aser_2016.pdf.

Autor, David H. "The 'Task Approach' to Labor Markets: An Overview." NBER Working Papers no. 18711. Cambridge, MA: National Bureau of Economic Research, 2013.

B. Hayes, Heather. "How Technology Is Helping Special-Needs Students Excel." EdTech. March 28, 2013. Accessed June 02, 2017. https://edtechmagazine.com/k12/article/2013/03/how-technology-helping-special-needs-students-excel.

Baker, David, Hilary Knipe, John Collins, Eric Cummings, Juan Leon, Clancy Blair, and David Gamson. "One Hundred Years of Elementary School Mathematics in the United States: A Content Analysis and Cognitive Assessment of Textbooks from 1900 to 2000." Journal for Research in Mathematics Education, Vol. 41, No. 4 (2010): 383-424.

Baker, David. The Schooled Society: The Educational Transformation of Global Culture. Stanford, CA: Stanford University Press, 2014.

Barro, Robert J. and Jong Wha Lee. "A New Data Set of Educational Attainment in the World, 1950-2010." Journal of Development Economics, Elsevier, vol. 104(C) (2013): 184-198.

Benassi, Victor, Elizabeth M. Tappin, Catherine E. Overson, Michael J. Lee, Edward J. O'Brien, Barbara Prudhomme White, Jennifer J. Stiegler-Balfour, and Christopher M. Hakala. "Applying the Science of Learning: The Cognition Toolbox." In Applying Science of Learning in Education: Infusing Psychological Science into the Curriculum, edited by Victor Benassi, Catherine E. Overson, Christopher M. Hakal. Society for the Teaching of Psychology, 2014.

Benavot, Aaron. "The Organization of School Knowledge: Official Curricula in Global Perspective." Academia. Accessed June 02, 2017. http://www.academia.edu/703588/The_Organization_of_School_Knowledge_Official_Curricula_in_Global_Perspective.

Benbow, Jane, Adela Mizrachi, Dan Oliver and Laisha Said-Moshiro. "Large Class Sizes in the Developing World: What Do We Know and What Can We Do?" American Institute for Research under the EQIP1 LWA, 2007. http://www.equip123.net/docs/E1-LargeClassrooms.pdf.

Benson, Carol. "School Access fir Children from Dominant Ethnic and Linguistic Communities." Paper commissioned for Fixing the Broken Promise of Education for All: Findings from the Global Initiative on Out-of-School Children. Montreal: UNESCO Institute for Statistics, 2015.

Benveniste, Luis, Jeffery Marshall, M. Caridad Araujo. "Teaching in Cambodia." Washington, D.C.: World Bank, 2008. https://openknowledge.worldbank.org/handle/10986/8073.

Benveniste, Luis, Jeffery Marshall, M. Caridad Araujo. "Teaching in Cambodia." Washington, D.C.: World Bank, 2008. https://openknowledge.worldbank.org/handle/10986/8073.

Bloom, Benjamin Samuel. Taxonomy of Educational Objectives: the Classification of Educational Goals. Handbook 1: Cognitive Domain. New York: David McKay, 1974.

Bogardus Cortez, Meghan. "Accessible Technology Helps Students with Disabilities Pursue STEM Degrees." EdTech Magazine. March 10, 2017. Accessed June 02, 2017. https://edtechmagazine.com/k12/article/2017/03/accessible-technology-helps-students-disabilities-pursue-stem-degrees.

Bold, T., D. Filmer, G. Martin, E. Molina, B. Stacy, C. Rockmore, J. Svensson, and W. Wane. "What Do Teachers Know and Do? Evidence from Primary Schools in Africa." World Bank Policy Research Working Paper 7956. World Bank, 2017.

Bonwell, Charles and James Eison. "Active Learning: Creating Excitement in the Classroom." ASHE-ERIC Education Reports. Washington, D.C.: ERIC Clearinghouse on Higher Education, 1991.

"Brazil Student performance (PISA 2015)." OECD Education GPS. Accessed June 02, 2017. http://gpseducation.oecd.org/CountryProfile?primaryCountry=BRA&treshold=10&topic=PI.

Broh, Beckett A. "Linking extracurricular Programming to Academic Achievement: Who Benefits and Why?" Sociology of Education (2002): 69-95.

Brynjolfsson, Erik, and Andrew McAfee. The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies. New York: W.W. Norton & Company, 2016.

Bush, Kenneth D., and Diana Saltarelli. The Two Faces of Education in Ethnic Conflict: Towards a Peacebuilding Education for Children. Florence, Italy: UNICEF, 2001.

C. K. Prahalad, and Richard A. Bettis. "The Dominant Logic: A New Linkage between Diversity and Performance." Strategic Management Journal 7 (1986): 485-501. doi:10.1002/smj.4250070602.

Canon, Maria E., and Elise Marifian. "Job Polarization Leaves Middle-Skilled Workers Out in the Cold." Federal Reserve Bank of St. Luis. January 2013. Accessed June 02, 2017. https://www.stlouisfed.org/publications/regional-economist/january-2013/job-polarization-leaves-middleskilled-workers-out-in-the-cold.

Care, Esther, and Kate Anderson. "How Education Systems Approach Breadth of Skills." The Brookings Institution, 2016. https://www.brookings.edu/wp-content/uploads/2016/05/brookings_how-education-systems-approach-breadth-of-skills_web_07-2016.pdf.

Care, Esther, and Kate Anderson. "How Education Systems Approach Breadth of Skills." Brookings Institution. August 18, 2016. Accessed June 02, 2017. https://www.brookings.edu/research/how-education-systems-approach-breadth-of-skills/.

Care, Esther, Helyn Kim, Kate Anderson, and Emily Gustafsson-Wright. "Skills for a Changing World: National Perspectives and the Global Movement." The Brookings Institution, 2017. https://www.brookings.edu/wp-content/uploads/2017/03/global-20170324-skills-for-a-changing-world.pdf.

Care, Esther, Kate Anderson, and Helyn Kim. "Visualizing the Breadth of Skills Movement across Education Systems." The Brookings Institution, 2016. https://www.brookings.edu/wp-content/uploads/2016/09/global_20160916_breadth_of_skills_movement.pdf.

Carnoy, Martin, Tatiana Khavenson, Leandro Oliveira Costa, Izabel Fonseca, and Luana Marotta. "Is Brazilian Education Improving? A Comparative Foray Using PISA and SAEB Brazil Test Scores." Higher School of Economics Research Paper No. WP BRP 22/EDU/2014, 2014. http://dx.doi.org/10.2139/ssrn.2539027.

Chabbott, Colette. Constructing Education for Development: International Organizations and Education for All. New York: Routledge, 2009.

Chanfreau, Jenny, Emily Tanner, Meg Callanan, Karen Laing, Amy Skipp, and Liz Todd. "Out of School Activities during Primary School and KS2 Attainment." Centre for Longitudinal Studies Working Paper 2016/1. London: University College London, April 2016.

Christensen, Clayton M., Michael B. Horn, and Curtis W. Johnson. Disrupting Class: How Disruptive Innovation Will Change the Way the World Learns. New York: McGraw-Hill, 2008.

Coleman, James S. "Families and Schools." Educational Researcher 16, no. 6 (1987): 32-38.

Covay, Elizabeth, and William Carbonaro. "After the Bell: Participation in Extracurricular Activities, Classroom Behavior, and Academic Achievement." Sociology of Education 83, no. 1 (2010): 20-45.

Cuban, Larry. How Teachers Taught: Constancy and Change in American Classrooms, 1890-1990. New York: Teachers College Press, 1993.

Cubberley, Ellwood P. Public Education in the United States. Cambridge, Massachusetts: The Riverside Press, 1947.

Darling-Hammond, Linda, Molly B. Zielezinski, and Shelley Goldman. "Using Technology to Support At-Risk Students' Learning." Stanford Center for Opportunity Policy in Education, 2014. https://edpolicy.stanford.edu/sites/default/files/scope-pub-using-technology-report.pdf.

Dean, Edwin. Education and economic productivity. Cambridge, MA: Ballinger Publishing, 1984.

DeSilver, Drew. "U.S. Students' Academic Achievement still Lags That of Their Peers in Many Other Countries." Pew Research Center. February 15, 2017. Accessed June 02, 2017. http://www.pewresearch.org/fact-tank/2017/02/15/u-s-students-internationally-math-science/.

Dewey, John. Democracy and Education. New York: Macmillan Company, 1944.

Dobbs, Richard, Anu Madgavkar, Dominic Barton, Eric Labaye, James Manyika, Charles Roxburgh, Susan Lund, and Siddarth Madhav. "The World at Work: Jobs, Pay, and Skills for 3.5 Billion People." McKinsey & Company, 2012. http://www.mckinsey.com/global-themes/employment-and-growth/the-world-at-work.

Dunleavy, Matt, and Chris Dede. "Augmented Reality Teaching and Learning." In Handbook of Research on Educational Communications and Technology, edited by Spector J., Merrill M., Elen J., Bishop M, 735-745. New York: Springer New York, 2014.

Echazarra, Alfonso, Daniel Salinas, Ildefonso Méndez, Vanessa Denis and Giannina Rech. "How Teachers Teach and Students Learn: Successful Strategies for School", OECD Education Working Papers, No. 130. Paris: OECD, 2016. http://dx.doi.org/10.1787/5jm29kpt0xxx-en.

Education Commission. "The Learning Generation: Investing in Education for a Changing World." International Commission on Financing Global Education Opportunity, 2016. http://report.educationcommission.org/report.

Education for All Global Monitoring Report. "Teaching and Learning: Achieving Quality for All." Paris: UNESCO, 2014.

"The Educurious Expert Network™." Our Solutions / Expert Network | Educurious. Accessed June 02, 2017. http://educurious.org/solutions/expert-network/.

Evans, D., and A. Popova. "What Really Works to Improve Learning in Developing Countries? An Analysis of Divergent Findings in Systematic Reviews." Policy Research Working Paper 7203. World Bank Group Africa Region. Office of the Chief Economist. Washington, D.C.: World Bank, 2015.

Fan, Lianghuo. "The Expansion of Education in China: 1949-1995." ERIC - Education Resources Information Center. February 28, 1997. http://files.eric.ed.gov/fulltext/ED411192.pdf.

