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One-to-One Laptop Programs in Latin America and the Caribbean

Panorama and Perspectives

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Executive Summary

The introduction of technology in education is gaining momentum worldwide. One model of incorporating technology into education that has gained tremendous traction in Latin America and the Caribbean is One-to-One computing. The term "One-to-One" refers to the ratio of digital devices per child so that each child is provided with a digital device, most often a laptop, to facilitate learning.

The objective of this document is to provide an overview of One-to-One implementations with a regional focus on Latin America and the Caribbean. It also proposes a systemic approach to improve the quality of education in contexts of mass laptop distributions to students and teachers.

The rationales for implementing One-to-One initiatives are frequently clouded by short-term political goals or by pressure from technology vendors. Nevertheless, from what the Inter-American Development Bank (IDB) has observed, the rationales and desired impact of One-to-One initiatives fall into three main categories:

- From an economic perspective, technology is seen as playing a major role in both the production processes and the results that these processes yield. Through the introduction of effective laptop programs, students can be better prepared to enter a technology-saturated workplace, maintaining a level of economic competitiveness.
- From a social perspective, laptops in schools are seen as a way to help bridge social and digital divides. They also have the potential to provide computer and Internet access to families and community members who would not otherwise have access.
- From an educational perspective, it is believed that laptops can facilitate new educational practices that are student-centered. They may also support the development of new skills and abilities required in the 21st century.

One-to-One models have been implemented in many Latin American and Caribbean countries including Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, El Salvador, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Paraguay, Peru, Trinidad & Tobago, Uruguay, and Venezuela. This paper provides an overview of these cases and others worldwide. The manners by which One-to-One programs have been designed, implemented, and evaluated are very diverse. Thus far, research has been inconclusive with regards to the economic, social, and educational impacts of One-to-One programs due to short time spans, lack of appropriate evaluation methodologies, and lack of commitment to study impact, among

other reasons. Since results vary with time and implementation, impacts should be evaluated over short-, mid-, and long-term time spans.

Given the IDB's experience with One-to-One initiatives in the region, we propose:

- A model of understanding One-to-One that focuses on the student and his/her learning results. Rather than describing the relationship between the digital device and the child, we describe One-to-One as the relationship between a child and learning, mediated by technology among other factors.
- A systemic approach to One-to-One design and implementation that simultaneously considers infrastructure, digital content, teacher training/support, community involvement, and policy.
- A general review of the Total Cost of Ownership (TCO) associated with these initiatives, which considers both the initial investment and its long-term sustainability.
- An emphasis on the role of monitoring and rigorous evaluations.

There is no silver bullet in education; in this sense, technology is no different from other learning interventions. To achieve educational, social, and economic progress, factors other than the sole distribution of laptops must be considered.

One-to-One: Why and what for?

Governments of both developed and developing countries are increasingly investing resources in the incorporation of technology in education. One model of incorporating computers into education that has gained traction in Latin America and the Caribbean (LAC) is known as One-to-One computing.[1] Low educational outcomes in the region have heightened public demand for new ways of improving education systems; One-to-One models appeal to many by presenting a high visibility program to improve education quality. Although promising in concept, One-to-One initiatives thus far have had little implementation time and varying results. This paper provides an overview of existing One-to-One programs and a new approach to understanding such initiatives.

One-to-One initiatives that we have observed in the region typically provide each child with a laptop for educational purposes. While the design and implementation details of these projects vary tremendously (as we describe further in the following section), the main rationales for investing in One-to-One initiatives are economic, social, and educational. These reasons are legitimate but require rigorous measurement to fully justify their investment. It is unlikely that the sole purchase of a device will meet all expectations of economic, social, and educational improvement simultaneously.

Clearly defined goals are essential to monitor the progress of One-to-One programs. Subsequently, each initiative should measure the impacts on the areas that it aims to improve. Thus far, consistency between the objectives proposed and the achievements evaluated has not been a strength of many existing One-to-One projects. For example, it is not uncommon for a program to launch as an educational project, and then be measured using social indicators. Aligning program goals with outcomes measured continues to be a challenge for many One-to-One programs in the region.

Despite the apparent popularity of One-to-One initiatives, we know little about their impacts and the existing research is inconclusive. In fact, some projects have had disappointing results in terms of design, implementation, and impact. This could be due to the short-term execution of the initiatives, the lack of appropriate measurement tools, and a lack of commitment to measure impact. Projects often are launched without clear goals, which makes them more difficult to measure.

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[1]　International Conference on 1-to-1 Computing in Education, Organized by the IDB, OECD, and World Bank in February 2010 in Vienna, Austria.

