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TRANSFORMING LEARNING THROUGH THE USE OF EDUCATIONAL TECHNOLOGY:

Challenges and Opportunities in Latin America

Working Group on Innovation and Technology in Education

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INTRODUCTION

Latin America is facing an education crisis. More children and young adults are attending school than ever before, but an alarming number of them drop out or graduate without the requisite knowledge and skills. Experts are increasingly concerned that young Latin Americans are unprepared to be productive workers and informed citizens in a changing global labor force. This crisis is due in large part to the lack of innovation in schools where teachers continue to use ineffective pedagogical practices and outdated teaching tools.

The incorporation of technology into the school environment has had a limited impact as it has focused excessively on equipment and hardware without fundamentally altering learning processes. It is urgent to explore how children learn and education systems can be innovated more radically and sustainably by harnessing the transformative potential of communication and information technologies.

While there are valuable efforts within national education systems, institutional barriers and resistance to change limit their impact at scale. Political cycles also often lead to disruptions that affect the sustainability of such efforts. At the same time, few of the innovations that come from outside the education system have so far achieved the transformative scale that Latin American countries need.

Although there may be different reasons for the limited adoption of educational technology, what is needed now is to generate a transformative vision of how to propagate innovations in the region's education systems, especially by leveraging opportunities offered by a region with more connectivity and internet access every day and new technologies, such as artificial intelligence, cloud computing, Big Data and virtual reality, becoming increasingly important.

The ***Working Group on Technology and Innovation in Education*** has the mission of contributing to the formation of an education innovation ecosystem in which public and private sector actors collaborate to generate creative, technology-based solutions to Latin America's learning and teaching challenges. The group has chosen to focus on three critical areas that, together, are necessary to develop an innovation ecosystem that can foster increased benefits from the growing use of technology in schools: (1) transform learning experiences to motivate students and allow them to develop the skills they need to be successful; (2) improve the effectiveness of teachers using the opportunities offered by new technologies, and (3) improve the efficiency of educational management systems.

This report summarizes the results of the second meeting of the Working Group, on September 19, 2019 in Washington, D.C. This meeting was dedicated to the first agenda item: the role of technology in transforming the learning experience, the opportunities that exist for implementing solutions at scale, and the public policy challenges that must be resolved for these opportunities to materialize for students.

The first part of the document identifies the potential for educational technology to drive the transformation of the learning experience through successful practices and experiences. The second part considers the main elements of an innovation ecosystem that allow for successfully scaling up the educational technology to transform learning in all schools in Latin America.

THE TRANSFORMATION OF LEARNING WITH THE USE OF EDUCATIONAL TECHNOLOGIES

The state of education in Latin America is mixed. While there has been significant progress in terms of coverage and schooling rates, the quality of education still leaves much to be desired. The OECD's International Program for Student Assessment (PISA), which evaluates mathematics, science and language, placed the region in *the lowest ranking of knowledge and skills among the 72 participating countries* worldwide (2015).

In addition, the world is in the midst of a profound technological revolution. Incredible advances in computing, the growth of artificial intelligence and the emergence of big data are transforming all facets of life and work in leaps and bounds. As a result, the skills that are required to enter the job market are different from and go beyond what is traditionally taught in schools.

What should we do to prepare the coming generations? What skills do people need to develop in order to actively participate in society and compete in the labor market? How should education be transformed, and why is technology—when used correctly—the key to this process?

21st Century Skills and the Need to Transform Learning

There are several studies and organizations that have begun to examine in detail what the *future of work* in Latin America will look like as the digital transformation of society progresses and tasks that were previously carried out by people become automated. Organizations such as the *Inter-American Development Bank* and initiatives such as the *Future of Work in the Global South* seek to better understand the risks and opportunities that exist in this space and the kind of concrete skills that future workers will need.

At a high level, there has been a general consensus on these skills for several years. Known as *21st century skills*, they refer to the knowledge and abilities that children and adults increasingly need to participate in 21st century society. They are:

- **Knowledge of 21st century content and themes**: This skill refers to traditional and important academic content, such as mathematics, reading and science, as well as a better understanding and awareness of global environmental, civic and health issues.

  Learning and innovation skills: Skills necessary to navigate work and home environments that are increasingly complex and changing. These include critical thinking, problem solving, communications, collaboration, creativity and innovation.

- **Digital skills**: The skills required to adapt to new technologies and the abundance of available information. According to the DQ Institute, *digital skills* can be divided into three categories: (i) digital citizenship, or the ability to use digital technology and media in a safe, responsible and effective manner; (ii) digital creativity, or the ability to create new content and transform ideas into reality through the use of digital tools; and (iii) digital entrepreneurship, or the ability to use digital technologies to solve global challenges or create new opportunities.

- **Life and work skills**: These skills are important for adapting to an ever-changing, interconnected world with less job stability. They include flexibility, adaptability, initiative, self-direction, productivity and responsibility.

The traditional teaching model of education does not allow learners to develop many 21st century skills (see Table 1). Conceived for another era, it is based largely on learning information by memory, with active instruction from the teacher and passive reception of knowledge by the student. In this model, students are unlikely to develop their own initiative and creativity, or learn to collaborate with others.

Preparing 21st century citizens requires a paradigm shift that starts with prioritizing the student, allowing them to learn at their own pace, and doing so more actively and according to their context. The table below lists some of the most prominent ideas about the kind of changes proposed to make this transformation possible.

Technology for Educational Transformation

The use of educational technology is fundamental to transform the education system mainly for three reasons. First, technology is increasingly present in the world, and the jobs of today and the future are ever more tied to and dependent upon these tools. It is only by using technology that people can develop their digital skills. In addition, younger generations are part of the technological revolution; they have grown up with technology, and technology should be a central component in their educational context.

Second, technology democratizes access to content and instruction by breaking down barriers such as teacher shortages, high costs or geographical location. In other words, it allows learning everywhere and at any time.

And third, when technology is used correctly, it promotes personalized and active educational experiences, which allow for continued learning outside of formal contexts and facilitates the development of new skills attuned to the needs of the world today and in the future.

While there are mixed results regarding technology programs in education, here we offer some examples that have been successful in terms of scale and results and others that, while lacking rigorous evaluations, we believe exhibit some clear patterns and the potential to adopt technology successfully in programs aimed at transforming learning.

We do not see educational transformation as an option without the use of technology. Although there is always a risk of *program failure,* it would be hasty and erroneous to draw the conclusion that the absence of technology

TABLE 1: TRADITIONAL EDUCATION VS EDUCATION OF THE FUTURE

TEACHER CENTERED	STUDENT CENTERED
Standardized: Professor instructs students, who are expected learn at the same pace .	**Personalized competency-based**: Every student can learn at their own pace and move forward only when the lesson objectives are achieved. Teachers are coaches and facilitador.
Passive learning: Students listen passively and work mostly independently.	**Active and contextualized learning**: Students do interactive group work on and offline. Learning is relevant to their everyday life.
Closed door: Learning happens and is evaluated inside the classroom/school.	**Open door**: Learning happens in many settings and there is a myriad of ways to evaluate progress and competencies/ abilities of students.
Conceptualization: Teaching is based on concepts and memorizations.	**Practical knowledge**: Learning is achieved by putting into practice the acquired concepts and the way in which they can solve problems.
Disciplinary: Discussions are generated between similar, similar disciplines and formations.	**Interdisciplinary**: Recognizes diversity as an added value to enrich critical thinking and how to solve complex situations.

is a better option. In most cases, programs that use technology fail not because of the technology itself—which is a tool—but because of defects in the program's design, implementation and development. Therefore, the fundamental question that teachers, school principals and policy makers must ask themselves is, what is the ultimate objective they are seeking, and from there start thinking about how technology can be used to support changes in teaching and improvement and transformation in learning.