"FGV opens Center for Excellence and Innovation in Education Policies." FGV Notícias. November 28, 2016. Accessed June 02, 2017. http://fgvnoticias.fgv.br/en/news/fgv-opens-center-excellence-and-innovation-education-policies#.

Fishman, Barry, Chris Dede, and Barbara Means. "Teaching and technology: New Tools for New Times." Handbook of Research on Teaching, (2015).

"Five Characteristics of Playful Experiences." LEGO Foundation. Accessed June 02, 2017. http://www.legofoundation.com/en-us/who-we-are/learning-through-play/play-characteristics.

Fletcher, Anne C., Pamela Nickerson, and Kristie L. Wright. "Structured Leisure Activities in Middle Childhood: Links to Well-Being." Journal of Community Psychology 31, no. 6 (2003): 641-659.

Fox, Jonathan, Joy Aceron, and Aránzazu Guillán. "Doing Accountability Differently. A Proposal for the Vertical Integration of Civil Society Monitoring and Advocacy." U4 Issue, Paper No.4. Bergen: U4 Anti-Corruption Resources Center, 2016.

Fox, Jonathan. "Social Accountability: What Does the Evidence Really Say?" World Development 72 (2015): 346-361.

Fox, Jonathan. "The Uncertain Relationship between Transparency and Accountability." Development in practice 17, no. 4-5 (2007): 663-671.

"Framework for 21st-century Learning." The Partnership for 21st-century Learning. Accessed June 02, 2017. http://www.p21.org/about-us/p21-framework.

Freire, Paulo. Pedagogy of the Oppressed. London, England: Penguin Books, 2017.

Friedman, Thomas L. Thank You for Being Late: An Optimist's Guide to Thriving in The Age of Accelerations. New York: Farrar, Straus and Giroux, 2016.

Frost, M. and A. Little. "Children's Learning Practices in Ethiopia: Observations from Primary School Classes." Oxford Review of Education, 40(1) (2014): 91-111. doi.org/10.1080/03054985.2013.873526.

Gamson, D. A., X. Lu, and S. A. Eckert. "Challenging the Research Base of the Common Core State Standards: A Historical Reanalysis of Text Complexity." Educational Researcher 42, no. 7 (2013): 381-91. doi:10.3102/0013189x13505684.

Gardner, Howard. Five Minds for the Future. Boston, MA: Harvard Business Review Press, 2009.

Global Education Monitoring Report. "Education for People and Planet: Creating Sustainable Futures for All." Paris: UNESCO, 2016. http://unesdoc.unesco.org/images/0024/002457/245752e.pdf.

Global Education Monitoring Report. "If You Don't Understand, How Can You Learn?" Policy Paper 24. Paris: UNESCO, February 2016.

Gordon Commission. "To Assess, To Teach, To Learn: A Vision For The Future Of Assessment." Princeton, NJ: Gordon Commission, 2013. http://www.gordoncommission.org/rsc/pdfs/

gordon_commission_technical_report.pdf.

Grant, Sheryl. "Promising Practices of Open Credentials: Five Years of Progress." Academia. Accessed June 02, 2017. https://www.academia.edu/31173947/Promising_Practices_of_Open_Credentials_Five_Years_of_Progress?auto=download.

Guerriero, Sonia. Pedagogical Knowledge and the Changing Nature of the Teaching Profession. Paris: OECD, 2017.

Gurstein, Michael B. "Open Data: Empowering the Empowered or Effective Data Use for Everyone?" First Monday 16, no. 2 (2011). doi:10.5210/fm.v16i2.3316.

Gustafsson-Wright, Emily, Katie Smith, and Sophie Gardiner. "Public-Private Partnerships in Early Childhood Development: The Role of Publicly Funded Private Provision." Washington, D.C.: Center for Universal Education at Brookings Institution, November 2016. https://www.brookings.edu/wp-content/uploads/2016/11/global-20161129-public-private-partnerships.pdf.

Hallgarten, J., V. Hannon, T. Beresford. Creative Public Leadership: How School System Leaders Can Create the Conditions for System-wide Innovation. Dubai: WISE, 2015.

Handa, Sudhanshu, Heiling Pineda, Yannete Esquivel, Blancadilia Lopez, Nidia Veronica Gurdian, and Ferdinando Regalia. "Non-formal Basic Education as a Development Priority: Evidence from Nicaragua." Economics of Education Review 28, no. 4 (2009): 512-522. doi:10.1016/j.econedurev.2009.01.001/.

Hansen, J., and P. D. Pearson. "An instructional Study: Improving the Inferential Comprehension of Fourth Grade Good and Poor Readers." Journal of Educational Psychology, 75, (1983): 821-829.

"Harmonized List of Fragile Situations FY 17." World Bank. May 9, 2016. Accessed June 02, 2017. http://pubdocs.worldbank.org/en/154851467143896227/FY17HLFS-Final-6272016.pdf.

Hattie, John. Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating To Achievement. London: Routledge, 2010. https://www.doi.org/10.23846/srs007.

Helft, Miguel. "Google Uses Searches to Track Flu's Spread." The New York Times. November 11, 2008. Accessed June 02, 2017. http://www.nytimes.com/2008/11/12/technology/internet/12flu.html.

Hiebert, J., R. Gallimore, H. Garnier, K. B. Givvin, H. Hollingsworth, J. Jacobs, A. M. Chui, D. Wearne, M. Smith, N. Kersting, A. Manaster, E. Tseng, W. Etterbeek, C. Manaster, P. Gonzales, and J. Stigler. Highlights from the TIMSS 1999 Video Study of Eighth Grade Mathematics Teaching. National Center for Educational Statistics U.S. Department of Education. Washington, D.C.: National Center for Education Statistics, 2003.

Hille, Adrian, and Jürgen Schupp. "How Learning a Musical Instrument Affects the Development of Skills." Economics of Education Review 44 (2015): 56-82.

Hilton, Margaret, and James Pellegrino. "Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st-century." National Research Council. Washington, D.C.: The National Academies Press, 2012. https://doi.org/10.17226/13398.

Hindman, Hugh D. The World of Child Labor: An Historical and Regional Survey. Armonk, NY: M.E. Sharpe, 2009.

Hirsh-Pasek, Kathy, and Roberta Michnick Golinkoff. "Transforming Cities into Learning Landscapes." The Brookings Institution (blog). November 02, 2016. Accessed June 02, 2017. https://www.brookings.edu/blog/education-plus-development/2016/11/02/transforming-cities-into-learning-landscapes/.

Hirsh-Pasek, Kathy, Roberta Michnick Golinkoff, Laura E. Berk, and Dorothy G. Singer. A Mandate for Playful Learning in Preschool: Applying the Scientific Evidence. Oxford University Press, 2009.

Howe, Jeff. Crowdsourcing: Why the Power of the Crowd Is Driving the Future of Business. New York: Three Rivers Press, 2009.

"INEE Wins Innovative Policy Award." Inter-Agency Network for Education in Emergencies. February 19, 2016. Accessed June 02, 2017. http://www.ineesite.org/en/blog/inee-wins-innovative-policy-award.

Inter-Agency Network for Education in Emergencies (INEE). "INEE Background Paper on Psychosocial Support and Social and Emotional Learning for Children and Youth in Emergency Settings." New York: INEE, 2016.

Inter-Agency Network for Education in Emergencies (INEE). "Minimum Standards for Education: Preparedness, Response, Recovery." New York: INEE, 2010.

International Commission on Education for the Twenty-first Century. "Learning: The Treasure Within." Paris: UNESCO, 1996. http://unesdoc.unesco.org/images/0010/001095/109590eo.pdf.

Kattan, Raja Bentaouet, and Miguel Székely. "Analyzing the Dynamics of School Dropout in Upper Secondary Education in Latin America: A Cohort Approach." World Bank Policy Research Working Paper 7223. World Bank, 2015.

Kattan, Raja Bentaouet, and Nicholas Burnett. User Fees in Primary Education. Washington, D.C.: Education Sector, Human Development Network, World Bank, 2004.

Keeley, Larry. Ten Types of Innovation: The Discipline of Building Breakthroughs. Hoboken, NJ: John Wiley & Sons, Inc., 2013.

Kingdon, Geeta. "Opinion | Indian Schools Are Failing Their Students." The New York Times. December 15, 2015. Accessed June 02, 2017. https://www.nytimes.com/2015/12/16/opinion/indian-schools-are-failing-their-students.html.

Kolb, David A. Experiential Learning: Experience as the Source of Learning and Development. FT Press, 2014.

Laabidi, Mohsen, Mohamed Jemni, Leila Jemni Ben Ayed, Hejer Ben Brahim, and Amal Ben Jemaa. "Learning Technologies for People with Disabilities." Journal of King Saud University-Computer and Information Sciences 26, no. 1 (2014): 29-45.

Leadbeater, Charles. The Problem Solvers: The Teachers, the Students and the Radically Disruptive Nuns Who Are Leading a Global Learning Movement. London: Pearson, 2016.

"Learning Metrics Task Force." Brookings Institution. May 11, 2017. Accessed June 02, 2017. https://www.brookings.edu/product/learning-metrics-task-force/.

Lieberman, Evan S., Daniel N. Posner, and Lily L. Tsai. "Does Information Lead To More Active Citizenship? Evidence from an Education Intervention in Rural Kenya." World Development 60 (2014): 69-83.

"Life Expectancy." World Health Organization. Accessed June 02, 2017. http://www.who.int/gho/mortality_burden_disease/life_tables/situation_trends_text/en/.

Lloyd, Cynthia B., Carol E. Kaufman, and Paul Hewett. "The Spread of Primary Schooling in sub-Saharan Africa: Implications for Fertility Change." Population and Development Review 26, no. 3 (2000): 483-515. doi:10.1111/j.1728-4457.2000.00483.x.

"Look before you leap." The Economist. August 06, 2016. Accessed June 02, 2017. https://brookings.idm.oclc.org/login?url=https://search.proquest.com/docview/1810528618?accountid=26493.

Lu, Jingyan, Susan Bridges, and Cindy E. Hmelo-Silver, "Problem-Based Learning." In The Cambridge Handbook of the Learning Sciences: Second Edition, edited by Keith Sawyer. New York, NY: Cambridge University Press, 2014.

"Madagascar." Education in Madagascar | Global Partnership for Education. Accessed June 02, 2017. http://www.globalpartnership.org/country/madagascar.

Marsh, Herbert, and Sabina Kleitman. "Extracurricular School Activities: The Good, the Bad, and the Nonlinear." Harvard Educational Review 72, no. 4 (2002): 464-515.