Defining One-to-One

The term One-to-One (often abbreviated as 1:1, 1-1, or 1 to 1) has been used to refer to the ratio of digital devices per child, with the goal that each child have access to a portable digital device with Internet access for educational purposes. Presently in the region, the devices most used for One-to-One initiatives are laptops (including netbooks, low-cost laptops). Thus, the scope of this paper will encompass only One-to-One laptop initiatives.[2]

Laptops for education have been used since their inception, but in 2005 this landscape changed dramatically when Nicolas Negroponte announced the One Laptop per Child (OLPC) initiative to design a $100 laptop for children in developing countries. The announcement of the OLPC device (referred to as the XO laptop) has been credited for prompting the netbook market, with other manufacturers quickly creating low-cost laptops of their own, some of which were especially designed for children and educational purposes. Intel released the Classmate PC, a netbook designed for educational purposes in 2006. The majority of One-to-One programs in LAC utilize one of these two netbook models, largely due to their price/functionality ratio. Typically, they are preloaded with basic software that includes word processors, Internet browsers, presentation software, multimedia authoring and design environments, calculators, games, and enable the use of sensors and robotics sets. The figure below provides an overview of laptop distribution in the region by device.

Table 1: Laptops distributed in LAC as of 2010

Hardware	# Distributed in LAC as of 2010
XO Laptop	835,115
Classmate	1,047,500
Other	15,000

Beyond their ultimate goal to provide children with laptops, One-to-One models vary tremendously with respect to hardware selection, ownership models, scope, and objectives. An ideal One-to-One program aims to offer 24/7 access to networked laptops, educational content, and Internet (Valiente, 2010). In reality, the implementation of a One-to-One project that fulfills its objectives is extremely challenging due to a variety of factors. The rationales and desired impact of each One-to-One initiative can also be very different, affecting program design and implementation.

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[2] While in LAC the term One-to-One most typically refers to each child having access to a laptop computer, the broader definition of One-to-One can include other digital devices. These devices include mobile phones, personal digital assistants (PDAs), tablets, and devices not yet brought to market. The use of such devices is beyond the scope of this paper, but notable with regards to other educational technology initiatives in developing countries.

Rationales and desired impact

From what the IDB has observed, reasons for choosing to invest in One-to-One computing models are as different as the projects themselves. Some of the justifications for implementing One-to-One programs given by policy makers include educational, social, and economic progress, or a combination of these (CEPAL, 2008). Some initiatives seek to improve the economic competitiveness of their countries by preparing students for a technology-saturated workplace. Others focus on equity of access to digital resources and reducing the digital divide. For other initiatives, the primary focus is to improve the quality of education through new practices such as student-centered learning. While these three foci are neither contradictory nor mutually exclusive, their prioritization is instrumental in properly measuring desired impacts.

Unfortunately, reasons for the proliferation of One-to-One projects are not always transparent. One-to-One initiatives have great political attraction. They present a high-visibility "quick-fix" to education quality and equity issues, and can be used for short-term political gain. The pressure from vendors who seek to widely distribute their hardware and software is also an important contributor to the phenomenon of mass technology distribution in education. Although we acknowledge the existence of these two factors, we will focus mainly on the positive justifications that have been given for implementing One-to-One programs: economic, social, and educational progress.

Economic

The economic rationale posits that information and communication technologies (ICTs) and investment in the region's human capital infrastructure are critical for economic competitiveness. Technology can play an important role by improving both the production processes and the results that these processes yield.

Access to technology and its appropriate use generally lead to greater productivity, hours worked, wages, economic growth, and innovation (Freeman, 2008). With the positive impacts of technology come concerns that countries lagging behind in ICT infrastructure, access, and labor skills will also lag economically, exacerbating the gap between richer and poorer countries (Campbell, 2001). According to the most recent World Economic Forum rankings, the only LAC countries to be ranked among the top 50 countries in global competitiveness were Chile (No. 30), and Barbados (No. 43) (World Economic Forum, 2010). One of the desired impacts of One-to-One initiatives is to address these deficiencies in ICT availability and labor skills.

