Technologies in education across the Americas:

The promise and the peril – and some potential ways forward

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Michael Trucano
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1818 H Street NW, Washington DC 20433 USA
Telephone: +1-202-473-1000; Internet: www.worldbank.org

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Acknowledgements

The *World Bank Education, Technology & Innovation: SABER-ICT Technical Paper Series* explores a variety of topics and issues related to the use of information and communication technologies (ICTs) in the education sector.

The Systems Approach for Better Education Results (SABER) initiative seeks to improve the global knowledge base related to education systems analyses, assessments, diagnoses, and opportunities for dialogue. SABER-ICT aims to improve the availability of policy-related data, information, and knowledge on what matters most in using ICTs to improve the quality of education.

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1. Introduction

New information and communication technologies (ICTs) have long been heralded around the world for their potential to 'revolutionalize' education.[1] This has been true no matter the place or the specific technologies considered, whether we are talking about early promises related to the use of television and radio in past decades or the laptops and tablets of today. Excitement around this 'transformative' potential is unlikely to subside in the near future: Devices will only get cheaper, and more powerful, in the coming years, and new technologies as yet un-invented will emerge to do things that were previously possible only in the realm of science fiction. That said, while connected computing devices like laptops, tablets and smartphones are increasingly to be found in the pockets and homes of many learners and teachers, slow-to-change formal education systems have led many people to observe that "technology is already revolutionizing education – just not in the classroom".[2]

Education systems across the Americas face myriad challenges, from educating the most vulnerable and disadvantaged and providing them with safe learning environments to preparing students to participate and thrive in increasingly globalized, knowledge-based economies, and policymakers have tough choices to consider as they allocate scarce resources. At the same time, the changing nature of work and life in the 21st century means that, even where 'business as usual' when it comes to educating some of our children may have worked in the past, there is no guarantee that it will continue to do so for all of our children in the future – a message highlighted in the recent 2016 World Development Report, *Digital Dividends*.[3] Given this rhetoric and reality, how might we consider the use of new technologies in education across the region?

If technology is the 'answer', what is the question?[4]

[1] *For example: "I believe the motion picture is destined to revolutionize our educational system and that in a few years it will supplant largely, if not entirely, the use of textbooks." -Thomas Edison (1922) as quoted in: Cuban, Larry. (1986). Teachers and Machines: The Classroom Use of Technology Since 1920. New York: Teachers College Press.*

[2] *This observation, as well as the coinage 'digital native' to describe young people who grow up accustomed to having access to and using new technologies in ways their elders did not, is most closely associated with the author Marc Prensky.*

[3] *World Bank. (2016). The World Development Report 2016: Digital Dividends. Washington: The World Bank.*

[4] *This is the fundamental question that animates: Haddad, W. (2006). ICT in Education Toolkit for Policymakers, Planners and Practitioners. Bangkok/Washington, DC: UNESCO/infoDev.*

2. ICT use in education across the region: Some notable initiatives and approaches

While information and communication technologies (ICTs) have been considered key to the *future* of education in many places, they are increasingly part of the *present* in increasing numbers of education systems today in the Americas – especially in formal K-12 schooling. Schools in the United States and Canada began to introduce computers into schools in significant ways in the 1980s and 1990s, and the past decade has seen an explosion in the procurement and delivery of devices into schools across Latin America and the Caribbean – and, to a lesser but still notable extent, initiatives to provide school connectivity. As a result of the innovative Plan Ceibal, for example, Uruguay became the first country in the world to provide all primary school students with their own (free) laptops and connect all schools to the Internet.[5] While Uruguay may be considered a regional leader, it is not the only one. From the early investments in Mexico in desktop computers in schools in the 1980s to the pioneering work in Costa Rica and Chile in the 1990s to the massive educational technology projects in recent years in countries such as Argentina, Panama, and Peru, the region has a long history exploring and experimenting with the use of new technologies to help support teaching and learning. The online Educopédia learning platform[6] in Rio de Janeiro, considered a global model, provides digital instructional materials to support thousands of teachers across that teeming municipality. Many of the small island developing states of the Caribbean have achieved near 1:1 access to laptops and tablets for their students.[7] Where educational technology projects previously mostly comprised small pilot projects, such activities are increasingly moving into the mainstream.