Content Democratization and Access to Cultural Heritage

Technology can improve traditional learning experiences by democratizing access to content, and removing barriers such as teacher shortages, high costs and remote distances.

The state of Amazonas in Brazil launched a program known as *Ensino Presencial com Mediação Tecnológica* (In-person learning with technological mediation), which currently serves more than 40,000 children in 3,000 remote communities that, until recently, did not have access to primary and secondary education. Classes are taught virtually in real time using video conferencing tools from a media center in the capital city of Manaus. Students attend a local classroom equipped with video and internet connection that allows them to interact directly with the remote teacher in Manaus, just as if he or she were present.

In a similar vein, some countries in Latin America have been experimenting with having English speakers teach languages via videoconference from their native countries, due to the lack of qualified local teachers. One example is the *Ceibal in English* program in Uruguay. The initiative reaches 80,000 children in 4th, 5th and 6th grades of primary school, and more than 17,000 students in the 1st to 6th years of secondary education. To date, the program's *results* have been very positive. In this model, the remote teacher does not replace the classroom teacher, but instead there is a transformation of roles. The local teacher plays an important role beyond managing class behavior, modeling how to learn, and thereby guiding students through the learning process.

Finally, technology allows access to cultural heritage, or those assets and resources that have historic, scientific, symbolic or aesthetic relevance. Globally, an important example is *Google Arts and Culture*, which allows anyone to access a vast global catalog of arts and culture relevant to society. The level of detail in the photographs presented there makes browsing the photos comparable to experiencing them in person. The *Biblioteca País* (Country Library) in Uruguay allows access to more than 5,000 books of literature for children, young people and adults, among which are many distinguished Latin American authors.

Customization, Flexibility and Learning Outside of Formal Contexts

Technology, especially artificial intelligence, allows us to identify knowledge gaps and/or misconceptions accurately, adapts to the needs of students and can be used in and out of formal learning contexts. The **Adaptive Mathematics Program in Uruguay,** known as *PAM*, is a good example of this potential. The program, whose content is aligned to the national curriculum, offers personalized support according to the skill level of each student. PAM has been implemented since 2013 in public schools, and its use continues to increase. In 2016, half of the students between 3rd and 6th grade were using it both inside and outside the classroom. A recent *evaluation* demonstrated a positive effect of 0.2 standard deviations on math test scores and determined that the impact increases as students' socioeconomic status decreases.

Mindspark in India offers another successful example: it is a learning software that adapts to the individual learning levels of students in language and mathematics. The program is administered outside the traditional school setting in computer labs. Children have 90-minute daily sessions: 45 minutes of individual computer work and 45 minutes in small groups with a tutor who instructs them. Mindspark diagnoses student misconceptions and provides individualized content to help children learn. The program has reached more than 400,000 students of all socioeconomic levels.

An *assessment* carried out by J-Pal at independent centers in India, which studied low-income government schools, found that the program had a significant impact on students at all income levels. The added-value for students who participated in the program was twice that of those in the control group (+0.37 standard deviations).

Just as Mindspark and PAM help personalize student learning in math and language, technology can be very useful for improving opportunities and outcomes for people with *special needs*. Customized applications, as well as the use of virtual reality (VR), can be beneficial

in shaping the learning process of people who, due to different types of disabilities and disadvantages (negative opinions and stereotypes, lack of physical access to learning spaces, difficulties for teachers to focus on students, etc.), have difficulty developing cognitive, behavioral, communicative and relational skills in their environment. Even where we do not find impact assessments, there are experiments that already have promising results such as *Picaa in Spain*, an application developed for children with autism, which showed improvement in language, mathematics, autonomy and sociability.

Betting on the benefits of technology in this field, the U.S. Department of Education announced in 2018 an investment of $2.5 million for *a new program* that will use **virtual reality** to foster social skills in students with disabilities. This is an extension of a program that has been developing technologies for students with special needs on computers and tablets since 2011. It should be noted that part of this investment aims to evaluate the programs in order to improve their design and implementation.

Technology allows teachers to identify conceptual knowledge gaps, adapt to students needs and can be used inside and outside of formal learning settings.

100% Virtual Learning

A very interesting example of how technology allows learning to happen anywhere, but especially outside of traditional contexts like school, is the case of *homeschooling* in the United States. Today there are nearly two million students, equivalent to about four percent of the student population, who learn at home. In recent years, this population has increased thanks to the opportunities opened by technological advancements. Twenty-six of the fifty American states now have several models of **virtual schools** accredited and integrated into the public system. While in some cases the learning is hybrid (i.e. the student completes lesson content online, but goes to school for tests or projects), in other cases it is 100% virtual.

Social-Emotional Skills Development

Technology, through the use of gamification (competition, interactive applications, etc), can improve students' motivation and develop their self-esteem and agency. In Chile, for example, a program called ConectaIdeas tracks how many exercises students complete on the application and presents different types of individual and group competitions to promote student motivation. The program has been implemented since 2013 and is administered to fourth graders in public school computer labs.

A recent *evaluation* of the program demonstrated positive effects on mathematical learning—0.27 standard deviation on the national standardized test. But the program also had both positive and negative non-academic results. It managed to increase "students' preference and motivation towards the use of technology for learning mathematics and promote the idea among students that the study effort can increase intelligence" (growth mindset). Among the less positive effects, there was an increase in mathematical anxiety and a reduction in students' preferences towards teamwork. These results suggest that gamification may be an important tool to generate motivation, self-esteem and agency, but we must also be attentive to unintended consequences that must be considered for the design, development and continuity of these types of programs.

Foreign Language

Increased motivation is not limited interactive math game programs. In foreign languages, for example, Duolingo is an example of an application that increases individual commitment to learning, while at the same time allowing democratized access to content and instruction.

Launched in 2012, *Duolingo* currently has 30 million monthly active users, scattered across 180 countries and learning 22 languages. Most of them are non-member users; in fact, only 1.75% of them pay for the ad-free version of the program. The platform is designed primarily for mobile users, and while it is sometimes used in schools (there is a version of the application designed for educational settings, which allows teachers to monitor student progress while the platform customizes exercises for each student), it is mainly used outside of classrooms.

Although there is plenty of information in newspapers about the impact of this application on language learning, academic journals only offer studies with small sample sizes that measure limited outcomes. For Duolingo, as well as other online learning platforms (such as Kahoot!), there is *little difference in academic achievement* between those exposed to platforms and those who are not. However, there is evidence of very positive perceptions regarding the format of online learning, learner enjoyment and level of difficulty. Clearly, more research is needed.