Achieving a population that is proficient in the use of technologies is seen as fundamental for meeting the labor demands of the new economy, and a way of developing human capital to increase

the productivity of the workforce. The demand for employees with specialization in technology is growing at a pace that most labor markets can hardly meet. Those employed by the ICT sector are nearly 16 million people in OECD countries, representing approximately 6% of the OECD business sector employment and growing faster than most other sectors (OECD, 2010b). Employment in occupations that are not in the ICT sector but utilize advanced technologies also require such competencies. This has been shown in not only OECD countries but in Latin America as well (Blanco & López Bóo, 2010).
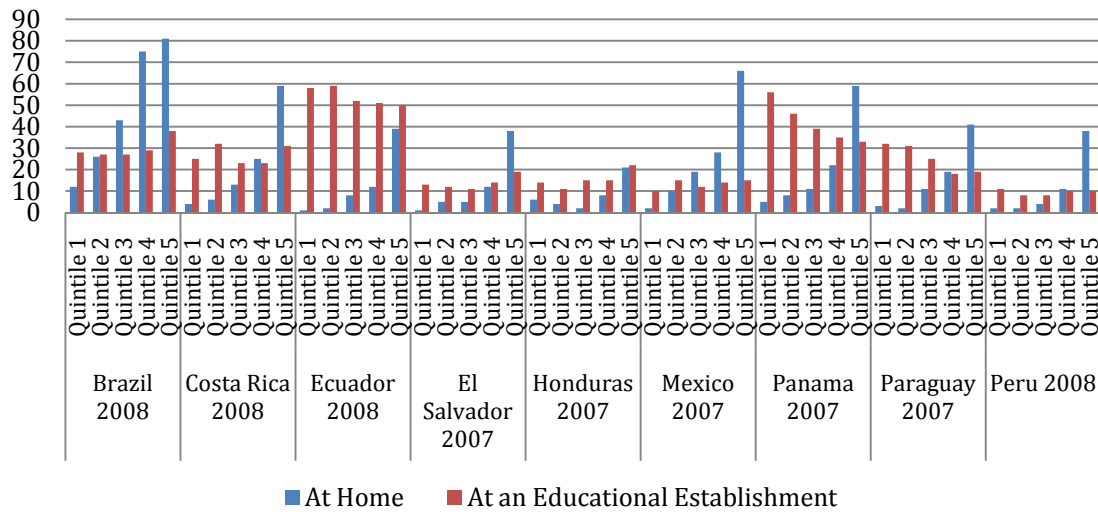
The economic rationale emphasizes the development of human capital for global competitiveness and new labor market demands. From this perspective, a rigorous evaluation aimed at studying the economic impact of One-to-One models would measure geographic regions as well as specific production sectors. Questions regarding whether participation in a One-to-One program improves student employability, income, career paths, and performance are still unanswered but important to better understand the economic benefits of such programs. On a larger scale, beneficial studies should aim to measure the quality of production processes or profitability of private sector entities that employ beneficiaries of One-to-One programs. Understanding the impacts of such goals requires measurement over mid- and long-term time spans; One-to-One initiatives that focus on improving economic conditions are long term investments.

Social

Social justifications for implementing One-to-One initiatives aim to reduce the digital divide and promote equity. Traditionally, the digital divide refers to the gap in access to technology, describing the differences in access between people of greater and fewer economic resources. As access increases (at least quantitatively), the digital divide also suggests a qualitative disparity in the way that technology is being used that is more cultural in nature (OECD, 2010a).

While the Internet penetration rate in Latin America (34.9%) is higher than the world average (28.7%), it still lags behind regions such as North America, Australia, and Europe (where Internet penetration rates are 77.4%, 61.3%, and 58.4%, respectively). Within LAC the distribution of Internet access is highly unequal; figures of Internet penetration range from 35.5% in Uruguay to 1.2% in El Salvador. In addition, within each country there is significant variation between the extreme income quintiles (CEPAL, 2010). Thus, the digital divide exists on both the international and national level.

Graph 1: Internet users between the ages of 10 to 19 by access point and income quintile

Horizontal axis categories (each country with Quintile 1–5): Brazil 2008, Costa Rica 2008, Ecuador 2008, El Salvador 2007, Honduras 2007, Mexico 2007, Panama 2007, Paraguay 2007, Peru 2008

Legend: ■ At Home ■ At an Educational Establishment

From this perspective, One-to-One initiatives are justified as an important step in closing the digital divide and promoting equity. This not only offers opportunities to children who receive laptops, but also to their families and community members. Laptop use of children, families, and community members can open new opportunities for participation, knowledge, and communication. When considering a One-to-One initiative with the explicit purpose of social impact, the ways in which the platforms can be optimally utilized by families and communities should be considered.[3] Detecting these social processes and supporting them as they align with the central effort is of great importance.

Designs that emphasize social change should specify expected outcomes. Measuring the effect of One-to-One initiatives on the reduction of social gaps requires a multidisciplinary approach that looks at short-, mid-, and long-term effects. In the short term, indicators for such research can include access to public services and goods, social organizations, and access to information and communication. In the long term, indicators for research should include social mobility, social cohesion, and social participation.