It is important to note that much of this activity so far has been related to access – to devices, to the Internet, and to a lesser extent, to learning content and 'technology training' – and not on improving the quality of the learning experience that this access is meant to help enable. Much less focus and attention, in other words, has been directed to how exactly the use of these devices is meant to impact teaching and learning processes in positive, meaningful ways.

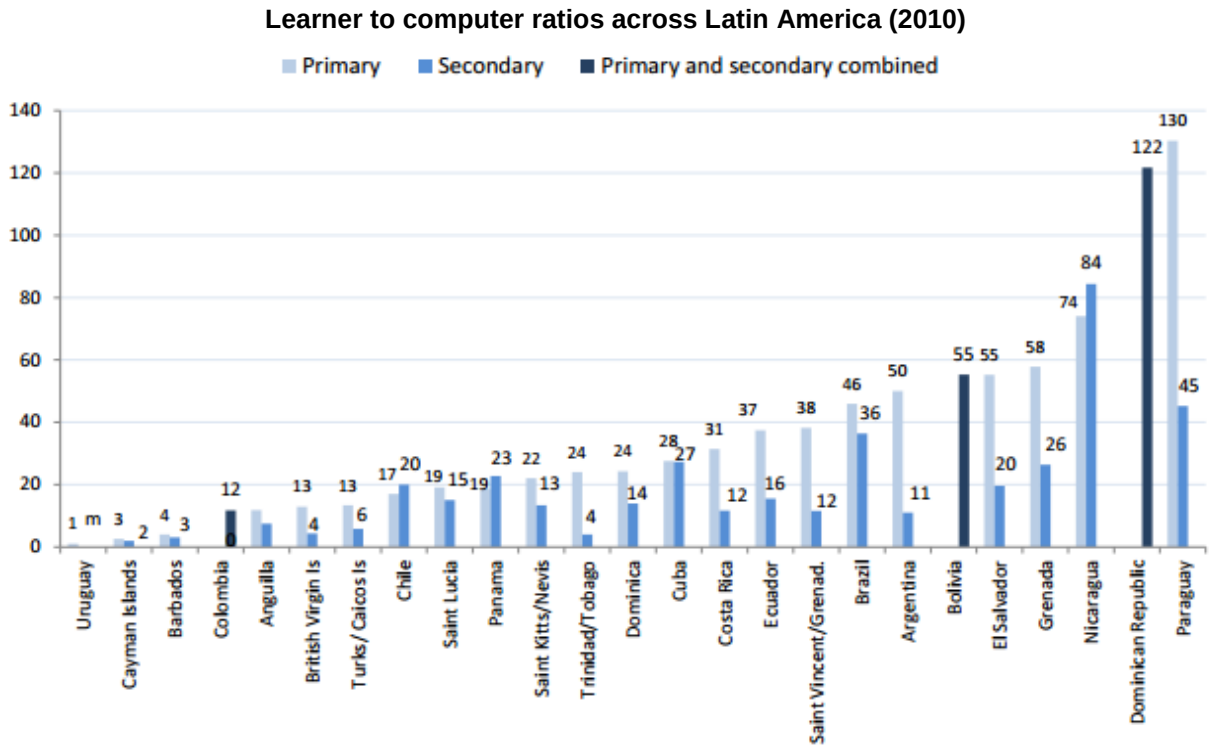
It is said that there are two basic types of 'innovation in education' – doing something that was done previously, just more cheaply and/or at a broader scale, or doing something that simply wasn't conceivable or possible before. While much of the rhetoric across the region has focused on this second type of change, in actual practice technology has largely been used to support traditional teaching and learning practices. Often times this has simply added additional expenses to education budgets and placed new burdens on teacher and schools in the absence of clear direction or support that could enable the introduction of new pedagogical approaches and administrative practices that might indeed be 'transformational' in nature.

What do policymakers need to consider in order to separate the hope from the hype related to the promise and potential (and peril) of the use of new technologies as they help steer their countries' education systems?

[5] *Technically, the tiny Pacific Island of Niue, which has a total population of less than two thousand people, was the first country to provide fee laptops to all of its students. Canada is generally considered the first 'developed' country to connect all of its schools to the Internet, Estonia the first 'developing' country to do so. For a useful analysis of Plan Ceibal, see Fullan, M., N. Watson & S. Anderson. (2013). Ceibal: Next Steps. Toronto: Michael Fullan Enterprises.*

[6] *See http://www.educopedia.com.br/.*

[7] *Tamin, R., E. Borokhovski; D. Pickup & R. Bernard. (2015). Large-Scale, Government-Supported Educational Tablet Initiatives. Commonwealth of Learning: Vancouver, BC.*



source: UNESCO Institute for Statistics. (2012). *ICT in Education in Latin America and the Caribbean: A Regional Analysis of ICT Integration and e-Readiness*. Montreal: UIS.