Mayer, Richard E. "Should There Be a Three-Strikes Rule Against Pure Discovery Learning? The Case for Guided Methods of Instruction." American Psychologist Vol. 59, No. 1 (2004): 14–19 DOI: 10.1037/0003-066X.59.1.14.

McDonald, Betty. "Self Assessment and Student-Centred Learning." ERIC - Education Resources Information Center, 2012. http://files.eric.ed.gov/fulltext/ED536980.pdf; Buzzeto-More, Nicole. "Assessing the Efficacy and Effectiveness of an E-Portfolio Used for Summative Assessment." Interdisciplinary Journal of E-Learning and Learning Objects, Volume 6 (2010): 61-85. www.ijello.org/Volume6/IJELLOv6p061-085Buzzetto691.pdf.

McGivney, Eileen, and Rebecca Winthrop. "Why Wait 100 Years? Bridging the Gap in Global Education." Washington: Brookings Institution, 2015.

McMahon, Walter W. "The social and external benefits of education." International Handbook on the Economics of Education (2004): 211-259.

McMurrer, J. "Choices, Changes, and Challenges: Curriculum and Instruction in the NCLB Era." The Center on Education Policy. Accessed June 02, 2017. https://www.cep-dc.org/displayDocument.cfm?DocumentID=312.

Menon, Naveen, Joel Nicholson, and Fouad Roukoz. "Rethinking K-12 Education: Defining a New Model." A.T. Kearney. Accessed August 1, 2017. https://www.atkearney.com/documents/10192/4540067/Rethinking K-12 Education.pdf/d385bd9b-b3af-4653-b5ea-727d2197ce98.

Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA). "Melbourne Declaration in Educational Goals for Young Australians." Carlton South, Australia: MCEETYA, 2008.

Mitullah, Winnie V., Romaric Samson, Pauline M. Wambua, and Samuel Balongo. "Building on Progress: Infrastructure Developments still a Major Challenge in Africa." Afrobarometer Round 6, Dispatch No. 69, 2016.

Miyamoto, Koji, M. Huerta, Katarzyna Kubacka, Hiroko Ikesako, and E. Oliveira. "Skills for Social Progress: The Power of Social and Emotional Skills." OECD Skills Studies. Paris: OECD, 2015. http://dx.doi.org/10.1787/9789264226159-en.

Moravec, John, and Arthur Hawkins. Leapfrog Initiatives. Accessed June 02, 2017. http://leapfrog.umn.edu/.

Moravec, John. Knowmad society. Minneapolis, MN: Education Futures LLC, 2013.

Murnane, Richard J., and Greg J. Duncan. Whither Opportunity? Rising Inequality, Schools, and Children's Life Chances. New York: Russel Sage Foundation, 2011.

Nathan, Mitchell J., and R. Keith Sawyer, "Foundations of the Learning Sciences." In The Cambridge Handbook of the Learning Sciences: Second Edition, edited by Keith Sawyer. New York, NY: Cambridge University Press, 2014.

New, Joshua. "Building a Data-Driven Education System in the United States." Center for Data Innovation, 2016. http://www2.datainnovation.org/2016-data-driven-education.pdf.

OECD. "PISA 2012 Results: Creative Problem Solving (Volume V): Students' Skills in Tackling Real-Life Problems." Paris: OECD, 2014. http://dx.doi.org/10.1787/9789264208070-en.

OECD. "Skills for Social Progress: The Power of Social and Emotional Skills." Paris: OECD, 2015.

OECD. Innovative Learning Environments. Educational Research and Innovation. Paris: OECD, 2013. http://dx.doi.org/10.1787/9789264203488-en.

Ostby, Gudrun, and Henrik Urdal. "Education and Conflict: What the Evidence Says." PRIO Policy Brief. Oslo: Peace Research Institute Oslo, 2011.

Pellegrino, James. "Teaching, Learning and Assessing 21st-century Skills." In Pedagogical Knowledge and the Changing Nature of the Teaching Profession, edited by S. Guerrero. Paris: OECD, 2017. http://dx.doi.org/10.1787/9789264270695-en.

Pritchett, Lant. The Rebirth of Education: Schooling Ain't Learning. Washington, D.C.: Center for Global Development, 2013.

Reardon, Sean F., and Ximena A. Portilla. "Recent Trends in Income, Racial, and Ethnic School Readiness Gaps at Kindergarten Entry." AERA Open, Vol. 2, no. 3 (2016): 1-18. doi:10.1177/2332858416657343.

Reimers, Fernando, and Connie K. Chung. Teaching and Learning for the Twenty-First Century: Educational Goals, Policies, and Curricula from Six Nations. Cambridge, MA: Harvard Education Press, 2016.

"Remedial education." The Abdul Latif Jameel Poverty Action Lab. Accessed June 02, 2017. https://www.povertyactionlab.org/scale-ups/remedial-education.

Resnik, Julia. "The Organization of School Knowledge: Official Curricula in Global Perspective." Rotterdam: Sense Publishers, 2008. http://www.academia.edu/703588/The_Organization_of_School_Knowledge_Official_Curricula_in_Global_Perspective.

Results for Development Institute (R4D). "Global Book Fund Feasibility Study: Final Report." Washington: R4D, 2016. http://pdf.usaid.gov/pdf_docs/PA00M8BK.pdf.

Robinson, Jenny Perlman, Rebecca Winthrop, and Eileen McGivney. "Millions Learning: Scaling up Quality Education in Developing Countries." The Brookings Institution. May 17, 2017. Accessed June 02, 2017. https://www.brookings.edu/research/millions-learning-scaling-up-quality-education-in-developing-countries/.

Rogers, Halsey. "The 'nini' youth of Latin America: Out of school, out of work, and misunderstood." World Bank. January 25, 2016. Accessed June 02, 2017. http://blogs.worldbank.org/education/nini-youth-latin-america-out-school-out-work-and-misunderstood.

Rose, P. M., Ricardo Sabates, B. M. Alcott, and I. S. Ilie. "Overcoming Inequalities within Countries to Achieve Global Convergence in Learning." Background Paper for Education Commission. Research for Equitable Access and Learning (REAL) Centre. Cambridge: University of Cambridge, 2017.

"Ruben Puentedura on Applying the SAMR Model." Common Sense Media: Ratings, Reviews, and Advice. Accessed June 02, 2017. https://www.commonsensemedia.org/videos/ruben-puentedura-on-applying-the-samr-model.

Ruben, Puentedura. "Transformation, Technology, and Education in the State of Maine." Ruben R. Puentedura's Blog. Accessed June 02, 2017. http://hippasus.com/blog/archives/18.

Santos, Indhira. "Labor market polarization in developing countries: challenges ahead." World Bank (blog). June 14, 2016. Accessed June 02, 2017. http://blogs.worldbank.org/developmenttalk/labor-market-polarization-developing-countries-challenges-ahead.

Sawyer, Keith, ed. The Cambridge Handbook of the Learning Sciences: Second Edition. New York, NY: Cambridge University Press, 2014.

Sawyer, Keith. "Conclusion: The future of Learning: Grounding Educational Innovation in the Learning Sciences." In The Cambridge Handbook of the Learning Sciences: Second Edition, edited by Keith Sawyer. New York, NY: Cambridge University Press, 2014.

Schuller, Tom, and Richard Desjardins. Understanding the Social Outcomes of Learning. Paris: OECD, 2007.

Smagorinsky, Peter, and Richard E. Mayer. "Learning to be Literate." In The Cambridge Handbook of the Learning Sciences: Second Edition, edited by Keith Sawyer. New York, NY: Cambridge University Press, 2014.

Snilstveit, Birte, Jennifer Stevenson, Radhika Menon, Daniel Phillips, Emma Gallagher, Maisie Geleen, Hannah Jobse, Tanja Schmidt, and Emmanuel Jimenez. "The Impact of Education Programmes on Learning and School Participation in Low- And Middle-Income Countries." International Initiative for Impact Evaluation. Systematic Review Summary 7. London: International Initiative for Impact Evaluation, 2016. doi:10.23846/srs007.

Sommer, Simon. "Commentary: Leapfrogging as a Principle for Research on Children and Youth in Majority World Settings." Journal of Research on Adolescence 23, no. 1 (2013): 187-88. doi:10.1111/j.1532-7795.2012.00835.x.

Songer, Nancy Butler, and Yael Kali, "Science Education and the Learning Sciences as Coevolving Species." In The Cambridge Handbook of the Learning Sciences: Second Edition, edited by Keith Sawyer. New York, NY: Cambridge University Press, 2014.

Soysal, Yasemin Nuhoglu, and David Strang. "Construction of the First Mass Education Systems in Nineteenth-Century Europe." Sociology of Education 62, no. 4 (1989): 277-88.

Strauss, Valerie. "No, Finland isn't ditching traditional school subjects. Here's what's really happening." The Washington Post. March 26, 2015. Accessed June 02, 2017. https://www.washingtonpost.com/news/answer-sheet/wp/2015/03/26/no-finlands-schools-arent-giving-up-traditional-subjects-heres-what-the-reforms-will-really-do/?utm_term=.bf177f5a5de8.

Sturgis, Chris. Reaching the Tipping Point: Insights on Advancing Competency Education in New England. Vienna, VA: Inacol, 2016.

Suárez-Orozco, Marcelo M., and Carolyn Sattin. "Introduction: Learning in the Global Era" in Learning in the Global Era: International Perspectives on Globalization and Education, Edited by Marcelo M. Suárez-Orozco. Berkeley: University of California Press 2007.

Taut, Sandy, Flavio Cortes, Christian Sebastian, and David Preiss. "Evaluating School and Parent Reports of the National Student Achievement Testing System (SIMCE) In Chile: Access, Comprehension, and Use." Evaluation and Program Planning 32, no. 2 (2009): 129-137.

Trucano, Michael. "Knowledge Maps: ICT in Education." Washington, D.C.: infoDev / World Bank, 2005.

Trucano, Michael. "Technologies in Education Across the Americas: The Promise and the Peril – and Some Potential Ways Forward." World Bank, Technology & Innovation: SABER-ICT Technical Paper Series 12. Washington, D.C.: World Bank, 2016. https://openknowledge.worldbank.org/handle/10986/26259.

U.S. Department of Education. "Reimagining the Role of Technology in Education." Office of Educational Technology, 2017. https://tech.ed.gov/files/2017/01/NETP17.pdf.