Computational Thinking

There are several technology platforms that promote the development of digital skills. Code.org and Scratch, for example, have seen their user numbers multiply exponentially around the world, including in Latin America. These programs are used to teach computational thinking, a subject that has been growing in importance around the world.

Computational thinking is not synonymous with programming. According to the authors of *Computational Thinking and the New Ecologies of Learning*, it is a basic skill that allows you to perform better in a digital society. It is a problem-solving process that includes formulating problems that allow learners to use technology, logically organize data and analyze it, represent that data through abstractions and identify and implement corresponding solutions. Seen this way, computational thinking is not a technical skill, but a creative way to approach and solve real problems in today's world.

Transforming Learning

The use of technology facilitates the transformation of learning processes that allow teachers to focus more on each student and support them in developing 21st century skills and abilities. This is the case, for example, with project-based learning, where students go far beyond knowledge acquisition to developing teamwork, communication skills and initiative. Likewise, utilizing technology in learning processes allows students to discover more pleasant approaches to concepts, formulas, numerical relationships, among others, since visualization and interactive activities can be more attractive.

For example, replacing a textbook with an e-Book is a classic example of substitution. If an e-Book can download content from the internet in a way that allows students to choose or supplement their assignments with different materials, there is an *improvement*. The same is true with teachers using free *Khan Academy* videos, which can complement lessons in various subjects. An initiative, I Connect to Learn, recognized in Chile's *Discovery Education* e-Books in math and science provides a platform aligned with the national curriculum. This platform contains a wide range of digital resources used by teachers and students in and out of the classroom like, for example, integrated training evaluation activities, practical activities, digital simulations, videos and support for teachers.

Educational transformation, however, requires that technology not be used simply to modify or improve an existing task, but also to create new ones that were not possible before. But, what happens when technology is used to transform traditional learning and better prepare children? Can teachers, for example, use technology to redesign traditional tasks and create new ones that were previously not possible or conceivable?

The use of technology facilitates the transformation of learning processes that allow teachers to focus more on each student and support them in developing 21st century skills and abilities.

Continuing with the e-Book example, we might suppose that a school aims to develop 21st century skills related to collaboration, creativity and critical thinking. To do that, they decide to give up a portion of classroom instruction and instead ask the children to prepare lessons outside the classroom using an e-Book, which can also contain adaptive learning programs, and come to class ready to discuss what they have learned and work in groups. This is called an inverted classroom, a form of blended learning. By removing the focus on instruction, the teacher designs classroom experiences that actively engage students at the individual level and in groups. If he or she wanted to go further, the teacher could also design experiences beyond

classwork, for example connecting students with others from different schools or countries, to develop projects.

The network of *Innova Schools* in Peru, one of the most innovative private school networks in the region, has been developing this model since its founding in 2011. With 54 schools serving 43,000 students in Peru, 70% of students' classroom time is dedicated to group work, usually project-based, and the remaining 30% is focused on self-guided learning, delivered through platforms such as Khan Academy. The role of the teacher in these schools is more that of a facilitator who guides the discussions and activities in the classroom, or a companion who watches over and gives feedback on the learning process of each student.

On the other hand, in 2014 Uruguay joined the *Global Learning Network* (New Pedagogies for Deep Learning), a global partnership that builds knowledge and practices to develop deep learning and transform education. Through project-based learning, student motivation is expected to increase, and academic content knowledge will be tied to real-life experiences. Educational technologies are an intrinsic part of this transformative process as they allow teachers to experience their roles differently, as is the case at Innova Schools.

The technological revolution will continue to rapidly change society and the workforce. In order for people to take advantage of opportunities in this new world, their ability to adapt, their initiative and their persistence to acquire skills and knowledge during their lives will be critical.

While the responsibility of education systems is to prepare students for this new reality, there are few examples in Latin America where this is happening. The movement towards a more student-centered, personalized education model that allows learners to develop 21st century competencies and skills must become the main objective of all stakeholders, including the state, teachers and the private sector. The use of a wide variety of technologies to facilitate this transformation will be fundamental. They are a critical tool for creating opportunities to democratize access to, customize and transform the teaching and learning processes.

The movement towards a more student-centered, personalized education model that allows learners to develop 21st century competencies and skills must become the main objective of all stakeholders, including the state, teachers and the private sector.

BUILDING AN ECOSYSTEM THAT FACILITATES THE TRANSFORMATIVE USE OF EDUCATIONAL TECHNOLOGIES AT SCALE

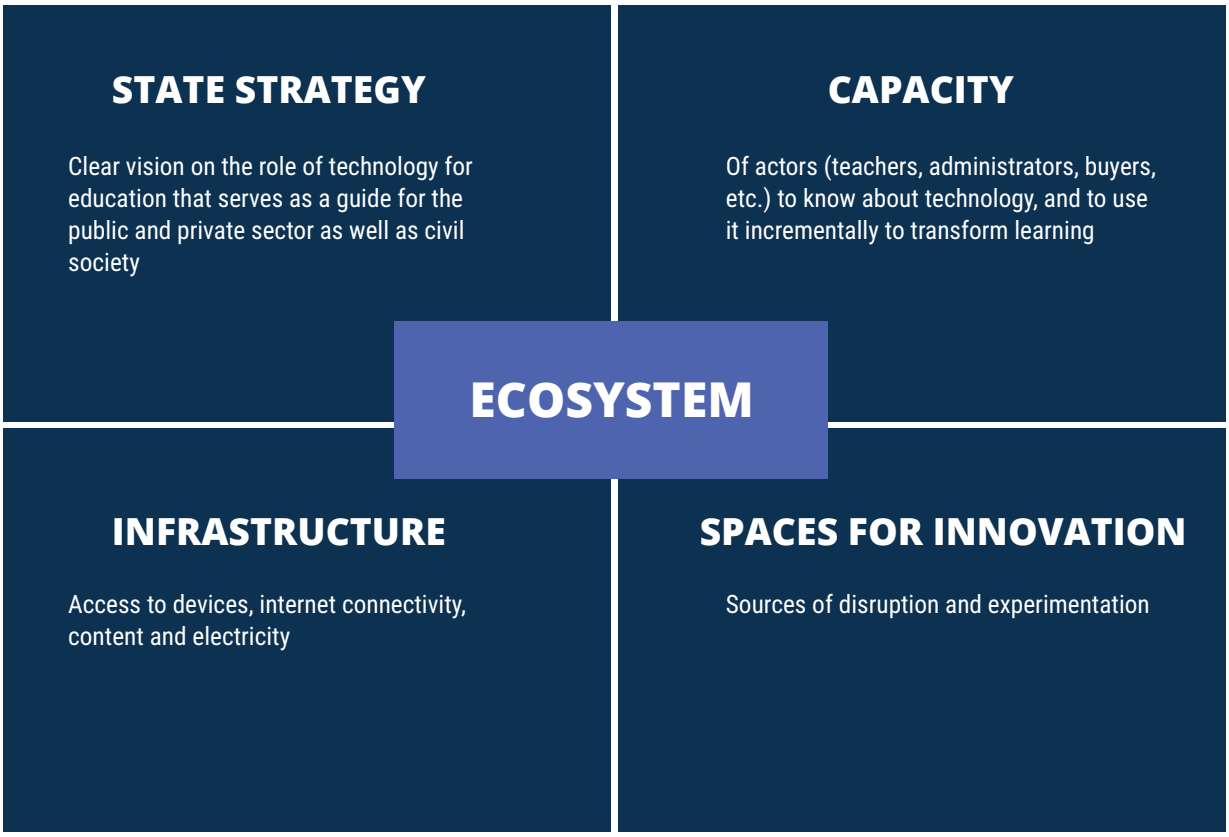
The use of educational technologies—implemented as part of a transformation of educational models—has the potential to improve the teaching and learning experience in and out of the classroom. Around the world, we are increasingly seeing successful educational innovations with digital technologies. However, in Latin America we do not yet see systemic technological changes. Instead, many initiatives remain stalled at the pilot stage or limited to small-scale experiences.