3. ICT use in education: Latin America & the Caribbean in a global context

Sharing of knowledge and experience

The Latin America and Caribbean region itself is paradoxically both open and insular when it comes to the use of ICTs in education. Because of shared languages, histories and cultural traditions, knowledge, information and expertise has flowed reasonably fluidly across constituent parts of the region, whether between Spanish-speaking countries, the English-speaking countries of the Caribbean, or the various internal regions of the Portuguese-speaking regional giant: Brazil. Despite flows of knowledge and expertise within various constituent parts of the Americas, however, the region itself can often feel walled off from communities of policymakers, practitioners, and scholars in other parts of the world. While such barriers continue to erode as a result of the increasing pervasiveness of the Internet, lessons, trends and practices from Asia, Africa and Europe often travel only fitfully, partially and with some delay, to impact decision making across Latin America and the Caribbean.

Student-computer ratios

For many years, policymakers have fixated on a single metric to help guide investments in technology in education: the student/computer ratio. According to the most recent figures from the OECD,[8] the student/computer ratio in a number of the Latin American countries considered leaders in their use of educational technologies (e.g. Brazil, Costa Rica, Mexico) hovers just above 15:1 for 15 year olds. This compares with an OECD average of around 5:1 (in countries like Australia, Slovakia, the UK and the United States, the figure is actually less than 2:1.) At the primary level, these ratios are typically much larger across the region (with the notable exception of Uruguay), reaching levels as high as 55:1 in Ecuador and 74:1 in Nicaragua (with some other countries sporting ratios so high that learners effectively have no access at all to computing devices), according to the most recent figures from the UNESCO Institute for Statistics.[9] Where access to ICT equipment is (relatively) good, computer labs remain a major access point in schools in the region,[10] despite strategies calling for a 'device in every lap'.

Classroom use of technology

In more and more places, popular conceptions of a 'typical' school include the presence of numerous computing devices. That said, despite pictures of schools and classrooms across the region which include the presence of technology and rhetoric touting the potential of 'transformation', most teachers continue to rely on traditional classroom instruction practices (e.g. lecturing at a blackboard) and make little use of existing technology resources.[11] This is not to say that things aren't changing anywhere, of course. The most recent survey of ICT use in schools in Brazil,[12] for example, notes that nearly half of public schools surveyed reported using computers and the internet for classroom activities with their students, a ten percent increase over the previous year. But this means that half of teachers report that they don't use such resources, and there is, it is worth noting, an important difference between reported use, actual use, and effective use.[13]

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[8] *OECD. (2015). Education at a Glance 2015: OECD Indicators. Paris: OECD Publishing.*
[9] *UNESCO Institute for Statistics. (2012). ICT in education in Latin America and the Caribbean: A regional analysis of ICT integration and e-readiness. UIS: Montreal, Quebec.*
[10] *Ibid.*
[11] *Bruns, B. & J. Luque. (2014). Great teachers: How to raise student learning in Latin America and the Caribbean. Washington, DC: World Bank Group.*
[12] *Comitê Gestor da Internet no Brasil. (2014) Pesquisa sobre o uso das Tecnologias de Informação e Comunicação nas escolas brasileiras - TIC Educação 2013. CGI.br: São Paulo.*
[13] *Ibid.*

To what extent will new technologies change the traditional functions and responsibilities of teachers, and how might they enable and even compel new ones?