UNESCO Institute for Statistics (UIS) and UNICEF. "Fixing the Broken Promise of Education for All: Findings from the Global Initiative on Out-of-School Children." Montreal: UNESCO Institute for Statistics, 2015. http://dx.doi.org/10.15220/978-92-9189-161-0-en.

UNESCO Institute for Statistics and UNESCO. "Global Report on Out-of-School Children, 2015." Montreal: UNESCO Institute for Statistics, 2015.

UNESCO. "Global Education Monitoring Report: Education for People and Planet: Creating Sustainable Futures for All." Paris: UNESCO, 2016. http://unesdoc.unesco.org/images/0024/002457/245752e.pdf.

UNESCO. "The Data Revolution in Education." Information Paper N.39. Montreal: UNESCO Institute for Statistics, March 2017.

UNESCO. "World Inequality Database on Education." Global Education Monitoring Report 2016. Accessed May 22, 2017. http://www.education-inequalities.org/.

Vavrus, Frances, Matthew Thomas, and Lesley Bartlett. "Ensuring Quality by Attending to Inquiry: Learner-Centered Pedagogy in Sub-Saharan Africa." Ethiopia: UNESCO-International Institute for Capacity Building in Africa, 2011.

Voelpel, Sven, Marius Leibold, and Eden B. Tekie. "The Wheel of Business Model Reinvention: How to Reshape Your Business Model to Leapfrog Competitors." Journal of Change Management 4, no. 3 (2004): 259-76. doi:10.1080/1469701042000212669.

Wallis, Claudia, and Sonja Steptoe. "How to Bring Our Schools Out of the 20th Century." Time. December 10, 2006. Accessed June 02, 2017. http://rotorlab.tamu.edu/me489/Assign_2/Time_1106_How_to_bring_schools-to_21_century.pdf.

Walters, Helen. "Reinventing education for millennials: Anant Agarwal at TEDGlobal 2013." TED Blog. June 14, 2013. Accessed June 02, 2017. http://blog.ted.com/reinventing-education-for-millennials-anant-agarwal-at-tedglobal-2013/.

Winthrop, Rebecca, and Eileen McGivney. "Skills for a Changing World: Advancing Quality Learning for Vibrant Societies." The Brookings Institution, 2016. https://www.brookings.edu/wp-content/uploads/2016/05/global_20160809_skills_for_a_changing_world.pdf.

Winthrop, Rebecca, and Eileen McGivney. "Why Wait 100 Years? Bridging the Gap in Global Education." Brookings Institution. November 28, 2016. Accessed June 02, 2017. https://www.brookings.edu/research/why-wait-100-years-bridging-the-gap-in-global-education/.

Winthrop, Rebecca, and Gene Sperling. What Works in Girls' Education: Evidence for the World's Best Investment. Washington: Brookings Institution Press, 2015.

Winthrop, Rebecca, Eileen McGivney, Timothy Williams, and Priya Shankar. "Innovation and Technology to Accelerate Progress in Education." Background Paper for Education Commission. Center for Universal Education (CUE) at The Brookings Institution, 2016.

Winthrop, Rebecca. "How Can We "Leapfrog" Educational Outcomes? (SSIR)." Stanford Social Innovation Review. November 7, 2016. Accessed June 02, 2017. https://ssir.org/articles/entry/how_can_we_leapfrog_educational_outcomes.

Winthrop, Rebecca. "Indian pupils invent their own lessons." BBC News. November 16, 2016. Accessed June 02, 2017. http://www.bbc.com/news/business-37618901.

World Bank. "World Bank Forecasts Global Poverty to Fall Below 10% for First Time; Major Hurdles Remain in Goal to End Poverty by 2030." World Bank. October 2015. Accessed June 02, 2017. http://www.worldbank.org/en/news/press-release/2015/10/04/world-bank-forecasts-global-poverty-to-fall-below-10-for-first-time-major-hurdles-remain-in-goal-to-end-poverty-by-2030.

World Economic Forum. "The Future of Jobs and Skills in Africa." Geneva: World Economic Forum, May 2017. http://www3.weforum.org/docs/WEF_EGW_FOJ_Africa.pdf.

World Economic Forum. "The Future of Jobs Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution." Geneva: World Economic Forum, January 2016. http://www3.weforum.org/docs/WEF_FOJ_Executive_Summary_Jobs.pdf.

Zhao, Yong. World Class Learners: Educating Creative and Entrepreneurial Students. Corwin, A SAGE Publications Company, 2012.

Endnotes

1.   Rebecca Winthrop, "Indian pupils invent their own lessons," BBC News, November 16, 2016, accessed June 02, 2017, http://www.bbc.com/news/business-37618901.

2.   The Education Commission, "The Learning Generation: Investing in Education for a Changing World," International Commission on Financing Global Education Opportunity, 2016, 68, http://report.educationcommission.org/report.

3.   Yasemin Nuhoglu Soysal and David Strang, "Construction of the First Mass Education Systems in Nineteenth-Century Europe," Sociology of Education 62, no. 4 (1989): 277-288.

4.   Ellwood P. Cubberley, Public Education in the United States (Cambridge, Massachusetts: The Riverside Press, 1947).

5.   Cynthia B. Lloyd, Carol E. Kaufman, and Paul Hewett, "The Spread of Primary Schooling in sub-Saharan Africa: Implications for Fertility Change," Population and Development Review 26, no. 3 (2000): 483-515, doi:10.1111/j.1728-4457.2000.00483.x.

6.   David Baker. The Schooled Society: The Educational Transformation of Global Culture (Stanford, CA: Stanford University Press, 2014).

7.   Rebecca Winthrop and Eileen McGivney, "Why Wait 100 Years? Bridging the Gap in Global Education," Brookings Institution, November 28, 2016, accessed June 02, 2017, https://www.brookings.edu/research/why-wait-100-years-bridging-the-gap-in-global-education/.

8.   Ibid.

9.   Claudia Wallis and Sonja Steptoe, "How to Bring Our Schools Out of the 20th Century," Time, December 10, 2006, accessed June 02, 2017, http://rotorlab.tamu.edu/me489/Assign_2/Time_1106_How_to_bring_schools-to_21_century.pdf.

10. On reading, see D. A. Gamson, X. Lu and S. A. Eckert, "Challenging the Research Base of the Common Core State Standards: A Historical Reanalysis of Text Complexity," Educational Researcher 42, no. 7 (2013): 381-91, doi:10.3102/0013189x13505684. On mathematics, see David Baker, Hilary Knipe, John Collins, Eric Cummings, Juan Leon, Clancy Blair, and David Gamson, "One Hundred Years of Elementary School Mathematics in the United States: A Content Analysis and Cognitive Assessment of Textbooks from 1900 to 2000," Journal for Research in Mathematics Education, Vol. 41, No. 4 (2010): 383-424. et al., See also J. McMurrer, "Choices, Changes, and Challenges: Curriculum and Instruction in the NCLB Era," The Center on Education Policy, accessed June 02, 2017, https://www.cep-dc.org/displayDocument.cfm?DocumentID=312.

11. Larry Cuban, How Teachers Taught: Constancy and Change in American Classrooms, 1890-1990 (New York: Teachers College Press, 1993).

12. David Baker, The Schooled Society: The Educational Transformation of Global Culture (Stanford, CA: Stanford University Press, 2014).

13. Colette Chabbott, Constructing Education for Development: International Organizations and Education for All (New York: Routledge, 2009).

14. Julia Resnik, "The Organization of School Knowledge: Official Curricula in Global Perspective" (Rotterdam: Sense Publishers, 2008).

15. J. Hiebert et al., "Highlights from the TIMSS 1999 Video Study of Eighth Grade Mathematics Teaching," U.S. Department of Education (Washington, D.C.: National Center for Education Statistics, 2003).

16. Rebecca Winthrop, and Eileen McGivney, "Why Wait 100 Years? Bridging the Gap in Global Education," Brookings Institution, November 28, 2016, accessed June 02, 2017, https://www.brookings.edu/research/why-wait-100-years-bridging-the-gap-in-global-education/.

17. "[Of] 1.4 billion school-aged children, 825 million will not be on track to reach 'low' proficiency on PISA, [and] 420 million will not be on track to meet 'low' proficiency on TIMSS and PIRLS (primary-level skills)." The Education Commission, "The Learning Generation: Investing in Education for a Changing World," International Commission on Financing Global Education Opportunity, 2016, 30, http://report.educationcommission.org/report.

18. The Education Commission, "The Learning Generation: Investing in Education for a Changing World," International Commission on Financing Global Education Opportunity, 2016, http://report.educationcommission.org/report.

19. UNESCO, "Global Education Monitoring Report: Education for People and Planet: Creating Sustainable Futures for All" (Paris: UNESCO, 2016), http://unesdoc.unesco.org/images/0024/002457/245752e.pdf.

20. UNESCO, "World Inequality Database on Education," UNESCO Global Education Monitoring Report 2016, accessed May 22, 2017, http://www.education-inequalities.org/.

21. Richard J. Murnane, and Greg J. Duncan, Whither Opportunity? Rising Inequality, Schools, and Children's Life Chances (New York: Russel Sage Foundation, 2011), 9.

22. Ibid.

23. OECD, PISA 2012 Results: Creative Problem Solving—Students' Skills in Tackling Real-Life Problems (Volume V) (Paris: OECD Publishing, 2014), http://dx.doi.org/10.1787/9789264208070-en.

24. For more information on measuring nonacademic skills, see: Fernando Reimers and Connie K. Chung, Teaching and Learning for the Twenty-First Century: Educational Goals, Policies, And Curricula from Six Nations (Cambridge, MA: Harvard Education Press, 2016); Koji Miyamoto, M. Huerta, Katarzyna Kubacka, Hiroko Ikesako, and E. Oliveira, "Skills for Social Progress: The Power of Social and Emotional Skills," OECD Skills Studies (Paris: OECD, 2015), http://dx.doi.org/10.1787/9789264226159-en.

25. Rebecca Winthrop and Eileen McGivney, "Why Wait 100 Years? Bridging the Gap in Global Education" (Washington: Brookings Institution, June 2015).

26. Education For All Global Monitoring Report, "Teaching and Learning: Achieving Quality for All" (Paris: UNESCO, 2014).