Are the conditions in place that would enable large-scale educational transformation? Will technology reach all students and classrooms equally? What are the main challenges and opportunities in this process?

These questions bring us to the challenge of having effective, stable, and established public policies to enable educational transformation.

The challenge is multifaceted as it demands actions in a variety of different dimensions, such as the existence of a long-term strategic vision, the building of human and institutional capacities (as well as infrastructure needed for their implementation), and the spaces for innovation that facilitate creativity and dynamism. In other words, it is necessary to build an *EdTech ecosystem* that allows for this much-needed educational transformation.

FIGURE 1: AN ECOSYSTEM FOR THE USE OF EDUCATIONAL TECHNOLOGIES



State Strategies to Scale Up the Effective Use of Educational Technologies

A critical step for scaling up educational technologies is a clear national vision that guides the decision-making within the education system and engages all relevant actors in the public and private sector, civil society, foundations and universities. This vision must have a high level of consensus and be expressed in a long-term strategy document that includes specific and measurable objectives, a concrete action plan designating responsibilities and resources, as well as the institutional commitment to support it.

In Latin America today, there is an express recognition of the importance of the use of technologies for education. A major set of countries in the region have programs or public policies that seek to enhance the use of technologies in the classroom. Some of them have a clear vision and objectives that mention multiple agents and/or institutions (they include not only the Ministry of Education but other state and non-state agencies) responsible for carrying out tasks. Examples of these programs include: Plan Ceibal in Uruguay, Enlaces in Chile and the Programa Nacional de Información Educativa (National Educational Information Program in English) operated by the Omar Dengo Foundation in Costa Rica.

But even in those countries where such plans and programs exist, the ongoing funding or institutional commitment—beyond a single political administration—necessary to implement them is not always guaranteed. In the case of Mexico, for example, there are several technology-oriented programs in schools, however their name and the funding focus may change depending on the government, making it difficult to follow through with plans. At the same time, the national vision, which is under the mandate of the Presidency of the Republic, focuses on digitization (*National Digital Strategy*) in general. The transformation of the educational experience is just one element of that strategy, which allows for flexibility in the implementation of the overall strategy depending on the priorities of the government in power. If the current government does not deem educational technology important for his agenda then he might leave out education as part of the digital strategy all together.

Promoting technology in education has to be a state-led strategy. Governments (and education ministers) change frequently, and that affects continuity in public policy. It is therefore necessary to create a national vision that enjoys broad consensus and translates into a long-term strategy with the requisite institutional supports.

Developing a truly successful state policy requires a set of critical elements. First, the national vision must be defined: What are the objectives that are to be achieved?, What is the role that technology plays in education and society in general? and What are the skills required of citizens? The strategy must respond to the needs of a 21st century population, and flexible enough to be adjusted periodically to cope with a rapidly changing world. Technology, and therefore the labor market, is constantly evolving and the strategy must reflect this dynamic. For this reason, the vision of technology in education must respond effectively to these challenges and contribute to the training of citizens to respond to the demands of the economy and society, both today and in the future.

The state cannot implement a successful policy without building partnerships and working together with members of the private sector, civil society organizations, philanthropic organizations, universities, etc. In many countries, the participation and involvement of local governments is also essential. Therefore, this policy should incorporate the various actors involved or affected by the policy, and must be expressed in a practical and sustainable action plan that is communicated to the whole community. Transparent communication allows for better incorporation of changes and greater community engagement, while recognizing pros and cons, including the risks of past experiences that may have negatively affected the public's expectations.

A central component of a cohesive national vision is an action plan. Such a plan must be defined with the relevant actors in order to be successfully implemented. To this end, it is essential to define clear and achievable objectives, including concrete indicators that will measure progress towards medium- and long-term goals. In addition, the plan must assign various stakeholders the responsibility to meet objectives, a monitoring and evaluation system, and regular funding. Ensuring that the plan is implemented efficiently and transparently requires clear leadership to guide implementation and build the capabilities and conditions for a robust technical team to execute effectively.

It is critical to shield action plans from political whims. Once these conditions are met, and in order to implement a coherent national vision, it is imperative to have an institutional structure that can guarantee continuity in the implementation of the plan, protecting valuable knowledge, long-term goals and budget resources from changing administrations. Achieving this most likely requires creating an entity that has sufficient administrative autonomy and permanence, as well as the necessary links and coordination mechanisms with key officials of all relevant ministries such as the Ministry of Education, of Information and Communication Technology (ICT) of Innovation, etc. The examples of Plan Ceibal in Uruguay and the Programa Nacional de Información Educativa (National Educational Information Program in English), operated by the Omar Dengo Foundation in Costa Rica, serve as inspirations (see Box 1). It is critical that the permanence and autonomy of these institutional spaces is sufficiently protected, which may require a legal framework to accompany or support its mandate.

The institutionalization of a regional space in which Latin American countries participate and exchange experiences in a permanent dialogue, is a mechanism that can also support continuity and avoid unnecessary disruptions in the implementation of educational technology policies. This space should be composed not only of representatives of governments, but also other actors including universities and civil society organizations. In this way, whenever there is a change of authorities, the new officials will have the information and knowledge of their peers from other countries. This interaction will help them adapt to their new roles, and allow all members to benefit from the collective wisdom that is generated over time. These spaces can also serve to reinforce the mutual commitment to advance the implementation of transformational strategies and make possible collaboration between countries in the region. An example of such a space is the *Alliance for the Digitization of Education in Latin America*.

BOX 1: THE CASE OF URUGUAY AND COSTA RICA

Plan Ceibal in Uruguay is an entity that was created in 2007 with the purpose of supporting the educational system in Uruguay through the use of technology. From its implementation, every child who is enrolled in the public education system can access a computer with a free Internet connection for their personal use. In 2010, Ceibal became an official state policy, with legislative support and funding, while maintaining its technical autonomy. This allows Ceibal to develop a plan of action with continuity that is not affected by changes in government. In addition, Ceibal's work in conjunction with educational authorities ensures that their initatives and programs are implemented at scale and throughout the country. Plan Ceibal has managed to expand its efforts by creating programs such as the Red Global de Aprendizajes y una Plataforma global en línea para enseñar Matematicas (Global Learning Network and PAM an Online adaptive platform to teach mathematics in English, respectively) just like Ceibal in English. All these programs benefit from the use of technology and promote the national vision that drives the transformation of learning in Uruguay.