'Impact'

Recent evaluations of the impact of technology use in schools as part of massive rollouts of laptops in places such as Peru[14] and Uruguay[15], as well as an earlier assessment in Colombia[16], have not shown demonstrable positive impacts of a significant magnitude. When it comes to the impact of technology use in schools as measured using currently available conventional metrics, Latin America is unfortunately not a global outlier. A recent report from the OECD finds that, when it comes to computer use in schools and learning outcomes as measured through efforts like PISA, "despite the pervasiveness of information and communication technologies (ICT) in our daily lives, these technologies have not yet been as widely adopted in formal education. And where they are used in the classroom, their impact on student performance is mixed, at best."[17]

It may well be that the timeline for impact is much longer than can be detected in the months or years following initial implementation, or that we are not using the correct or most relevant measures of what 'impact' might mean.[18] Investments in education are by their very nature meant to be considered over the long term, and it can be difficult to isolate cause and effect when there are so many variables involved. Almost three decades ago, the Nobel laureate Robert Solow famously observed that, "You can see the computer age everywhere but in the productivity statistics,"[19] and this observation can reasonably be applied to the state of impact evaluation today when it comes to technology use in education. That said, progress in this regard is being made. Two recent analyses of rigorous impact evaluations of technology use in education[20] have suggested that, while the impact of technology use in education can be highly variable (and indeed negative, in some circumstances), there are certain practices which correlate to positive outcomes. Projects to provide increased access to computers which include related training for teachers and which are characterized by "guided use", for example, where instructors help direct student use of computing facilities in schools in targeted ways, focusing on specific activities and academic subjects, have shown demonstrated positive impacts. Such interventions stand in direct opposition to one of the so-called 'worst practices' observed in countless large educational technology projects around the world: *Dump hardware in schools, hope for magic to happen*.[21] If technology is the answer to our problems, we need to make sure that we are asking the right questions.

What are the goals and objectives we hope to achieve through our investments in ICTs in education, how do we expect this to happen -- and how will we know if we've succeeded?

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[14] *Cristia, J., P. Ibarraran, S. Cueto, A. Santiago & E. Severin. (2012). Technology and Child Development: Evidence from the One Laptop Per Child Program. IDB Working Paper No. IDB-WP-304.*

[15] *de Melo, G., A. Machado, A. Miranda & M. Viera. (2013). Profundizando en los efectos del Plan Ceibal. Montevideo: Universidad de la República.*

[16] *Barrera-Osorio, F. & L. Linden. (2009). The Use and Misuse of Computers in Education: Evidence from a Randomized Experiment in Colombia. Working document Nº 4836. Washington, D.C.: The World Bank.*

[17] *The quote is from a blog post by Andreas Schleicher, the Director for Education and Skills at the OCED ("Students, computers and learning: Where's the connection?" http://oecdeducationtoday.blogspot.com/2015/09/students-computers-and-learning-wheres.html). The report itself is: OECD. (2015) Students, Computers and Learning: Making the Connection. OECD Publishing: Paris.*

[18] *For a related discussion, see: Trucano, M. "Evaluating One Laptop Per Child (OLPC) in Peru." The World Bank EduTech blog, 23 March 2012.*

[19] *Solow, R. "We'd better watch out", New York Times Book Review, July 12, 1987, p. 36.*

[20] *See: Arias Ortiz, e. & J. Cristia. (2014) The IDB and technology in education: How to promote effective programs? IDB Technical Note No. IDB-TN-670. McEwan, P. (2013) Improving Learning in Primary Schools of Developing Countries: A Meta Analysis of Randomized Experiments." Wellesley, MA: Wellesley College.*

[21] *Trucano, M. "Worst practice in ICT use in education." World Bank EduTech blog, 04 April 2010.*

Connectivity

As is the case with investments to provide ICT devices for learning in other parts of the world, when it comes to connecting schools to the Internet, the Latin America region is in many ways also not an outlier. Despite the fact that one of the regional goals under the eLAC2015 initiative[22] was to connect all public education institutions to broadband, this target has not been achieved, and significant variations exist across the region. As is the case with other regions of 'developing' countries, the Americas are home to both some of the most and some of the least connected education systems in the world. While many Caribbean islands register nearly 100% penetration in both secondary and primary schools, for example, less than one in five schools are connected in countries such as Nicaragua, Suriname and Paraguay.[23]