27. Richard J. Murnane and Greg J. Duncan, Whither Opportunity? Rising Inequality, Schools, and Children's Life Chances (New York: Russel Sage Foundation, 2011).

28. Sean F. Reardon and Ximena A. Portilla, "Recent Trends in Income, Racial, and Ethnic School Readiness Gaps at Kindergarten Entry," AERA Open, Vol. 2, no. 3 (2016), 12, doi:10.1177/2332858416657343.

29. UNESCO Institute for Statistics and UNESCO, "Global Report on Out-of-School Children, 2015" (Montreal: UNESCO Institute for Statistics, 2015), http://www.uis.unesco.org/Education/Documents/oosci-global-report-en.pdf: "In countries in the final mile, it is clear that there is an urgent need for specially-targeted efforts to overcome the particular barriers that keep the hardest-to-reach children out of school. They will not be reached simply by business-as-usual approaches that expand existing education systems still further. Instead, there needs to be a shift towards greater equity in education, moving away from systems that allocate resources uniformly and towards systems that allocate resources according to actual needs of marginalised children."

30. Hugh D. Hindman, The World Of Child Labor: An Historical and Regional Survey (Armonk, NY: M.E. Sharpe, 2009), 4.

31. UNESCO Institute for Statistics (UIS) and UNICEF, "Fixing the Broken Promise of Education for All: Findings from the Global Initiative on Out-of-School Children" (Montreal: UNESCO Institute for Statistics, 2015), http://dx.doi.org/10.15220/978-92-9189-161-0-en.

32. Raja Bentaouet Kattan, and Nicholas Burnett, User fees in Primary Education (Washington, D.C.: Education Sector, Human Development Network, World Bank, 2004).

33. UNESCO Institute for Statistics (UIS) and UNICEF, "Fixing the Broken Promise of Education for All: Findings from the Global Initiative on Out-of-School Children" (Montreal: UNESCO Institute for Statistics, 2015), http://dx.doi.org/10.15220/978-92-9189-161-0-en.

34. For a thorough analysis of out-of-school children and the barriers they face see: UNESCO Institute for Statistics (UIS) and UNICEF, "Fixing the Broken Promise of Education for All: Findings from the Global Initiative on Out-of-School Children" (Montreal: UNESCO Institute for Statistics, 2015); P. M. Rose, Ricardo Sabates, B. M. Alcott, and I. S. Ilie, "Overcoming Inequalities Within Countries to Achieve Global Convergence in Learning," Background Paper for Education Commission, Research for Equitable Access and Learning (REAL) Centre (Cambridge: University of Cambridge, 2017).

35. Halsey Rogers, "The 'nini' youth of Latin America: Out of school, out of work, and misunderstood," World Bank, January 25, 2016, accessed June 02, 2017, http://blogs.worldbank.org/education/nini-youth-latin-america-out-school-out-work-and-misunderstood; Raja Bentaouet Kattan and Miguel Székely, "Analyzing the dynamics of school dropout in upper secondary education in Latin America: a cohort approach," World Bank Policy Research Working Paper 7223 (World Bank, 2015).

36. Lant Pritchett, The Rebirth of Education: Schooling Ain't Learning (Washington, D.C.: Center for Global Development, 2013), 14.

37. One in four primary-school-aged children are not in school, and the other three-fourths of children not learning are in school. The Education Commission, "The Learning Generation: Investing in Education for a Changing World," International Commission on Financing Global Education Opportunity, 2016, 33, http://report.educationcommission.org/report/.

38. Ibid.

39. Jane Benbow, Adela Mizrachi, Dan Oliver, and Laisha Said-Moshiro, "Large Class Sizes in the Developing World: What Do We Know and What Can We Do?" American Institute for Research under the EQIP1 LWA, 2007, http://www.equip123.net/docs/E1-LargeClassrooms.pdf; Results for Development Institute (R4D), "Global Book Fund Feasibility Study: Final Report" (Washington: R4D, 2016), http://pdf.usaid.gov/pdf_docs/PA00M8BK.pdf.

40. The Education Commission, "The Learning Generation: Investing in Education for a Changing World," International Commission on Financing Global Education Opportunity, 2016, 66, http://report.educationcommission.org/report.

41. T. Bold, D. Filmer, G. Martin, E. Molina, B. Stacy, C. Rockmore, J. Svensson, and W. Wane, "What Do Teachers Know and Do? Evidence from Primary Schools in Africa," World Bank Policy Research Working Paper 7956 (World Bank, 2017).

42. Global Education Monitoring Report, "If you don't understand, how can you learn?" Policy Paper 24 (Paris: UNESCO, February 2016); The Education Commission, "The Learning Generation: Investing in Education for a Changing World," International Commission on Financing Global Education Opportunity, 2016, 62, http://report.educationcommission.org/report; Carol Benson, "School Access fir Children from Dominant Ethnic and Linguistic Communities," Paper commissioned for Fixing the Broken Promise of Education for All: Findings from the Global Initiative on Out-of-School Children (Montreal: UNESCO Institute for Statistics, 2015).

43. "Remedial education," The Abdul Latif Jameel Poverty Action Lab, accessed June 02, 2017, https://www.povertyactionlab.org/scale-ups/remedial-education.

44. The Education Commission, "The Learning Generation: Investing in Education for a Changing World," International Commission on Financing Global Education Opportunity, 2016, 93-94, http://report.educationcommission.org/report.

45. Winnie V. Mitullah, Romaric Samson, Pauline M. Wambua, and Samuel Balongo, "Building on Progress: Infrastructure Developments Still a Major Challenge in Africa," Afrobarometer Round 6, Dispatch No. 69, 2016.

46. Erik Brynjolfsson and Andrew McAfee, The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies (New York: W.W. Norton & Company, 2016).

47. Thomas Friedman, Thank You for Being Late: An Optimist's Guide to Thriving in The Age of Accelerations (New York: Farrar, Straus and Giroux, 2016).

48. David H. Autor, "The 'Task Approach' to Labor Markets: An Overview," NBER Working Papers no. 18711 (Cambridge, MA: National Bureau of Economic Research, 2013).

49. M. Arntz., T. Gregory and U. Zierahn, "The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis," OECD Social, Employment and Migration Working Papers, No. 189 (Paris: OECD Publishing, 2016), http://dx.doi.org/10.1787/5jlz9h56dvq7-en.

50. Ibid.

51. World Economic Forum, "The Future of Jobs Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution" (Geneva: World Economic Forum, January 2016), http://www3.weforum.org/docs/WEF_FOJ_Executive_Summary_Jobs.pdf.

52. World Economic Forum, "The Future of Jobs and Skills in Africa" (Geneva: World Economic Forum, May 2017), http://www3.weforum.org/docs/WEF_EGW_FOJ_Africa.pdf.

53. The Education Commission, "The Learning Generation: Investing in Education for a Changing World," International Commission on Financing Global Education Opportunity, 2016, http://report.educationcommission.org/report.

54. World Economic Forum, "The Future of Jobs Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution" (Geneva: World Economic Forum, January 2016), http://www3.weforum.org/docs/WEF_FOJ_Executive_Summary_Jobs.pdf.

55. Maria E. Canon, and Elise Marifian, "Job Polarization Leaves Middle-Skilled Workers Out in the Cold," Federal Reserve Bank of St. Luis, January 2013, accessed June 02, 2017, https://www.stlouisfed.org/publications/regional-economist/january-2013/job-polarization-leaves-middleskilled-workers-out-in-the-cold; Indhira Santos, "Labor market polarization in developing countries: challenges ahead," World Bank (blog), June 14, 2016, accessed June 02, 2017, http://blogs.worldbank.org/developmenttalk/labor-market-polarization-developing-countries-challenges-ahead.

56. Richard Dobbs, Anu Madgavkar, Dominic Barton, Eric Labaye, James Manyika, Charles Roxburgh, Susan Lund, and Siddarth Madhav, "The World at Work: Jobs, Pay, and Skills for 3.5 Billion People," McKinsey & Company, 2012, http://www.mckinsey.com/global-themes/employment-and-growth/the-world-at-work.

57. Yong Zhao, World Class Learners: Educating Creative and Entrepreneurial Students (Corwin, A SAGE Publications Company, 2012).

58. Naveen Menon, Joel Nicholson and Fouad Roukoz, "Rethinking K-12 Education: Defining a New Model," A.T. Kearney, accessed August 1, 2017. https://www.atkearney.com/documents/10192/4540067/Rethinking K-12 Education.pdf/d385bd9b-b3af-4653-b5ea-727d2197ce98.

59. Rebecca Winthrop and Eileen McGivney, "Skills for a Changing World: Advancing Quality Learning for Vibrant Societies," The Brookings Institution, 2016, https://www.brookings.edu/wp-content/uploads/2016/05/global_20160809_skills_for_a_changing_world.pdf.

60. Fernando Reimers and Connie K. Chung, Teaching and Learning for the Twenty-First Century: Educational Goals, Policies, and Curricula from Six Nations (Cambridge, MA: Harvard Education Press, 2016).

61. For more information, see our report, Rebecca Winthrop and Eileen McGivney, "Skills for a Changing World: Advancing Quality Learning for Vibrant Societies," The Brookings Institution, 2016, https://www.brookings.edu/wp-content/uploads/2016/05/global_20160809_skills_for_a_changing_world.pdf.

62. See, for example: "About Us," Leap Innovations, accessed June 02, 2017, http://www.leapinnovations.org/about-us; Helen Walters, "Reinventing education for millennials: Anant Agarwal at TEDGlobal 2013," TED Blog, June 14, 2013, accessed June 02, 2017, http://blog.ted.com/reinventing-education-for-millennials-anant-agarwal-at-tedglobal-2013/; "FGV opens Center for Excellence and Innovation in Education Policies," FGV Notícias, November 28, 2016, accessed June 02, 2017, http://fgvnoticias.fgv.br/en/news/fgv-opens-center-excellence-and-innovation-education-policies#.

63. Marcelo M. Suárez-Orozco and Carolyn Sattin, "Introduction: Learning in the Global Era" in Learning in the Global Era: International Perspectives on Globalization and Education, ed. Marcelo M. Suárez-Orozco (Berkeley: University of California Press 2007), 1.

64. "Life Expectancy," World Health Organization, accessed June 02, 2017. http://www.who.int/gho/mortality_burden_disease/life_tables/situation_trends_text/en/.