On the other hand, the Omar Dengo Foundation in Costa Rica is a non-profit organization, whose objective is to develop new capacities for the population through innovative educational proposals with the use of new technologies. The foundation works autonomously with the support of a group of advisors from the Ministry of Public Education (MEP), which helps with the implementation of educational proposals within the framework of the Programa Nacional de Información Educativa (PRONIE MEP – FOD). Once again, having this connection with the national government facilitates the implementation of innovative programs that are not tied to the limitations of an agency such as the Ministry of Education. However, the Foundation is in constant communication with the Ministry so as not to duplicate efforts. The Foundation focuses on a variety of topics such as science, professional development, entrepreneurship and programming. All these programs benefit from the use of technology and new innovations to improve their development.

Capacity for the Effective Incorporation of Educational Technologies

To implement a national vision and action plan for the transformation of the learning experience across the education system, there must be sufficient institutional and professional capacity at various levels of the system. If ministry officials, teachers, and directors do not have the capacity to make informed decisions and effectively use technology, even the best plans will not lead to the expected results.

At a very basic level, having this capacity means knowing what technology to procure. Indeed, a central pre-requisite is that procurement decision makers (in the ministry or at sub-national level) have the skills and knowledge to acquire and evaluate the use of technology in schools. In Latin America today, the ability of public officials and institutions to make these decisions in an informed manner is limited.

It is not only the administrators in ministries who should have greater clarity about technology products but also end users that ideally must have a say in influencing such purchases.

It is critical to strengthen the knowledge of decision makers about purchases of services or the types of technologies that must be implemented in the classroom. These decisions are many times more complex than those related to the acquisition of physical goods like textbooks. Typically, it is necessary to define the device to be purchased (computer, tablet, virtual reality or other), which must be compatible with the type of infrastructure that the school has (broadband, wifi, electrical outlets and voltage, etc). Decision-making must also consider the systems and/or programs implemented, i.e. whether open or closed platforms are used, whether there is a direct internet connection all the time or whether the program can be used offline. There are several topics such as data management and storage, continuous service delivery, technological obsolescence and teacher training which should be taken into account when making purchases. When it comes to software and different applications, the ability to evaluate alternatives can be an even greater limitation.

While in most Latin American countries, schools do not have the authority to make decisions related to technology acquisition, the low capacity of schools to understand the pros or cons of what is being purchased may be a challenge when using what they buy. It is not only the administrators in ministries who should have greater clarity about technology products but also end users that ideally must have a say in influencing such purchases.

In addition to training, one proposition is to develop EdTech platforms that allow users to view reviews and facilitate the selection of technology products. For example, EdSurge in the United States is an open platform that contains research information, news and program reviews (organized by topic, educational degree, cost, etc.) that can be consulted by teachers and students.

A crucial element for the successful implementation of the national vision on educational technologies is teacher training. In effect, the introduction of technology into the classroom will not lead to improvements in learning if the teaching approach remains unchanged. This requires not only the familiarization of teachers with the use of new technologies but, fundamentally, that teachers have the ability to innovate pedagogically with technology. Therefore, adjustments to pedagogical models that tend to limit the teacher's actions are also a priority.

However, initial teacher training (ITT) in the region is very traditional. *Evidence* shows that there is a low degree of integration of Information and Communication Technologies (ICTs) into ITT, and very little research is being produced. An analysis of the use of *ICTs in ITT in countries in the Andean region* (Bolivia, Ecuador, Peru, Colombia and Venezuela), showed that there are different experiences of ITT, not all of which are aligned with international standards. In this region, *Chile and Uruguay* are benchmarks for their policies in educational technology and initiatives to incorporate ICTs into ITT.

Several universities in the region have recognized that it is necessary to incorporate ICT curricula into teacher

training. Therefore, they offer master's degrees and accreditation programs for teachers who want to learn more about the pedagogical use of technology (see Box 2). But beyond these specialized programs, it is very important to transform the learning of pre-service teachers by attracting talented applicants (through rigorous selection mechanisms, scholarships, incentives to join the teaching profession, etc.) who are motivated to change traditional learning models. Similarly, it is important to establish a feedback mechanism between in-service teachers and pre-service teachers regarding their classroom experiences in order to encourage creativity and the exchange of ideas from both sides. In the region, there are multiple examples of certification programs or master's degrees that require teachers to incorporate innovative initiatives in technology in order to complete the program, a good practice in that regard.

It is likewise essential to implement a capacity-building system that is not based on isolated trainings, but instead recognizes teachers' need for continuous monitoring and support. According to the OECD *Talis 2019* study, training in the use of ICTs is the second area mentioned by teachers as a priority for their professional development. In Latin American countries, this demand was expressed both by teachers who have participated, as well as those who have not participated, in training programs, reflecting the high need to increase training efforts in ICTs. Teachers understand that their students need to develop 21st century skills and recognize that students need appropriate training to use technologies.

Mechanisms to empower leaders in the field, such as recognizing teachers that effectively use technology and implementing teacher-mentor programs have been used in the past but must be expanded. Training should be part of a broad teacher support system, such as the *Ceibal Plan* in Uruguay where more than 28,000 teachers have participated in professional development activities.

The Enlaces program in Chile used components of its training programs in a *project in the Temuco area*. It was developed by the University of the Frontier Zone of Temuco (Universidad de la Frontera de Temuco) which adopts some of the components through its system of trainers of future trainers, where the training is carried out by mentors who must have experience in primary or early secondar education, and specific training in educational technology. One element from the program that stands out is that, upon completion, teachers receive a certification recognized by the Ministry of Education, which allows them to advance in their career ladder. In practice, the program has found that one way to address teacher training deficits is for highly experienced teachers to take on leadership roles to facilitate and coordinate the use of ICTs in schools after a technical training process. It has also been important to incorporate educational technology specialists who can guide teachers through certain studies or activities to help their students.

Technology can also play a facilitating role within the framework of coaching programs not specifically aimed at ICT training. In a coaching program implemented in the State of Ceará, in Brazil, teachers received self-help resources, such as books and examples of online videos, used Skype a regular basis to communicate and share experiences. An *impact assessment* of the program revealed positive results both in terms of teaching practices and student learning levels.

Training should be part of a broad teacher support system that recognizes teachers' need for continuous monitoring and support.

There are a variety of actors participating in the training of in-service teachers in the area of ICTs. A significant example for its scale is the *Telefónica Foundation*, which, through the ProFuturo program, has been implemented in 31 countries in Latin America, sub-Saharan Africa and Asia, training more than 300,000 teachers in digital education. The potential to coordinate diverse efforts within the framework of a national teacher training and support strategy is highly promising.