In addition, it is worth noting that connectivity speeds in schools in the *most connected* countries in Latin America and the Caribbean lag *far behind* countries considered to be at the leading edge globally – and this gap is growing. South Korea[24], for example, currently aims to supply all of its schools with 1 gigabit/second broadband connectivity, while the United States' target[25] is to provide 1 MB/second for each student. Depending on how you decide to benchmark such figures, such broadband levels *represent minimum levels of connectivity that are tens, and in some cases hundreds, of times faster than what is available today in the most connected schools in Latin America*. As a practical matter, this difference manifests itself with large groups of students in some schools enjoying near instantaneous access to a wide variety of media-rich learning materials and personalized assessment tools while much smaller groups of students in other technically 'connected' schools huddle together in school computer labs struggling to access their email. Experience from education systems around the world suggests that, as fast as bandwidth supply increases in schools, the demand for this bandwidth tends to increase even faster, as applications previously considered luxuries are considered 'necessary'.[26] Reliable, affordable broadband connections to the Internet – and local networks within schools that enable students to access this bandwidth – will increasingly provide a basic 'dial tone for education' in schools.[27]

Do we invest in improving the physical infrastructure of our schools and buying new textbooks — or in putting into a place a 'virtual' infrastructure of connectivity and digital learning content?

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[22] *For more information on eLAC2015, see the program web site, http://www.cepal.org/elac2015/.*
[23] *UNESCO Institute for Statistics. (2012) ICT in education in Latin America and the Caribbean: A regional analysis of ICT integration and e-readiness. UIS: Montreal, Quebec.*
[24] *Broadband Commission. (2014). The State of Broadband 2014: Broadband for all. Geneva: ITU/UNESCO.*
[25] *Education SuperHighway. (2015). State of the States: National report on the state of connectivity in America's K-12 schools. http://stateofthestates.educationsuperhighway.org/*
[26] *For a discussion of the challenges around defining minimal levels of connectivity within education systems, see: Trucano, M. "Broadband for Schools?" World Bank EduTech blog, 05 February 2013.*
[27] *For a look at lessons from what is possible in some of the most connected education systems in the world, see: Minges, M. (2015). School Connectivity for the 21st Century. San Jose: Cisco Systems.*

4. Challenges and opportunities

Equity and the Second Digital Divide

Much has been made of the challenges related to differing levels of access to ICTs in education and across broader society. Many governments and education systems have plans in place to address equity issues related to this so-called *digital divide*, which is often considered to present a technical challenge that can be solved over time by making available more devices and connecting schools to the Internet, given sufficient money and political commitment. As the OECD and others have noted[28], however, "the digital divide in education goes beyond the issue of access to technology. A second digital divide separates those with the competencies and skills to benefit from computer use from those without."

This second digital divide lies at the core of the educational challenge faced by many countries today, as investments in devices and connectivity in and of themselves don't represent a panacea, and indeed can serve to further marginalize groups already excluded or marginalized from existing educational practices and environments unless care is taken.[29] Those who are most able to benefit from the introduction of ICTs (e.g. children with educated parents and good teachers, who live in prosperous communities, etc.) are indeed often the ones who benefit the most. Just because investments in educational technology use are justified by rhetoric claiming that such use will benefit 'the poor' doesn't mean that this will actually happen.[30] The same holds for a variety of other beneficiary groups as well, whether related to gender, geography, ethnicity, geography or students with special education needs.

As we move ahead, how can we ensure that others don't fall behind?

Potential uses of technology in education

Technology use in education can take many forms. This flexibility and mutability represents both an opportunity and a challenge for educators and education systems. While the end goal of introducing a particular technology or technology-enabled approach in education may be to raise learning outcomes, many particular technology interventions may target intermediate or complementary outcomes, such as raising the general level of computer literacy, promoting more learner engagement, providing access to a greater and wider variety of educational content or to bring about greater efficiencies in existing practices within schools and education systems. Traditional textbooks can be digitized and made available to students in school computer labs or on mobile devices – and potentially updated with the press of a button. Educational television and radio programming can reach students – and teachers – in remote villages, providing access to learning content and opportunities otherwise absent and to support teachers remotely. Teachers and students can be networked together to form online communities to share information and support each other, whether across national borders or within an individual classroom. Teachers can project information on a classroom wall for viewing by students and archive their presentation materials for future study or re-use. Computer simulations and games can help provide students with new perspectives and insights about scientific phenomena in ways not previously possible, while promoting greater engagement with topics being studied. Students can learn and develop sets of so-called 21st century skills, which increasingly include, and are enabled by, the use of digital technology tools, and which can be assessed and measured through tests conducted using many of these same tools. More narrowly, students

[28] *OECD. (2010). Educational Research and Innovation: Are the New Millennium Learners Making the Grade?: Technology Use and Educational Performance in PISA 2006. Paris: OECD Publishing.*
[29] *Note that this section draws on and excerpts from a related discussion in: Trucano, M. "The Second Digital Divide." World Bank EduTech blog, 16 April 2010.*
[30] *For a related discussion, see: Trucano, M. "The Matthew Effect in Educational Technology." World Bank EduTech blog, 07 June 2013.*

can develop skills in computer programming and coding, as part of efforts to better understand many of the forces that determine some of the key underlying processes and activities which lie at the heart of our increasingly digital societies and economies, as well as to contribute to and participate in such processes and activities. 'Technology use in education' encompasses both 'ICT in education' as well as 'education in ICT'.