Educational

The educational rationale asserts that One-to-One initiatives, like other educational technology initiatives, have the potential to improve the quality of education. One-to-One models can provide

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[3] For example, in the instances of Uruguay and Paraguay, many spontaneous third parties arose to strengthen the social impact of One-to-One initiatives on communities.

personalized, student-centered educational experiences within school and beyond classroom walls. They can provide an education to students and teachers in remote areas. They also have the potential to address internal efficiency issues, academic achievement, and new skills required for the 21st century; they can be measured in the short term (up to three years), medium term (between three and six years) and long term (more than six years) according to the indicators selected in each case.

Internal efficiency

Higher quality education requires improved internal efficiency of schools; this includes goals such as higher rates of enrollment, attendance, promotion, and graduation, whenever possible. Any educational initiative

Table 2: 21st Century Skills
Ways of thinking   1. Creativity and innovation   2. Critical thinking, problem solving, and decision making   3. Learning to learn, metacognition   **Ways of working**   4. Communication   5. Collaboration and teamwork   **Tools for working**   6. Information literacy   7. Digital literacy   **Living in the world**   8. Citizenship, local and global   9. Life and career   10. Personal and social responsibility, including cultural awareness and competence

should aim to increase these metrics. Lack of motivation, low school participation, and poor expectations are known to lead to poor learning results. One-to-One initiatives can and should measure impact on these engagement variables. The expectations, opinions, and beliefs of different stakeholders (teachers, students, families, principals, community members, companies, and authorities) should also be considered.

At the systems level, the use of technology has the potential to provide inclusion for students who do not currently have access to educational opportunities due to geographic, social, or cultural restraints. In Latin America, One-to-One models could provide flexible educational offerings that would expand coverage, especially for secondary education.

Administrative data, surveys, interviews and other instruments are widely available for measuring these variables. The technologies themselves can provide an opportunity to improve data quality, supporting better and timelier decisions.

Skills

The ways we communicate, collaborate, learn, diffuse knowledge, and create knowledge, have all been profoundly influenced by technology. Despite these changes, education systems have been slower to adjust than other sectors of society (Davidson & Goldberg, 2009). Schools are challenged to meet the

demands of today's society and students, bearing not only the responsibility of preparing students for the 21st century, but keeping them engaged with learning and academic results.

The 21st century presents new ways of working, thinking, and living and therefore, a new set of abilities and competencies that youth need to master. Educating for "21st century skills" has become a high priority in the region. [4] These skills include increased creativity, innovation, critical thinking, real-world problem solving, communication, collaboration, digital literacy, and various levels of citizenship. Use of technology by students can facilitate the skills, learning, and type of thinking that the 21st century demands (Warschauer, 2005/2006). More specifically, it empowers children to collaborate with peers, learn independently, and communicate and collaborate on a global level.

Thus far there is no broad consensus regarding the definition of 21st century skills, how technologies aid their development, and which instruments can be used to measure these competencies. To address this knowledge gap, the Assessment and Teaching of 21st Century Skills (ATC21S) was formed as an international consortium of researchers from industry and academia dedicated to defining 21st century skills and developing ways to measure them using ICTs. [5] In its first year of work, it has proposed the definitions of ten 21st century skills, and is in the process of developing instruments to measure them.

The IDB is part of the initiative's Advisory Board, and is supporting a pilot in Costa Rica that aims to validate the proposed instruments in 2011. Meanwhile, there have been other attempts to measure 21st century competencies. The Raven test has been applied to study knowledge abilities, and the Universidad Católica de Chile developed specific instruments to measure the use of technology, collaboration, and communication. All of these are used and tested by the IDB in order to strengthen the battery of tests available for its member countries.

Academic achievement

As with all educational programs, One-to-One initiatives should aim to consistently improve and measure their impact on academic achievement. The measurement of academic achievement is costly and presents many limitations. Due to financial constraints, many of these tests are limited to Language and Math, and sometimes Science.

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[4]   The term "21st century skills" is controversial. There is no reason to believe that these abilities were not relevant in the 20th century, or will not be relevant after the 21st century. However, we use this terminology for consistency, due to the fact that a great deal of literature on this topic uses this term.

[5]   The ATC21S initiative was launched at the Learning and Technology World Forum 2009 in London and supported by Cisco, Intel and Microsoft. More information can be found by visiting http://atc21s.org. The Partnership for 21st Century Skills (www.p21.org) is another consortium on this theme, based in the United States.

Even with the challenges faced in measuring academic achievement, methods of measuring the impact of technology on curricular learning are essential. Such measurements should help identify pedagogical strategies for the use of technology in education that offer the best results. Indeed, technology itself can be used to measure academic achievement in a more effective, frequent, and economical way.