BOX 2: UNIVERSIDAD PEDAGÓGICA NACIONAL IN BOGOTA, COLOMBIA

The Master's Program in Applied Information Technologies at the National Pedagogical University in Bogota, Colombia, was created in 1992 with the aim of educating teachers and researchers in developing skills for incorporating ICTs in school settings to improve learning. Now 30 years in, this program has a 50 credit requirement that includes nine credits in the area of technology, nine in the area of pedagogy and ICTs, twenty credits in the area of research and twelve elective credits in academic areas that includes design of web environments, learning ecologies and writing scientific texts. A UNESCO report highlighted that a study conducted by the Bogota Ministry of Education, which aimed to identify good programs of educational informatics in the District, showed that a high number of students in this master's program managed or led these programs. Another important indicator of the master's success is the permanent publication of articles in specialized research journals by students (current and graduates). Finally, UNICEF concluded that the understandings gained in the master's degree are linked to the student-teachers' classroom context, allowing the results of the research projects try and resolve specific problems. This program has received accreditation in the years 1992, 2000, 2010 and 2016, by the Colombian Ministry of National Education and high quality accreditation in 2016. To date, the master's degree has 299 graduates.

Infrastructure as a Precondition to Scaling-Up Educational Technology

It is difficult to imagine a strategy that seeks to transform the learning experience for all students without ensuring connectivity in schools, regardless of their geographic location or the characteristics of students and their communities. Without connectivity—even if it is limited—the return on investments in devices and applications will be very low, and access to online educational resources will naturally be limited. Moreover, connectivity must increasingly be taken as a reality of today's world. Today's students will live in a connected and globalized future. Refusing to recognize this reality harms students and their ability to perform on an equal footing in the modern economy. Thus, efforts to universalize connectivity in schools must be an integral part of EdTech strategy and action plans that make up state policy in this area.

Infrastructure *gaps* are an important barrier. Many Latin American countries have made significant investments in devices (computers, laptops, tablets). For example, seven out of ten high school students have access to technology resources in schools. Most have access to desktop computers (71%) and laptops (50%) in their schools, compared to OECD levels (80% and 49%, respectively). However, these devices often operate within the framework of inadequate school infrastructure. While the percentage of primary school students with internet access increased from 47% in 2006 to 66% in 2013, the regional landscape is mixed, and there are significant access gaps in many countries (see Figures 2 and 3). While in Uruguay, primary schools have already achieved 100% connectivity, UNESCO reports that in 2017, only 40% of primary schools in Argentina had access to the internet, in Brazil, 62%, and in Colombia, 39%.

Latin America has been proactive in integrating technologies into schools, but structural problems persist, as well as deep inequalities between different social groups and geographical areas within countries (see Figures 4 and 5).

In addition, fixed internet coverage in the region is lower than the global average. Chile is the fastest-connected country (36.3 Mbps). In second and third place are Uruguay and Panama, followed by Mexico. Venezuela, which has the slowest fixed internet connection globally at only 3.53 Mbps, also has a high monthly maintenance cost, which can be a barrier for schools with limited resources.

A precondition to connectivity is adequate electrical coverage. In Latin America, electricity coverage is very high, and several countries (e.g. Uruguay) are reaching 100% electricity coverage. Countries showing high

electricity coverage in schools are Argentina (97%), Colombia (96%) Costa Rica (96%). In other countries, services are unreliable in certain areas, generally where people with access to limited resources live.

Achieving connectivity in schools should be an crucial aspect of any action plan. A clear starting point is to recognize the different realities within any country—rural or urban, high-income or low-income, etc—so that future plans can respond to these different needs and contexts. Even within the same country, there are differences between schools with internet connectivity. In Peru, for example, UNESCO reported that in 2018 41% of primary schools had internet access, while in secondary schools the connection rate reached 74%. In addition, the disparity between urban and rural sectors can be monumental. In implementing any educational technology strategy and its accompanying action plan at the classroom level, it is necessary to develop unique approaches to solving the connectivity challenge .

Implementing a plan where the goal is to ensure that the whole country achieves 100% connectivity and electricity in their schools can be an ambitious target in some countries with high rates of schools in remote and low-density areas. In rural areas, it may be advisable to look for innovative