The potential uses of ICT in education are not limited to the classroom. ICT can also allow better, more frequent monitoring of the various dimensions of a national education system and is therefore a valuable tool for implementing a systems approach to education reform. ICT can lower the cost of implementing student learning assessments and can better link those assessment results to both teacher development and the allocation of education resources. ICT can also make it much easier to supply up-to-date information on teacher professional development programs to prospective trainees, as well as enable learning opportunities outside of formal school settings. By helping to capture data about processes and activities at the point of teaching and learning, and across schools and education systems, ICT can help document, click by click, what is actually happening in ways not previously possible, and to share these data with wider groups of decision makers and stakeholders than previously possible. Where data is presented in 'open' formats for public information and use, so-called 'open data' can help can be used not only by government, but also by diverse sets of stakeholder groups, to drive more data-driven decision making.

What will it take for students in the Americas to be able to compete with students educated elsewhere in high tech, highly connected learning environments – and to collaborate with them as well?

Problems and perils

While the potential and promise of ICT use in education is clear in many regards, so too are related perils. The process of introducing new technologies, whether at a micro level at the point of learning or at the macro level across an entire education system, is almost inevitably disruptive in the short term, and can be difficult to manage. The technology itself may not always work, or work well, or work as planned. High profile 'billion dollar failures' of educational technology initiatives such the roll out of iPads in the Los Angeles Unified School District[31] and NewsCorp's Amplify[32] subsidiary underscore just how possible it is for lots of smart people to come together and still get things spectacularly, and expensively, wrong.

As a result of investments in new technologies, teachers may be saddled with new responsibilities for which they receive inadequate support and training, and indeed may be worried (and in this regard the words of some policymakers and pundits provide them with little consolation) about being 'replaced'. As a result, they may resist or complicate efforts to introduce and integrate new technologies in schools.

The costs associated with technology-related initiatives in the education sector can be quite large, and their magnitude, and who will bear them, are not always fully understood until the initiatives are well underway. Decisions related to technology use in education can also carry large opportunity costs as well. Do you buy more computers or hire more teachers (or pay the teachers you already have better)? Where poor policies or practices are in place, simply extending them into the digital realm can have negative consequences. If you are pointed in the wrong direction, technology will help you get there more quickly.[33] And, it could be noted: 'More expensively' as well.

[31] *Margolin, J. et al. (2015). Evaluation of LAUSD's Instructional Technology: Year 2 Report. Washington, DC: AIR.*
[32] *Herold, B. "Big Hype, Hard Fall for News Corp.'s $1 Billion Ed-Tech Venture." Education Week, 25 August 2015.*
[33] *Haddad, W. (2007). ICT in Education Toolkit for Policymakers, Planners and Practitioners. Paris/Washington, DC: UNESCO/infoDev.*

Issues around student privacy and data security become more acute as new technologies are introduced into individual teaching and learning activities in ways that are increasingly integral and personal. In addition, the introduction of ICTs can (potentially) open a Pandora's Box of new inconveniences and threats as a result of things like so-called 'cyberbullying', intellectual property theft and 'cybercrime'.

> *How can policymakers chart a course for the future in ways that can ensure that today's students become tomorrow's engaged citizens and productive workers in ways that lead to greater levels of happiness, social inclusion, peace and prosperity across the hemisphere?*

The challenge and opportunity going forward: Access, equity and quality

Across education systems today, the relevant question for policymakers is no longer, *does technology make a difference?*, but rather, *how can technology make a difference – and what needs to be done in order to make this difference happen?* Attempts to answer such a question should consider issues and options related to access, equity and quality.