Thus far, studies regarding the effect of One-to-One laptop programs on test scores and other measures of academic achievement are inconclusive. The only two domains in which laptops have consistently shown a positive effect are computer literacy and writing (Penuel, 2006). Family and community involvement with a child's education can also lead to better academic results. Once educational practices have been modified and new pedagogical models are implemented, it is reasonable to expect that the use of technologies will improve educational outcomes in all subject matters.

The following table presents a tentative exercise in which we brainstorm some of the possible impacts of a One-to-One initiative on education by implementation time. Its purpose is to moderate the expectations surrounding what can realistically be accomplished in the best-case scenario of each implementation phase.

Table 3: Maximum Desired Impacts

	Short Term (Up to 3 years)	Medium Term (3 to 6 years)	Long Term (More than 6 years)
Internal Efficiency	Greater student interest in learning and attendance Higher expectations of teachers and families	Family participation in the educational process Better teacher-school-family communication Increase in promotion and graduation	Greater school and community integration Significant increase in coverage Decrease in overaged students
Skills and Competencies	Some improvements in communication, collaboration and teamwork Better technology skills	Development of critical thinking, strengthening of problem solving and decision making abilities Increased creativity and innovation	Development of metacognition, knowledge management, personal responsibility (life, career) and social responsibility (local and global citizenship)
Academic Achievement	Null or minor improvements in educational results (if improvements, most likely in Language)	Moderate improvements in some subjects	Significant improvements in key subjects

One-to-One Experiences

The following section provides an overview of One-to-One initiatives in the region and worldwide. In Latin America, One-to-One models are being implemented with great speed; it is the continent where the most One-to-One deployments have occurred. Many countries in the region have developed pilot projects.

Due to the pioneering stage of One-to-One in the region, monitoring and evaluation of ongoing initiatives is especially important. The countries in LAC provide an important source of knowledge regarding the expected impacts and conditions that are most appropriate for implementation. Careful and collaborative review of each ongoing experience is essential and currently being pursued by the IDB.

Some projects described below have benefited from the technical and/or financial assistance of the IDB. Other projects have been developed without formal involvement of the IDB, although it has developed a network of communication and cooperation with most initiatives. To date, nearly 2 million portable laptops have been distributed to children and teachers across Latin America and the Caribbean.

Table 4: One-to-One programs in Latin America and the Caribbean

	Start Date	Laptops Committed	Laptops Distributed	Educational Level	Institution	Current Reach
Argentina	2010	3,000,000	360,000	Secondary	National Government	Nationwide
	2010	60,000	60,000	Primary	Government of La Rioja Province	Regional
	2007	10,000	7,500	Primary	Government of San Luis Province	Regional
Bolivia	2009	**	**	-	Open Learning Exchange	Pilot
Brazil	2007	150,000	150,000	Primary	Ministry of Education	Pilot
		1,500,000	0	**	Ministry of Education	National
Chile	2009	30,000	30,000	Primary	Ministry of Education	Pilot
Colombia	2008	6,500	6,000	Primary	The Barefoot Foundation	Pilot
Ecuador	2010	4,020	**	Primary	Ministry of Education	Pilot
El Salvador	2009	6,000	**	Primary	Ministry of Education	National
Haiti	2008	13,700	**	Primary	Ministry of Education	Pilot
Honduras	2012	55,000	**	**	**	**
Jamaica	2011	115	115	Primary	OLPC Jamaica	Pilot
Mexico	2008	103,740	**	**	TELMEX	**
Nicaragua	2008	25,000	15,000	Primary	Zamora Teran Foundation	Regional
Paraguay	2008	9,000	4,000	Primary	ParaguayEduca	Regional
Peru	2008	800,000	330,000	Primary	Ministry of Education	Regional
Trinidad and Tobago	2010	20,300	15,000	Primary	Ministry of Education	National
Uruguay	2007	545,000	420,000	Primary & Secondary	LATU/CITS	National
Venezuela	2008	1,000,000	500,000**	Primary	Ministry of Education	National

** Official Information not available

Latin American and Caribbean Projects with IDB Involvement

Brazil

Project Description

In 2007, the Brazilian Government launched a One-to-One program called *Um Computador por Alumno* (UCA), with the goal of providing laptops for students in public schools. Phase one of this program launched with 5 separate pilot projects in Palmas, Piraí, Porto Alegre, São Paulo, and Brasilia.