65. Rebecca Winthrop and Gene Sperling, What Works in Girls' Education: Evidence for the World's Best Investment (Washington, D.C.: Brookings Institution Press, 2015), 29.

66. Ibid.

67. World Bank, "World Bank Forecasts Global Poverty to Fall Below 10% for First Time; Major Hurdles Remain in Goal to End Poverty by 2030," World Bank, October 2015, accessed June 02, 2017, http://www.worldbank.org/en/news/press-release/2015/10/04/world-bank-forecasts-global-poverty-to-fall-below-10-for-first-time-major-hurdles-remain-in-goal-to-end-poverty-by-2030.

68. Edwin Dean, Education and Economic Productivity (Cambridge, MA: Ballinger Publishing, 1984).

69. Robert J. Barro and Jong Wha Lee, "A New Data Set of Educational Attainment in the World, 1950-2010," Journal of Development Economics, Elsevier, vol. 104(C) (2013): 184-198.

70. Jeff Howe, Crowdsourcing: Why the Power of the Crowd Is Driving the Future of Business (New York: Three Rivers Press, 2009).

71. James Coleman, "Families and Schools," Educational Researcher 16, no. 6 (1987): 32-38.

72. Ibid.

73. Benedict Anderson, Imagined Communities: Reflections on the Origin and Spread of Nationalism (London: Verso, 2016).

74. Kenneth D. Bush and Diana Saltarelli, The Two Faces of Education in Ethnic Conflict: Towards a Peacebuilding Education for Children (Florence, Italy: UNICEF, 2001).

75. McMahon reviews the literature (and his own quantitative work) on education's impact on variety of outcomes and finds positive impact on both democracy and human rights (especially investments in secondary education), along with other public goods. Walter W. McMahon, "The Social and External Benefits of Education," International Handbook on the Economics of Education (2004): 211-259.

76. Gudrun Ostby and Henrik Urdal, "Education and Conflict: What the Evidence Says," PRIO Policy Brief (Oslo: Peace Research Institute Oslo, 2011).

77. Esther Care and Kate Anderson, "How Education Systems Approach Breadth of Skills," The Brookings Institution, 2016, https://www.brookings.edu/wp-content/uploads/2016/05/brookings_how-education-systems-approach-breadth-of-skills_web_07-2016.pdf.

78. Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA), "Melbourne Declaration in Educational Goals for Young Australians" (Carlton South, Australia: MCEETYA, 2008).

79. For example, the Partnership for 21st-century Skills—which was developed as a collaboration between business, educators, and government—sets out four large domains: life and career skills; learning and innovation skills; information, media, technology skills; and academic subjects and 21st-century themes. For more details, see "Framework for 21st-century Learning," The Partnership for 21st-century Learning, accessed June 02, 2017, http://www.p21.org/about-us/p21-framework.

80. Esther Care, and Kate Anderson, "How education systems approach breadth of skills," Brookings Institution, August 18, 2016, accessed June 02, 2017, https://www.brookings.edu/research/how-education-systems-approach-breadth-of-skills/.

81. The International Commission on Education for the Twenty-first Century, "Learning: The Treasure Within," (Paris: UNESCO, 1996), http://unesdoc.unesco.org/images/0010/001095/109590eo.pdf.

82. Howard Gardner, Five Minds for the Future (Boston, MA: Harvard Business Review Press, 2009): 1.

83. Ibid.

84. Personal communication, Shankar Maruwada and Rebecca Winthrop, May 2017, The Brookings Institution, Washington D.C.

85. Global Education Monitoring Report, "Education for People and Planet: Creating Sustainable Futures for All" (Paris: UNESCO, 2016), http://unesdoc.unesco.org/images/0024/002457/245752e.pdf.

86. M. Frost and A. Little, "Children's Learning Practices in Ethiopia: Observations from Primary School Classes," Oxford Review of Education, 40(1) (2014): 91-111, doi.org/10.1080/03054985.2013.873526.

87. Luis Benveniste, Jeffery Marshall, M. Caridad Araujo, "Teaching in Cambodia" (Washington, D.C.: World Bank, 2008), https://openknowledge.worldbank.org/handle/10986/8073.

88. Frances Vavrus, Matthew Thomas, and Lesley Bartlett, "Ensuring Quality by Attending to Inquiry: Learner-Centered Pedagogy in Sub-Saharan Africa" (Ethiopia: UNESCO-International Institute for Capacity Building in Africa, 2011); See also: T. Bold, D. Filmer, G. Martin, E. Molina, B. Stacy, C. Rockmore, J. Svensson, and W. Wane, "What Do Teachers Know and Do? Evidence from Primary Schools in Africa," World Bank Policy Research Working Paper 7956, World Bank, 2017.

89. Alfonso Echazarra, Daniel Salinas, Ildefonso Méndez, Vanessa Denis and Giannina Rech, "How teachers teach and students learn: Successful strategies for school", OECD Education Working Papers, No. 130 (Paris: OECD, 2016), http://dx.doi.org/10.1787/5jm29kpt0xxx-en.

90. See also D. Ansari, J. König, M. Leask, and T. Tokuhama-Espinosa, "Developmental Cognitive Neuroscience: Implications for Teachers' Pedagogical Knowledge," in Pedagogical Knowledge and the Changing Nature of the Teaching Profession, ed. S. Guerrero (Paris: OECD, 2017), http://dx.doi.org/10.1787/9789264270695-en. http://dx.doi.org/10.1787/9789264270695-en; Sonia Guerriero, Pedagogical Knowledge and the Changing Nature of the Teaching Profession (Paris: OECD, 2017), 197; Keith Sawyer, "Conclusion: The future of learning: Grounding educational innovation in the learning sciences," in The Cambridge Handbook of the Learning Sciences: Second Edition, ed. Keith Sawyer (New York, NY: Cambridge University Press, 2014), 726-746; Victor Benassi, Elizabeth M. Tappin, Catherine E. Overson, Michael J. Lee, Edward J. O'Brien, Barbara Prudhomme White, Jennifer J. Stiegler-Balfour, and Christopher M. Hakala, "Applying the Science of Learning: The Cognition Toolbox," in Applying Science of Learning in Education: Infusing Psychological Science into the Curriculum, ed. Victor Benassi, Catherine E. Overson, Christopher M. Hakal (Society for the Teaching of Psychology, 2014), 194; J. Hiebert et al., "Highlights from the TIMSS 1999 Video Study of Eighth Grade Mathematics Teaching," U.S. Department of Education (Washington, D.C.: National Center for Education Statistics, 2003).

91. Keith Sawyer, "Conclusion: The future of learning: Grounding Educational Innovation in the Learning Sciences," in The Cambridge Handbook of the Learning Sciences: Second Edition, ed. Keith Sawyer. (New York, NY: Cambridge University Press, 2014), 726-746.

92. Ibid.

93. John Dewey, Democracy and Education (Lanham: Dancing Unicorn Books, 2017); Paulo Freire, Pedagogy of the Oppressed (London, England: Penguin Books, 2017).

94. Charles Leadbeater, The Problem Solvers: The Teachers, the Students and the Radically Disruptive Nuns Who are Leading a Global Learning Movement (London: Pearson, 2016).

95. See for example, Clayton M. Christensen, Michael B. Horn, and Curtis W. Johnson, Disrupting Class: How Disruptive Innovation Will Change the Way the World Learns (New York: McGraw-Hill, 2008); Larry Keeley, Ten Types of Innovation: The Discipline of Building Breakthroughs (Hoboken, NJ: John Wiley & Sons, Inc., 2013); Sven Voelpel, Marius Leibold, and Eden B. Tekie, "The Wheel of Business Model Reinvention: How to Reshape Your Business Model to Leapfrog Competitors," Journal of Change Management 4, no. 3 (2004): 259-76, doi:10.1080/1469701042000212669. In academic literature more broadly, leapfrogging as term is used to describe widely different concepts across diverse disciplines from patterns of urban development, to improvements in hospital performance, to descriptions of voting patterns. There is no clear definition that cuts across disciplines. See, for example: "Look before you leap," The Economist, August 06, 2016, accessed June 02, 2017, https://brookings.idm.oclc.org/login?url=https://search.proquest.com/docview/1810528618?accountid=26493; Simon Sommer, "Commentary: Leapfrogging as a Principle for Research on Children and Youth in Majority World Settings," Journal of Research on Adolescence 23, no. 1 (2013): 187-88, doi:10.1111/j.1532-7795.2012.00835.x"".

96. Rebecca Winthrop, "How Can We "Leapfrog" Educational Outcomes? (SSIR)," Stanford Social Innovation Review, November 7, 2016, accessed June 02, 2017, https://ssir.org/articles/entry/how_can_we_leapfrog_educational_outcomes.

97. Ibid.

98. John Moravec and Arthur Hawkins, Leapfrog Initiatives, accessed June 02, 2017, http://leapfrog.umn.edu/.

99. John Moravec, Knowmad Society (Minneapolis, MN: Education Futures LLC, 2013), 18.

100. John Moravec, Knowmad Society (Minneapolis, MN: Education Futures LLC, 2013), 21.

101. See for example the debates within the global education community leading up to the development of the United Nations Sustainable Development Goal 4 on education, including debates taking place within the Learning Metrics Task Force: "Learning Metrics Task Force," Brookings Institution, May 11, 2017, accessed June 02, 2017, https://www.brookings.edu/product/learning-metrics-task-force/.

102. "Madagascar," Education in Madagascar | Global Partnership for Education, accessed June 02, 2017. http://www.globalpartnership.org/country/madagascar.

103. Valerie Strauss, "No, Finland isn't ditching traditional school subjects. Here's what's really happening," The Washington Post, March 26, 2015, accessed June 02, 2017, https://www.washingtonpost.com/news/answer-sheet/wp/2015/03/26/no-finlands-schools-arent-giving-up-traditional-subjects-heres-what-the-reforms-will-really-do/?utm_term=.bf177f5a5de8.

104. Personal communication, Dzingai Mutumbuka and Rebecca Winthrop, September 27, 2012, at Learning Metrics Task Force, New York City.

105. Prahalad C. K and Richard A. Bettis, "The Dominant Logic: A New Linkage between Diversity and Performance," Strategic Management Journal 7 (1986): 485–501, doi:10.1002/smj.4250070602.

106. Esther Care, Helyn Kim, Kate Anderson, and Emily Gustafsson-Wright, "Skills for a Changing World: National Perspectives and the Global Movement," The Brookings Institution, 2017, https://www.brookings.edu/wp-content/uploads/2017/03/global-20170324-skills-for-a-changing-world.pdf.