Access

A basic prerequisite for ICTs to impact teaching and learning in useful ways is that learners and teachers have access to it. Large scale government procurement of personal devices like laptops and tablets is an obvious way that some countries are addressing such access. That said, progress in providing access to the Internet to schools, teachers and learners, lags far behind progress in making available computing devices.

When it comes to technology use in education across the hemisphere, the access question has not been 'solved', and it won't go away. Indeed, advances in technology – and the emergence of new technologies – mean that, when it comes to technology use in education, *'access' will represent a moving target for policymakers going forward.*

Discussions related to 'access' can mean many things. In some places, these relate to access to hardware and/or connectivity, in other to specific educational content or opportunities, in still others to access to education more broadly. Setting targets related to the ideal, or appropriate, learner/device ratio within an education system – a common 'access' goal -- is only possible once there is first a clear understanding about what should be done – tempered by an understanding of what is affordable. The question should not be about whether or not to buy laptops or tablets, nor what the specs of specific devices or technology tools should be. Related discussions are of course necessary, but they should flow natural from a consideration of larger educational and developmental objectives – and not the other way around. Once educational objectives are clear, many relevant potential technology 'solutions' are known, and implementation can largely boil down to issues of financing, time, and political will.

Increasingly, the value of an individual device is not to be found in what the device itself can do, but rather in the type of connections – to content, to applications and services, to other people – it can enable. Setting targets related to connectivity is more difficult for educational policymakers, as doing so inevitably requires close coordination with other government ministries and the private sector in ways that are often new for education authorities. That said, efforts to promote better school connectivity led by groups such as Education Superhighway in the United States and the Lemann Foundation in Brazil [34] provide useful roadmaps and measuring sticks that can help provide practical orientation to policymakers across the region about how to make such plans – and how to go about realizing them. In some countries, this

[34] *Fundação Lemann. (2015). Escolas Conectadas: equidade e qualidade na educação brasiliera. Fundação Lemann: São Paulo.*

may help resolve questions about how to *get ahead* – in others, how to *avoid falling further behind*.

As more schools become connected to the Internet, there is a growing awareness that laying fibre to a school or providing access to the Internet via satellite isn't worth it if there is not sufficient connectivity within a school to provide access to this school level connectivity for teacher and students within a school itself. In addition, there is a recognition that providing access to the Internet from within schools only addresses one part of the Internet access challenge for learners. Efforts in countries such as Portugal, the United Kingdom and Estonia to provide subsidized access for low income students to the Internet at home through a variety of means are a reflection of this realization.

In many countries where 'bring your own technology' policies reflect the reality that government may not need to purchase devices itself for learners, or at least for certain segments of the student population which already has them (a computer a home, a smart phone in their pocket), issues around access to ICT are transitioning from efforts focused on the procurement of devices to the procurement of broadband Internet connectivity. This calls for an *expanded vision of access* -- not only focused on what is made available within schools, but rather what needs to be put in place to support learning, wherever it may occur.

Equity

While much of the rhetoric that has accompanied large scale rollouts of ICTs in schools have touted the potential of such initiatives to 'level the playing field' by providing access to learning opportunities and materials to all students that were previously only available to schools in relatively wealthy, urban environments. In reality, however, unless care is taken, efforts meant to reduce so-called 'digital divides' across an education system can have the opposite effect. Pro-equity approaches are possible, but don't happen on their own.

One approach for policymakers to consider is to *start down and out, and then move up and in*. What types of educational technology projects are most likely to scale across an entire education system: those that are piloted in relatively 'privileged' environments until they 'work', and then expanded to reach other, less advantaged communities, or projects that take the opposite approach? If it (the technology, the model, the approach) works in a privileged environment, success may be a product of a number of factors that that don't apply in other, less advantaged places. Education systems following this approach may well find that their 'learning curve' will be steeper in the short run, and the 'model' implemented may have more modest goals when compared with what can be achieved in some of the most privileged and advantaged schools and communities. But it just might work *everywhere, for everyone* – or, if not 'everywhere, for everyone', at least it might work in a lot more places and for many more students. Such an approach would inevitably focus attention and effort on addressing the needs and contexts in rural and poor communities, and on the populations in traditional disadvantaged groups more generally.[35]

While the record of 'impact' of educational technologies on student achievement is decidedly mixed, there is a group of students for whom the benefits are much more clear, and in fact can be truly transformative – those with various special educational needs. Targeted and more personalized learning programs for students who have visual or audio impairments, for example, or a variety of motor or cognitive challenges, can benefit greatly from the use of many ICTs technologies while at the same time helping to mainstream some students within more traditional learning environments.