In Palmas, the Department of Education of the State of Tocantins supported the pilot using donated Classmate laptops for students. Students used the laptops in three shifts; rather than there being one laptop for one child, there was one laptop per three children. In Piraí, The Federal University of Rio de Janeiro (UFRJ) was given sufficient Intel Classmates so that each child in the school could have his or her own laptop. In Porto Alegre, the Federal University of Rio Grande do Sul (UFRGS) implemented a pilot with XO laptops, with a ratio of one laptop per student. In São Paulo, the University of São Paulo implemented a pilot using XO laptops, each laptop shared by several students in different shifts. In Brasilia, the Education Secretariat of the Federal District in Brasilia coordinated the pilot in one school with the Mobilis laptop, donated by the Asian vendor Encore. The pilot in Brasilia was discontinued in 2009.

In 2010, after the experience in the five pre-pilots, the Brazilian government expanded the pilot project to a larger scale (phase two), including the purchase and delivery of 150,000 laptops to students in 300 public schools spread throughout all Brazilian states, benefiting both state and city school systems.

Beginning in 2011, UCA's third phase, known as Program UCA (PROUCA), the government provided funding for 1.5 million laptops through the Brazilian Development Bank (BNDES). These funds are available to states and local governments, who can apply to access funds for their projects. Unlike the first and second phases, in which the Ministry of Education donated laptops to schools, the third phase requires that the state or city governments acquire the laptops. They receive long-term, low-interest, tax-exempt credit from the BNDES, guaranteed by a national bid.

Highlights

The main conclusions of the monitoring process have been:

a) From the beginning of the program, the Brazilian government engaged researchers from several national universities to design, plan, and evaluate the national One-to-One project. Four working groups were created with the purpose of strategic planning, teacher professional

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development, project evaluation and research to be developed during the project's implementation.

b) UCA emphasized the **importance of pre-pilot projects**. Lessons learned throughout the pre-pilot and pilot stages helped inform later implementation and design decisions.

c) Pre-pilots demonstrated that **teacher training is critical**. In order for teachers to feel comfortable, they need sustained support and suggestions on how to best incorporate machines into the classroom.

d) Pre-pilots also showed that **children used laptops to become better communicators** and more enthusiastic about their learning. For example, by using laptops, students interacted with children in the UK to practice their English.

e) **Partnerships** with external agencies, companies, and organizations were originally lacking during the pre-pilot phase. Collaboration with multiple stakeholders could have made implementation easier and with more buy-in.

f) It was found that **technical support** is key to keep the program running smoothly. This technical support should include both hardware-related issues and software-related issues. Updating software and the operating systems was initially overlooked.

g) Another lesson learned is that **community involvement** should be an important component of a One-to-One program.

Further Information

Official website: http://www.uca.gov.br

Colombia

Project Description

The program in Colombia was launched in 2008 with the objective of improving Writing and Math achievement in vulnerable and displaced primary school children, especially second and third grade students.

The Fundación Pies Descalzos (FPD; translated as The Barefoot Foundation) partnered with the IDB, OLPC Foundation, and Alianza Educativa to pilot a One-to-One laptop program in 3 different locations: Quibdó, Barranquilla and Bogotá; the beneficiaries of all of the pilots were children who had been displaced from the guerilla combat zones.

In Quibdó, the Colegio Maria Barchmans was given 241 XO laptops for primary school students; pedagogical support was given from the Alianza Educativa. In Barranquilla, the Institución Educativa las Americas was given 126 laptops for students in the second and third grades. In Soacha, the Institución Educativa Gabriel García Marquez was given 278 XO laptops for students at the basic primary level, also accompanied by the pedagogical help of the Alianza Educativa.

Since the FDP's first experiences with OLPC, several other organizations have purchased XO laptops. The Fundación Gente Unida, Fundación Marina Orth, Ministry of Defense, and local governments have begun to participate in independent XO projects.

Highlights

a) This is a **small initiative developed by a foundation**, which implies different deployment conditions than a large scale public program.

b) This program has a special **focus on improving learning** in children living in especially vulnerable conditions, for which an abundance of teacher trainings and evaluations were developed.

c) Teacher training and measurement concentrated on the subjects of Spanish and Mathematics, in order to improve **basic learning**.

d) This program was deployed in specific schools (not in context of **saturation**, in which all schools in an area received computers) and only for specific grade levels (in other words, not all grades in a school received laptops).

e) **Preliminary results:** The evaluation for the OLPC Colombia program has not yet been published, but preliminary results were presented in November 2010.[6] A quasi-experimental study of 2nd and 3rd grade students in Quibdó, Barranquilla and Bogotá of each year (2008, 2009, and 2010) were used for the study (n=576). Students were tested on their language and math skills. It was found that the use of laptops was correlated with an increase in math scores across all three pilot programs. Language skills, however, decreased with the use of the XO. A full evaluation is due in 2011.