107. Esther Care, Kate Anderson, and Helyn Kim, "Visualizing the Breadth of Skills Movement Across Education Systems" The Brookings Institution, 2016, https://www.brookings.edu/wp-content/uploads/2016/09/global_20160916_breadth_of_skills_movement.pdf.

108. Esther Care, Helyn Kim, Kate Anderson, and Emily Gustafsson-Wright, "Skills for a Changing World: National Perspectives and the Global Movement," The Brookings Institution, 2017, https://www.brookings.edu/wp-content/uploads/2017/03/global-20170324-skills-for-a-changing-world.pdf.

109. The Education Commission, "The Learning Generation: Investing in Education for a Changing World," International Commission on Financing Global Education Opportunity, 2016, http://report.educationcommission.org/report.

110. The Education Commission, "The Learning Generation: Investing in Education for a Changing World," International Commission on Financing Global Education Opportunity, 2016, 68, http://report.educationcommission.org/report.

111. Rebecca Winthrop, Eileen McGivney, Timothy Williams, and Priya Shankar, "Innovation and Technology to Accelerate Progress in Education," Background Paper for Education Commission, Center for Universal Education (CUE) at The Brookings Institution, 2016.

112. We were in particular inspired by the work from the University of Minnesota's Leapfrog Institute, including that of John Moravec and Arthur Hawkins: John Moravec and Arthur Hawkins, Leapfrog Initiatives, accessed June 02, 2017, http://leapfrog.umn.edu/.

113. D. Evans and A. Popova, "What Really Works to Improve Learning in Developing Countries? An Analysis of Divergent Findings in Systematic Reviews," Policy Research Working Paper 7203, World Bank Group Africa Region, Office of the Chief Economist (Washington, D.C.: World Bank, 2015).

114. John Hattie, Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement (New York: Routledge, 2009).

115. Birte Snilstveit, Jennifer Stevenson, Radhika Menon, Daniel Phillips, Emma Gallagher, Maisie Geleen, Hannah Jobse, Tanja Schmidt, and Emmanuel Jimenez, "The Impact of Education Programmes on Learning and School Participation in Low and Middle-income Countries," International Initiative for Impact Evaluation, Systematic Review Summary 7 (London: International Initiative for Impact Evaluation, 2016), doi:10.23846/srs007.

116. See, for example, James Pellegrino, "Teaching, Learning and Assessing 21st-century Skills," in Pedagogical Knowledge and the Changing Nature of the Teaching Profession, ed. S. Guerrero (Paris: OECD, 2017), 245, http://dx.doi.org/10.1787/9789264270695-en; D. Ansari, J. König, M. Leaskand T. Tokuhama-Espinosa, "Developmental Cognitive Neuroscience: Implications for Teachers' Pedagogical Knowledge," in Pedagogical Knowledge and the Changing Nature of the Teaching Profession, ed. S. Guerrero (Paris: OECD, 2017), 197, http://dx.doi.org/10.1787/9789264270695-en. http://dx.doi.org/10.1787/9789264270695-en; Victor Benassi, Elizabeth M. Tappin, Catherine E. Overson, Michael J. Lee, Edward J. O'Brien, Barbara Prudhomme White, Jennifer J. Stiegler-Balfour, and Christopher M. Hakala, "Applying the Science of Learning: The Cognition Toolbox," in Applying Science of Learning in Education: Infusing Psychological Science into the Curriculum, ed. Victor Benassi, Catherine E. Overson, Christopher M. Hakal (Society for the Teaching of Psychology, 2014), 194.

117. John Dewey, Democracy and Education (New York: Macmillan Company, 1944), 167.

118. Benjamin Samuel Bloom, Taxonomy of Educational Objectives: the Classification of Educational Goals. Handbook 1: Cognitive Domain (New York: David McKay, 1974); Lorin W. Anderson, Benjamin Samuel Bloom, and David R. Krathwohl, A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives (New York: Longman, 2001).

119. Alfonso Echazarra, Daniel Salinas, Ildefonso Méndez, Vanessa Denis and Giannina Rech, "How Teachers Teach and Students Learn: Successful Strategies for School", OECD Education Working Papers, No. 130 (Paris: OECD, 2016), http://dx.doi.org/10.1787/5jm29kpt0xxx-en.

120. Peter Smagorinsky, and Richard E. Mayer, "Learning to be Literate," in The Cambridge Handbook of the Learning Sciences: Second Edition, ed. Keith Sawyer (New York, NY: Cambridge University Press, 2014), 612.

121. J. Hansen and P. D. Pearson, "An Instructional Study: Improving the Inferential Comprehension of Fourth Grade Good and Poor Readers," Journal of Educational Psychology, 75, (1983): 821-829.

122. Margaret Hilton and James Pellegrino, "Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st-century," National Research Council (Washington, D.C.: The National Academies Press, 2012), 175, https://doi.org/10.17226/13398.

123. Charles Bonwell and James Eison, "Active Learning: Creating Excitement in the Classroom," ASHE-ERIC Education Reports (Washington, D.C.: ERIC Clearinghouse on Higher Education, 1991), 18-19.

124. Kathy Hirsh-Pasek, Roberta Michnick Golinkoff, Laura E. Berk, and Dorothy G. Singer, A Mandate for Playful Learning in Preschool: Applying the Scientific Evidence (Oxford University Press, 2009).

125. David A. Kolb, Experiential Learning: Experience as the Source of Learning and Development (FT press, 2014).

126. "Five Characteristics of Playful Experiences," LEGO Foundation, accessed June 02, 2017, http://www.legofoundation.com/en-us/who-we-are/learning-through-play/play-characteristics.
Note: The Lego Foundation provides financial support to the Center for Universal Education.

127. Mitchell J. Nathan and R. Keith Sawyer, "Foundations of the Learning Sciences," in The Cambridge Handbook of the Learning Sciences: Second Edition, ed. Keith Sawyer (New York, NY: Cambridge University Press, 2014).

128. Nancy Butler Songer and Yael Kali, "Science Education and the Learning Sciences as Coevolving Species," in The Cambridge Handbook of the Learning Sciences: Second Edition, ed. Keith Sawyer (New York, NY: Cambridge University Press, 2014).

129. See, for example: Joseph S. Krajcik and Namsoo Shin, "Project-Based Learning," in The Cambridge Cambridge Handbook of the Learning Sciences: Second Edition, ed. Keith Sawyer (New York, NY: Cambridge University Press, 2014); Jingyan Lu, Susan Bridges, and Cindy E. Hmelo-Silver, "Problem-Based Learning," in The Cambridge Cambridge Handbook of the Learning Sciences: Second Edition, ed. Keith Sawyer (New York, NY: Cambridge University Press, 2014).

130. Margaret Hilton and James Pellegrino, "Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st-century," National Research Council (Washington, D.C.: The National Academies Press, 2012), 175, https://doi.org/10.17226/13398.

131. Richard E. Mayer, "Should There Be a Three-Strikes Rule Against Pure Discovery Learning? The Case for Guided Methods of Instruction," American Psychologist Vol. 59, No. 1 (2004): 16, DOI: 10.1037/0003-066X.59.1.14.

132. John Hattie, Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement (New York: Routledge, 2009).

133. Margaret Hilton and James Pellegrino, "Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st-century," National Research Council (Washington, D.C.: The National Academies Press, 2012), 180, https://doi.org/10.17226/13398.

134. Keith Sawyer, "Conclusion: The Future of Learning: Grounding Educational Innovation in the Learning Sciences," in The Cambridge Cambridge Handbook of the Learning Sciences: Second Edition, ed. Keith Sawyer (New York, NY: Cambridge University Press, 2014), 726-746.

135. Chris Sturgis, Reaching the Tipping Point: Insights on Advancing Competency Education in New England (Vienna, VA: Inacol, 2016).

136. See Betty McDonald, "Self Assessment and Student-Centred Learning," ERIC - Education Resources Information Center, 2012, http://files.eric.ed.gov/fulltext/ED536980.pdf;

137. Nicole Buzzeto-More, "Assessing the Efficacy and Effectiveness of an E-Portfolio Used for Summative Assessment," Interdisciplinary Journal of E-Learning and Learning Objects, volume 6 (2010): 61-85, www.ijello.org/Volume6/IJELLOv6p061-085Buzzetto691.pdf.

138. Sheryl Grant, "Promising Practices of Open Credentials: Five Years of Progress," Academia, accessed June 02, 2017, https://www.academia.edu/31173947/Promising_Practices_of_Open_Credentials_Five_Years_of_Progress?auto=download.

139. Jenny Perlman Robinson, Rebecca Winthrop and Eileen McGivney, "Millions Learning: Scaling up Quality Education in Developing Countries" (Washington, D.C: Center for Universal Education at The Brookings Institution, 2016).

140. The Education Commission, "The Learning Generation: Investing in Education for a Changing World," International Commission on Financing Global Education Opportunity, 2016, http://report.educationcommission.org/report.

141. Jenny Perlman Robinson, Rebecca Winthrop and Eileen McGivney, "Millions Learning: Scaling up Quality Education in Developing Countries" (Washington, D.C: Center for Universal Education at The Brookings Institution, 2016). The Education Commission, "The Learning Generation: Investing in Education for a Changing World," International Commission on Financing Global Education Opportunity, 2016, http://report.educationcommission.org/report.

142. World Health Organization, "Strengthening the Capacity of Community Health Workers to Deliver Care For Sexual, Reproductive, Maternal, Newborn, Child And Adolescent Health" (Geneva: World Health Organization, 2015).

143. OECD, "Innovative Learning Environments," Educational Research and Innovation (Paris: OECD, 2013), 23, http://dx.doi.org/10.1787/9789264203488-en.

144. Ibid.

145. U.S. Department of Education, "Reimagining the Role of Technology in Education," Office of Educational Technology, 2017, https://tech.ed.gov/files/2017/01/NETP17.pdf.

146. Tom Schuller and Richard Desjardins, Understanding the Social Outcomes of Learning (Paris: OECD, 2007)

147. Jenny Chanfreau, Emily Tanner, Meg Callanan, Karen Laing, Amy Skipp, and Liz Todd, "Out of School Activities during Primary School and KS2 Attainment," Centre for Longitudinal Studies Working Paper 2016/1 (London: University College London, April 2016).