[35] *See Trucano, M. "A different approach to scaling up educational technology initiatives", World Bank EduTech blog, 31 May 2013.*

Quality

Compared with addressing issues around ‘access’, for which many specific approaches exist and for which in the end success is largely a result of sufficient funding, time and political commitment, our collective evidence base on how new technologies can be utilized to improve educational quality offers less clear guidance. That said, there are general rules of thumb and approaches that appear to be important.

Experience from around the world reveals that, over time, the roles of ***teachers*** become more central — and not peripheral — as a result of the introduction of new technologies. The development of the types of so-called '21st century skills' — problem-solving, critical thinking, cross-cultural communication, etc. — as well as a variety of non-cognitive skills (such as grit and mindset) is increasingly considered to be important to success in academics, and in life. To a great extent, these are the sorts of skills that teachers, and not machines, are uniquely able to help students develop. But doing so is not easy, and often requires more highly capable teachers than many education systems currently have. Introducing new technologies will, however, replace some of the things that teachers do — and require that teachers take on new, often times more sophisticated, duties and responsibilities. That said, teachers who don't use technology will be replaced by teachers who do. An increased commitment to continuous, ongoing support for teachers through a variety of means will be critical if investments in new technologies in education are to be realized to their potential.

Investments in high quality digital educational ***content*** are also critical if investments in technology infrastructure are to pay off. The diffusion of technology tools and connectivity means that such content can increasingly be developed not only by traditional educational publishers, as in the past, but also potentially by many other groups, including teachers and students themselves. That said, support for vibrant, sustainable local educational publishing industries which provide affordable content in local languages in digital formats will be vital to help ensure that quality, curriculum-relevant learning materials are available.

The development of ***local capacity*** to oversee, implement and evaluate educational technology initiatives will increasingly represent a core competence of successful education systems. Such capacity will be beyond the means of government alone, and will need to be nurtured through a variety of partnerships with the private sector and civil society.

History has shown that technological change inevitably outpaces the ability of policymakers to ‘keep up’. In addition to the development of local capacity, education systems will need to place greater emphasis on and invest in ***monitoring and evaluation*** of ‘what works’ (and what doesn’t). ICTs themselves, it should be noted, can help greatly with such efforts. This pace of change will, like it or not, place a premium not only on good planning in advance of rolling out new efforts, but just as importantly, on the ability of key actors within an education system to ***experiment*** and quickly identify where things are not working, so that iterative solutions can be explored and implemented.

5. Conclusion

When it comes to the key decisions facing policymakers related to investments in new technologies in education, most of the key questions aren't actually about technology, but rather about people and institutions -- and eventually about the goals of education itself. Investments in the supporting environment and ecosystem of actors and stakeholders across an education system -- in the analogue components of our increasingly digital world, to borrow a phrase from the *2016 World Development Report*[36] -- are more important than new technologies themselves. If these aren't worked out, investments in technology may in the end only improve things at the margins – if at all.

Leaders will need to raise awareness of this challenge while working together with a diverse set of partners and stakeholders, across government and communities and in in concert with industry, academia and civil society.

Much known across the region, and around the world, about what doesn't work: *There is no need to repeat the mistakes that many other have already made.* As numerous cautionary examples from around the world have well demonstrated, when it comes to technology use in education, the costs of failure are potentially quite high. The stakes are high as well, however, and the cost of inaction may be higher still.

Given the many challenges affecting education systems across the region today, the potential allure of new technologies representing new solutions to old problems can be quite seductive. That said, while it is said that 'fortune favors the bold', no one would argue that success will come to the foolish or the rash. 'Success' will come in part as a result of a willingness to experiment and take risks – but calculated, informed risks. The capacity to take such risks, and to confront them successfully, will depend in part on high level leadership to make the case about why such investments are important, and to help identify the general route forward.

Technologies by themselves won't make education systems better. Education systems that are function poorly today will face further challenges in the future as a result of the complexities introduced by the widespread use of new technologies. Where technology is put forward as the 'answer' to many of today's educational problems, our leaders are challenged to make sure that we are asking the right questions.

[36] *World Bank. (2016). Digital Dividends. World Development Report 2016. Washington, DC: The World Bank.*

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