[6]   Sierra, P. (2010, November). *Evaluación de XO para la Fundación Pies Descalzos en alianza con la FIPC*. Presented at the New Paths for Learning International Seminar: Technology and Education. Fundación Omar Dengo, San José, Costa Rica.

Haiti

Project Description

Prior the earthquake in 2010, One-to-One computing in primary schools was part of the Haitian government's education strategy to encourage child-centered learning. In 2008, the Haitian Ministry of Education and Vocational Training (MENFP) and the IDB implemented and evaluated a pre-pilot program with the following objectives:

1. To gain knowledge and experience concerning the best practices for implementing and administering One-to-One initiatives in Haitian primary schools.
2. To identify best teacher training methods in the shift from teacher-centered to student-centered (constructivist) learning.

The pre-pilot was implemented in the École Nationale République du Chili (ENRC), an all-female public school in Port-au-Prince. 116 students participated in a summer camp, which took place daily from 8:30 AM to 12:00 PM from June 30, 2008 to July 18, 2008. XO laptops running the Sugar desktop environment were selected for the project. Laptops arrived with standard applications such as productivity software and media editing software. While there was an attempt to translate the laptop content from English to French (and in some cases, Haitian Creole), translation was not streamlined and therefore the majority of XO laptops used during the pre-pilot remained in English (Näslund-Hadley et al., 2009).

Following pre-pilot, the IDB and OLPC Foundation supported a larger-scale pilot that was to provide laptops to 13,700 students in grades 2 to 5 and 500 teachers in 40 communities and 60 schools. The plan encompassed the development of inputs for the project, including the development of content in Haitian Creole, teacher training, maintenance, and evaluation. As a consequence of the earthquake in January 2010, plans for the OLPC Haiti program have been suspended.

In addition to the IDB-supported OLPC project in Haiti, the Waveplace Foundation funded a pilot project in the John Branchizio School and Orphanage in Port-au-Prince in 2008. Since the earthquake, The Waveplace Foundation has been active in further piloting One-to-One initiatives in Haiti.[7]

Highlights

a) The implementation context was especially complex, addressing highly vulnerable sectors and populations that yielded restrictions on the **physical condition** of the available schools.

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[7] http://www.waveplace.com/

b) Due to the program's **social context**, many children preferred not to bring the laptops home, in fear that the machines would get stolen.

c) The **linguistic aspects** of this implementation have been key. Some machines were in English or French but not in the native language, Haitian Creole, which restricted use. A major contribution of the project was the translation of the interface to Creole and the development of literacy and numeracy content in Creole.

d) There was **concentration on few activities**. Based on observational and usage tracking data, four of the seventeen activities available on the XO laptop ("Record", "Write", "Browser Internet" and "Paint") represented 88% of participants' laptop use.

e) The **role of teachers is key**. Observational data on teacher engagement and student usage of the XO laptop suggests that increased levels of teacher engagement decreased levels of student distraction.

f) T**eacher involvement** is important and has an optimal state. Data show that when teacher involvement is very low or very high, student attention decreases.

g) **Preliminary results:** In 2009, the IDB published the pre-pilot evaluation of the OLPC program in the École Nationale République du Chili. Due to an unexpected shortage of laptops, rather than implementing the intended "One-to-One" program, the reality was a one-to-two computing model, in which children shared a laptop with one other student. Interview data revealed that the one-to-two model resulted in unequal sharing of the laptop, with the XO laptop being dominated by students who are better versed with the laptop or are more advanced academically. The attention of students was also affected by sharing, as students whose laptops were being dominated by their partner demonstrated a lower level of focus. The attention level of all children began diminishing once the XO battery began to lose charge. The simultaneous low battery life led to fights over electrical outlets mid-morning. More than half of students interviewed reported feeling afraid of taking the laptop home due to possible theft.

Interviews with students, school staff, and MENFP staff showed a perceived improvement in student reading and writing in Haitian Creole and French, as well as a general positive disposition of the XO laptop and its symbolism for opportunity and progress.

It was found that more guidance for students and teachers was needed with regards to the constructivist pedagogy. Although the essence of the pedagogy is knowledge through exploration, participants reported a greater need for help in learning how to use the XO and

assistance with the transition to student-centered learning. Interviews showed the need for thorough technical and pedagogical training prior to the introduction of the XO laptop into schools, as well as sustained support (Näslund-Hadley et al., 2009).

Unfortunately, due to the tragic earthquake that occurred in January 2010, no results of the larger-scale OLPC deployment are available.