FIGURE 2: RATE OF INTERNET ACCESS IN PRIMARY EDUCATION, TERCE - 2013

Source: CIMA, BID 2013

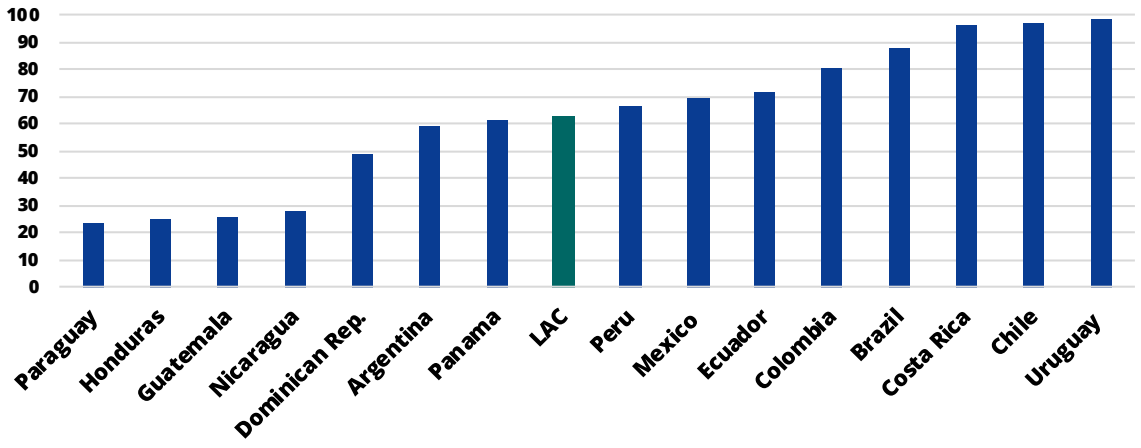


FIGURE 3: RATE OF INTERNET ACCESS IN SECONDARY EDUCATION, PISA - 2015

Source: CIMA, BID 2015

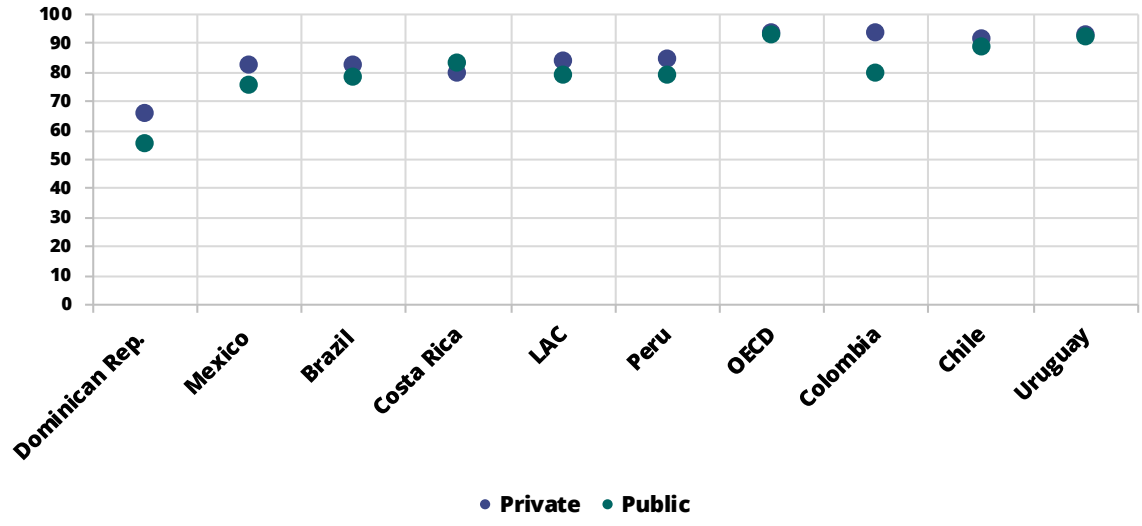
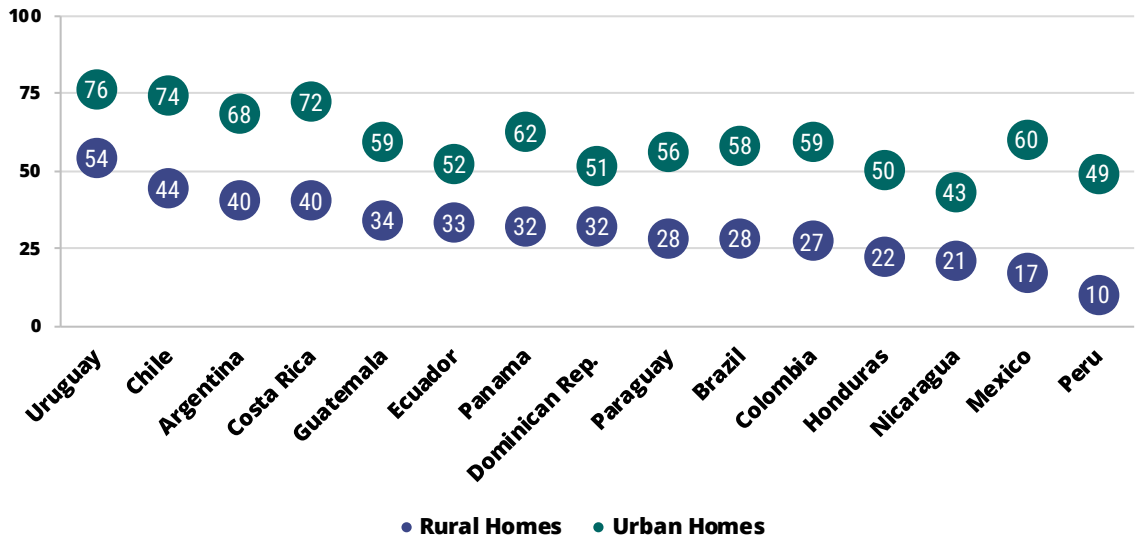


FIGURE 4: HOME INTERNET ACCESS BY GEOGRAPHIC LOCATION, 2013

Source: CIMA, BID 2013



alternatives to provide internet connectivity to schools without having to make large investments in laying fiber optic cable. There are options today such as TV white spaces, Loon's WIFI-providing balloons (project Loon), or connection via cell phones or satellite dishes. The *TV White Spaces* system, for example, is designed to transmit on VHF and UHF spectrum that was traditionally assigned for broadcast television and covers long distances making it an attractive alternative for rural areas. By leveraging these unused frequencies, internet providers can create wireless broadband connections while protecting broadcasters and other license-holders from harmful interference and reducing the total cost of extending broadband coverage to more isolated areas.

At the same time, evidence shows that an increasing number of users are *connected to the internet by mobile devices*, reaching a total of 62% of people (674 million) in Latin America and the Caribbean in 2017. There may be an opportunity to use mobile technology as an instrument for teaching, which would of course also mean a larger effort on the part of teachers to be able to adjust their traditional teaching plans. Teachers are finding innovative ways to use cell phones in an academic context inside and outside the room. Thanks to modern applications, teachers in the *United States* get their students to download material relevant to their lessons such as Reminder101 (which reminds students when they have assignments), iAmerica (which provides information about the history of the White House and American presidents) and LiveBinders (which allows students to collect and organize web pages and materials created in PDF or Word format in thematic groups). In Latin America, some countries have made strides to have high 4G connectivity, which deliver a better quality and faster connection. In Latin America the country best positioned in terms of connection availability are Uruguay (82%), followed by Peru (79%), Mexico (77%), Bolivia (74%) Argentina (74%). However, for many other countries connectivity is not as high.

Given the difficulties in ensuring constant and reliable internet access, programs that allow the use of offline educational technology (such as the *KA Lite program in Guatemala*) can also play an important role, with mechanisms for regular database synchronization and online resources. For automatic synchronization that is easy to deploy, cloud storage is an attractive option; the teacher can upload the relevant content for their class in applications like Dropbox or Google Drive and students download it before class to work offline.

Ministries need to seek and promote innovative solutions with urgency and long-term vision. The development of these action plans requires detailed and up-to-date information on which schools have internet and which do not. The reality is that many ministries of education in Latin America lack a comprehensive database of their schools and cannot easily determine investment needs to ensure universal connectivity. But beyond this very basic aspect, few ministries of education have played an active role in the search for innovative mechanisms to bring

internet access to schools. Addressing this gap requires the ministries to have a greater understanding of the situation on the ground, not only through better and clearer information about schools that need services, but by building partnerships with other ministries and public and private institutions to implement the necessary solutions.

A successful example of this type of partnership comes from Uruguay, where the massive expansion of connectivity in Uruguayan schools was the result of an alliance between Plan Ceibal and the state-owned telecommunications company, Antel. Both sides agreed that Antel would extend internet coverage throughout the national territory in a way that ensured connectivity for as many schools as possible. Of course, these types of expansion plans should include realistic funding strategies that support infrastructure initiatives to make meaningful changes. In this sense, it is essential to develop a modern financing strategy that includes public-private partnerships, venture capital, crowdfunding and other fiscal resources.