148. See: Herbert Marsh, and Sabina Kleitman, "Extracurricular School Activities: The Good, the Bad, and the Nonlinear," Harvard Educational Review 72, no. 4 (2002): 464-515; Elizabeth Covay and William Carbonaro, "After the Bell: Participation in Extracurricular Activities, Classroom Behavior, and Academic Achievement," Sociology of Education 83, no. 1 (2010): 20-45.

149. Sudhanshu Handa, Heiling Pineda, Yannete Esquivel, Blancadilia Lopez, Nidia Veronica Gurdian, and Ferdinando Regalia, "Non-Formal Basic Education as a Development Priority: Evidence from Nicaragua," Economics of Education Review 28, no. 4 (2009): 512-522, doi:10.1016/j.econedurev.2009.01.001.

150. Matt Dunleavy and Chris Dede, "Augmented Reality Teaching and Learning," in Handbook of Research on Educational Communications and Technology, eds. Spector J., Merrill M., Elen J., Bishop M. (New York: Springer New York, 2014), 735-745.

151. Kathy Hirsh-Pasek and Roberta Michnick Golinkoff, "Transforming Cities into Learning Landscapes," The Brookings Institution (blog), November 02, 2016, accessed June 02, 2017, https://www.brookings.edu/blog/education-plus-development/2016/11/02/transforming-cities-into-learning-landscapes/.

152. Puentedura Ruben, "Transformation, Technology, and Education in the State of Maine," Ruben R. Puentedura's Blog, accessed June 02, 2017, http://hippasus.com/blog/archives/18.

153. "Ruben Puentedura on Applying the SAMR Model," Common Sense Media: Ratings, Reviews, and Advice, accessed June 02, 2017, https://www.commonsensemedia.org/videos/ruben-puentedura-on-applying-the-samr-model.

154. Michael Trucano, "Knowledge Maps: ICT in Education" (Washington, D.C.: infoDev / World Bank, 2005).

155. Michael Trucano, "Technologies in Education Across the Americas: The Promise and the Peril – and Some Potential Ways Forward," World Bank, Technology & Innovation: SABER-ICT Technical Paper Series 12 (Washington, D.C.: World Bank, 2016), 2, https://openknowledge.worldbank.org/handle/10986/26259.

156. Ibid.

157. Linda Darling-Hammond, Molly B. Zielezinski, and Shelley Goldman, "Using Technology to Support at-Risk Students' Learning," Stanford Center for Opportunity Policy in Education, 2014, https://edpolicy.stanford.edu/sites/default/files/scope-pub-using-technology-report.pdf.

158. Barry Fishman, Chris Dede, and Barbara Means, "Teaching and Technology: New Tools for New Times," Handbook of Research on Teaching, (2015), 276.

159. Jenny Perlman Robinson, Rebecca Winthrop and Eileen McGivney, "Millions Learning: Scaling up Quality Education in Developing Countries" (Washington: Center for Universal Education at The Brookings Institution, 2016).

160. See, for example, the discussion on measuring SDG 4 in: UNESCO, "The Data Revolution in Education," Information Paper N.39 (Montreal: UNESCO Institute for Statistics, March 2017).

161. For a discussion of data practices in education, see: Joshua New, "Building a Data-driven Education System in the United States," Center for Data Innovation, 2016, http://www2.datainnovation.org/2016-data-driven-education.pdf; Michael B. Gurstein, "Open Data: Empowering the Empowered or Effective Data Use for Everyone?" First Monday 16, no. 2 (2011), doi:10.5210/fm.v16i2.3316; Gordon Commission, "To Assess, To Teach, To Learn: A Vision for the Future of Assessment" (Princeton, NJ: Gordon Commission, 2013). http://www.gordoncommission.org/rsc/pdfs/gordon_commission_technical_report.pdf

162. Husein Abdul-Hamid, Sarah Mintz, and Namrata Saraogi, "From Compliance to Learning: A System for Harnessing the Power of Data in the State of Maryland," World Bank Studies (Washington, D.C.: World Bank, 2017), doi:10.1596/978-1-4648-1058-9.

163. UNESCO, "The Data Revolution in Education," Information Paper N.39 (Montreal: UNESCO Institute for Statistics, March 2017).

164. Miguel Helft, "Google Uses Searches to Track Flu's Spread," The New York Times, November 11, 2008, accessed June 02, 2017, http://www.nytimes.com/2008/11/12/technology/internet/12flu.html.

165. UNESCO, "The Data Revolution in Education," Information Paper N.39 (Montreal: UNESCO Institute for Statistics, March 2017).

166. Jonathan Fox, Joy Aceron, and Aránzazu Guillán, "Doing Accountability Differently. A Proposal for the Vertical Integration of Civil Society Monitoring and Advocacy," U4 Issue, Paper No.4 (Bergen: U4 Anti-Corruption Resources Center, 2016).

167. Jonathan Fox, "Social Accountability: What Does the Evidence Really Say?" World Development 72 (2015): 346-361; Jonathan Fox, "The Uncertain Relationship between Transparency and Accountability," Development in Practice 17, no. 4-5 (2007): 663-671.

168. Evan S. Lieberman, Daniel N. Posner, and Lily L. Tsai, "Does Information Lead to More Active Citizenship? Evidence from an Education Intervention in Rural Kenya," World Development 60 (2014): 69-83.

169. See, for example: Sandy Taut, Flavio Cortes, Christian Sebastian, and David Preiss, "Evaluating School and Parent Reports of the National Student Achievement Testing System (SIMCE) in Chile: Access, Comprehension, and Use," Evaluation and Program Planning 32, no. 2 (2009): 129-137; UNESCO, "The Data Revolution in Education," Information Paper N.39 (Montreal: UNESCO Institute for Statistics, March 2017); Gordon Commission, "To Assess, To Teach, To Learn: A Vision for the Future of Assessment" (Princeton, NJ: Gordon Commission, 2013), http://www.gordoncommission.org/rsc/pdfs/gordon_commission_technical_report.pdf.

170. Husein Abdul-Hamid, "What Matters Most for Education Management Information Systems: A Framework Paper," Systems Approach for Better Education Results (SABER) Working Paper Series, Number 7 (Washington, D.C.: World Bank, 2014), http://wbgfiles.worldbank.org/documents/hdn/ed/saber/supporting_doc/Background/EMIS/Framework_SABER-EMIS.pdf.

171. For example: Drew DeSilver, "U.S. Students' Academic Achievement Still Lags that of their Peers in Many Other Countries," Pew Research Center, February 15, 2017, accessed June 02, 2017, http://www.pewresearch.org/fact-tank/2017/02/15/u-s-students-internationally-math-science/.

172. Geeta Kingdon, "Opinion | Indian Schools Are Failing Their Students," The New York Times, December 15, 2015, accessed June 02, 2017, https://www.nytimes.com/2015/12/16/opinion/indian-schools-are-failing-their-students.html.

173. ASER, "Annual Status of Education Report (Rural) 2016" (New Delhi: ASER, January 2017), http://img.asercentre.org/docs/Publications/ASER%20Reports/ASER%202016/aser_2016.pdf.

174. "Brazil Student performance (PISA 2015)," OECD Education GPS, accessed June 02, 2017, http://gpseducation.oecd.org/CountryProfile?primaryCountry=BRA&treshold=10&topic=PI; Martin Carnoy, Tatiana Khavenson, Leandro Oliveira Costa, Izabel Fonseca, and Luana Marotta, "Is Brazilian Education Improving? A Comparative Foray Using PISA and SAEB Brazil Test Scores," Higher School of Economics Research Paper No. WP BRP 22/EDU/2014, 2014, http://dx.doi.org/10.2139/ssrn.2539027.

175. UNESCO, "World Inequality Database on Education," UNESCO Global Education Monitoring Report 2016, accessed May 22, 2017, http://www.education-inequalities.org/.

176. Ibid.

177. "The Educurious Expert Network™," Our Solutions / Expert Network | Educurious, accessed June 02, 2017, http://educurious.org/solutions/expert-network/.

178. Emily Gustafsson-Wright, Katie Smith, and Sophie Gardiner, "Public-Private Partnerships in Early Childhood Development: The Role of Publicly Funded Private Provision" (Washington: Center for Universal Education at Brookings Institution, November 2016), 10, https://www.brookings.edu/wp-content/uploads/2016/11/global-20161129-public-private-partnerships.pdf.

179. "Harmonized List of Fragile Situations FY 17," World Bank, May 9, 2016, accessed June 02, 2017, http://pubdocs.worldbank.org/en/154851467143896227/FY17HLFS-Final-6272016.pdf.

180. "INEE Wins Innovative Policy Award," Inter-Agency Network for Education in Emergencies, February 19, 2016, accessed June 02, 2017, http://www.ineesite.org/en/blog/inee-wins-innovative-policy-award.

181. The Inter-Agency Network for Education in Emergencies (INEE), "INEE Background Paper on Psychosocial Support and Social and Emotional Learning for Children and Youth in Emergency Settings" (New York: INEE, 2016).

182. The Inter-Agency Network for Education in Emergencies (INEE), "Minimum Standards for Education: Preparedness, Response, Recovery" (New York: INEE, 2010).

183. See, for example, Mohsen Laabidi, Mohamed Jemni, Leila Jemni Ben Ayed, Hejer Ben Brahim, and Amal Ben Jemaa, "Learning Technologies for People with Disabilities," Journal of King Saud University-Computer and Information Sciences 26, no. 1 (2014): 29-45; Heather B. Hayes, "How Technology Is Helping Special-Needs Students Excel," EdTech, March 28, 2013, accessed June 02, 2017, https://edtechmagazine.com/k12/article/2013/03/how-technology-helping-special-needs-students-excel; Bogardus Cortez, Meghan, "Accessible Technology Helps Students with Disabilities Pursue STEM Degrees," EdTech Magazine, March 10, 2017, accessed June 02, 2017, https://edtechmagazine.com/k12/article/2017/03/accessible-technology-helps-students-disabilities-pursue-stem-degrees.

184. Andreas Schleicher, Schools for 21st-Century Learners: Strong Leaders, Confident Teachers, Innovative Approaches (Paris: OECD Publishing, 2015), 62, http://www.oecd.org/publications/schools-for-21st-century-learners-9789264231191-en.htm.

B | Center for
Universal Education
at BROOKINGS

SKILLS FOR A CHANGING WORLD