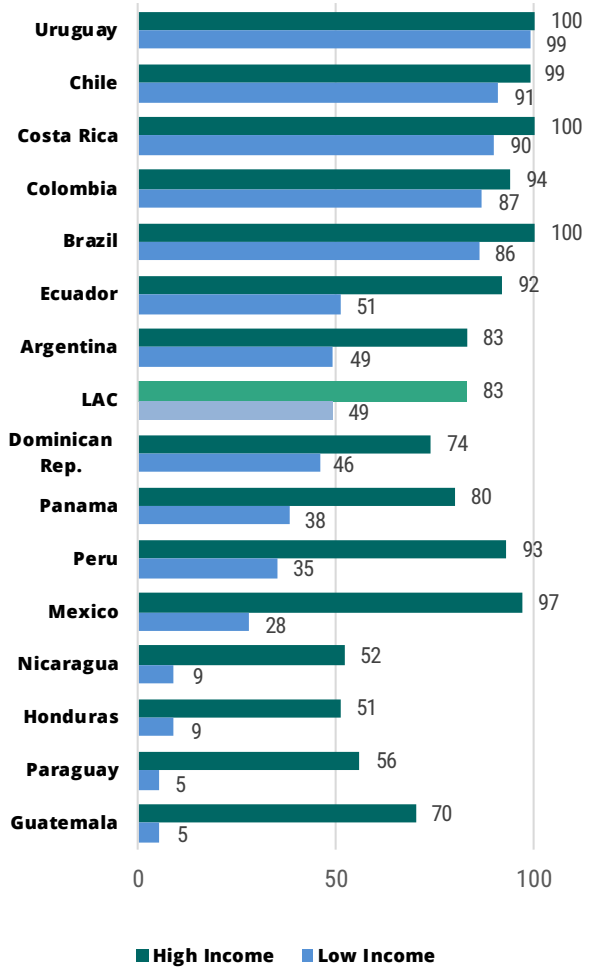
In Costa Rica, the Ministry of Public Education (MEP), the Ministry of Science, Technology and Telecommunications (MICITT) and the Omar Dengo Foundation (FOD) have begun working together with the purpose of installing an Educational Network that connects all schools in the country. To do this, they have developed a deployment and financing proposal that does not require additional fiscal investment. The idea is to take advantage of the private nature of the FOD and combine it with the institutional and legal supports of the MEP by transfering public funds to the FOD, in order to streamline the recruitment process and expand the funding sources (public and private) available to the foundation.

Another example of a public-private partnership that provides solutions for connectivity is *School +*, which seeks increase the connection in rural schools in Latin America through satellite and digital television plus DVR (Digital Video Recorder), provided by DIRECTV, which allows users to save and manage audiovisual content.

Continuous Innovation in Education for 21st Century Citizens

The incorporation and use of technology as a tool to transform the learning experience is not a one-time event, but instead a dynamic process that demands a clear and well thought-out research and development agenda.

FIGURE 5: INTERNET ACCESS BY SOCIO-ECONOMIC STATUS, 2013
Source: CIMA, BID 2013



Available technologies are constantly changing and therefore their application in the educational field must be adjusted periodically. Moreover, there is no model for education technology that will work for all students and in all contexts. It is therefore critical to have mechanisms in place to promote research and development of educational technologies and thus contribute to the continuing process of innovation in the sector.

This effort requires a systemic approach in which a variety of actors play an important role. Experience in sectors such as health or trade suggests that private enterprises (often small and medium-sized) can be an important source of innovation by developing new technology applications in service delivery.

While there is growing interest from the private sector in the field of education today, investments related to the

application of new technologies are still relatively limited: comparing the *EdTech entrepreneurial portfolio* we find an average investment of $300,000 versus $3.6 million in the offline education portfolio. For many new ventures, access to capital is difficult given the challenges of demonstrating impacts and thus attracting greater investment to bring their products to scale. But the main bottleneck faced by entrepreneurs is the difficulty of operating at scale in public primary and secondary schools. In many cases, these entrepreneurs express *frustration* with education officials' resistance to cross-sector collaboration and incorporating technologies into schools.

To open up spaces of innovation, **it is necessary to create more opportunities for small or medium-sized companies (even in their start-up phase)** to enter the EdTech market, either by adjusting the procurement processes, facilitating access to investment capital or providing access to technical resources for carry out impact assessments.

Universities, both public and private, are another stakeholder that can contribute to making continuous innovation possible by promoting research of teaching models using ICTs and collaborating with EdTech ventures (by, for example, evaluating the impact of their initiatives). The Centro de Innovación Avanzada en Educación (CIAE, Center for Advanced Innovation in Education in English) at the University of Chile is an illustrative case. It has a research area dedicated to information technology and education that has carried out projects in the classroom to investigate the impact of technology on student learning, including in areas such as gamification.

The establishment of innovation laboratories driven by ministries, but open to the participation of diverse actors, is a promising model. Many advances in the application and use of educational technologies are already happening every day in the classroom, but there are no mechanisms developed to (1) identify them, (2) support them, (3) evaluate them and (4) bring them to scale. The government is the greatest potential user of educational technology since the public system is the largest provider of educational services, but in general ministries prefer to acquire fully developed products with a proven impact and which are ready for large-scale implementation.

Generating strategic alliances where, for example, a philanthropic institution funds the pilot, universities evaluate impact and the government is committed to fund the move from pilot to final product, is a very attractive option.

Philanthropic foundations, which are already making significant contributions in the field of education, can also play a critical role in promoting and facilitating all these efforts. The case of the *Lemann Foundation* in Brazil is an example of a foundation that is making innovative investments in EdTech. Working with governments at different levels, entrepreneurs and civil society, the foundation has helped align the efforts of multiple stakeholders and thus helped in creating a strategic vision for the incorporation of technologies in schools throughout Brazil.

Ministries of education have an inescapable role in coordinating and managing these efforts. An interesting initiative of the Ministry of Education in Peru is *Minedulab*, a laboratory based on collaboration between non-profit organizations, Peruvian civil society and international organizations with the aim of promoting innovative interventions in education. This is done through developing projects that are evaluated using experimental methods and Minedu data and that, according to the evidence generated, can be brought to scale in schools. Minedulab is currently in its third cycle, where, out of 50 innovation proposals submitted by the offices of the ministry or the private sector, 4 initiatives were selected that are being designed to subsequently implement them and finally take them to scale.

CONCLUSION

The *Commission for Quality Education for All* concluded its analysis of new technologies in education by emphasizing that LATAM's country approach "*must shift from a shorttermist policy of simply providing students with computers, laptops and tablets, to one that creates links between access to the equipment and guided-use strategies, with specific contents by level and subject, and with clear targets based on measurable learning indicators*". There is a fairly wide recognition today that this is indeed the right direction and in many countries there are ongoing efforts seeking to implement that recommendation.

When considering educational technology and innovation in Latin America at the public policy level, the main challenge is less about what to do and more about how to do it. The emphasis, therefore, can no longer lie in finding a silver bullet (such as the distribution of equipment or the application of specific software), but instead in developing a systemic effort aimed at transforming the learning experience by making it more active and oriented to the acquisition of relevant competencies in which technology is an instrument and not an objective in and of itself.

This task requires educational authorities to play a strategic role in building recognition for the fact that a growth and development model must be based on the educational system in which it will be implemented.

At the same time, carrying out this model will be impossible without the active participation of multiple actors, including companies, universities and civil society organizations.

Teachers (and school directors) are also essential stakeholders in these efforts; without them, no educational technology strategy can be successful. Building and developing their capabilities should therefore be a key component of plans and strategies to scale technological initiatives. Recognizing this, the next step for the Working Group will be an analysis of how to improve the effectiveness of teachers using the opportunities offered by technologies.

Similarly, taking the transformative vision to scale will require more agile and efficient administrative and management systems that can generate and leverage information for decision-making at all levels. Again, the effective incorporation of ICTs into the management of school systems is a priority and will be an important aspect of the Working Group's future actions.

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APPENDIX

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