Further Information

IDB Pre-pilot Evaluation: www.iadb.org/document.cfm?id=2062678

Paraguay

Project Description

In 2008, the Paraguay Educa Foundation, an NGO established for the purpose of implementing OLPC initiatives in Paraguay, launched project in Caacupé, the capital city of the Cordillera department. The organization is dedicated to using ICTs as a tool for student-centered and collaborative learning, integrating educational stakeholders within and outside of the classroom. The program launched with the following objectives [8]:

1. To implement a technological tool that significantly contributes to improving the learning and achievement of technological skills in Paraguayan elementary schools.
2. To promote digital inclusion and contribute to the reduction of the digital divide that exists within the country.

Paraguay Educa began its program in 2008 with the training of 20 teacher trainers, followed by 160 teachers. The program was implemented over the course of 2009 and 2010, with several months dedicated to professional development. Teachers received four weeks of intensive training on the use of the laptops prior to introducing the laptops in the classrooms. They also received classroom help by the teacher trainers once laptops in schools were distributed.

Paraguay Educa began with 4,000 XO laptops that were donated to them by the Society for Worldwide Interbank Financial Telecommunication (SWIFT). The deployment saturated 10 schools, covering approximately 50% of students ages 6-12 in the city. In terms of infrastructure, electricity was available in all the schools and Internet connectivity was provided by Personal, a telecommunications company that agreed to provide free Internet access to beneficiary schools during the OLPC program's first two years. Maintenance and technical support for hardware and software issues are handled by a small repair team, CATS (Centro de Asistencia Técnica y Soporte); this team has a central location in Caacupé but travels to the beneficiary schools to perform onsite maintenance. The educational digital resources used in classrooms are mostly preloaded XO applications. A digital library is also available for teachers seeking materials in Spanish.

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[8]   http://www.paraguayeduca.org/

Highlights

a) This project was designed and implemented by an NGO, although its scope is broad and intended to reach **saturation** so that all children in participating communities receive a laptop.

b) This project highlights the tremendous **importance of school leaders** in implementing the project in order to promote change in educational practices.

c) This experience has placed special **emphasis on community involvement**, both in terms of laptop care and use as well as the design of the teacher training program.

d) **Preliminary results**: Thus far, two formal evaluations of the OLPC program in Paraguay have been completed.

The first was executed by the ALDA Foundation, which was contracted by Paraguay Educa to assess the impact of the XO laptop from the views of stakeholders via observation. This study aimed to assess the overall impact of the addition of XO laptops in the educational community Caacupé, more specifically to: (1) Determine the implications of the incorporation of the XO computers in the learning process of students; (2) Explain the impact of the introduction of the XO in teacher performance; (3) Identify distinctive elements of performance management system from the school principals and the education community; (4) Specify the minimum infrastructure requirements for the proper conduct of activities. The study was conducted between July 2009 and June 2010 in three of the ten schools operated by Paraguay Educa, with two of them in urban areas and one in a rural area. It should be noted that baseline data was collected one year after implementation and therefore cannot be used as a true baseline (ALDA Fundación, 2010).

The second evaluation was executed by the Instituto Superior de Educación (ISE) to assess the impact that the XO laptop has had on the construction of social skills and citizenship from the views of stakeholders and observations in four different schools. Its objectives were to: (1) Characterize the methodology used by the teacher for the development of social skills in the construction of citizenship mediated by the XO; (2) Describe the educational use of software on the XO that enables citizenship learning experiences; (3) Identify the type of student participation that is generated in the classroom and at home with the XO; (4) Record the perception of students, teachers and parents about the XO in schools and at home; (5) investigate the issues involved with regards to the project's sustainability (Instituto Superior de Educación, 2010).

Both evaluations were qualitative in nature, with no baseline data by which to compare results. However, preliminary data from the first two evaluations of OLPC Paraguay have provided insight into the implementation and classroom use of the laptops. Both studies found that the physical infrastructure was sufficient, with all schools equipped with electricity and Internet connectivity; connectivity was generally perceived as stable by teachers and students. Laptop maintenance was perceived as very good, although some reports indicated a slightly understaffed maintenance team. Perhaps not surprising given that Paraguay Educa was founded out of community interest in the OLPC program, community inclusion for the program was positive, as were the attitudes and beliefs of the various stakeholders. While teachers generally desired to incorporate the XO laptops into their classrooms, they felt that more training and support was necessary to help them with specific classroom uses of the laptops. The ISE study noted that in some classes the classroom aides (teacher trainers) were disapproved of; rather than fulfilling their role as an aide or assistant, they were sometimes asked to replace the teacher completely, without the teacher's request. This was especially true in one school where the aide was asked by the administrators of the school to act as a substitute when teachers were absent. Both studies highlighted the importance of school administrators that were informed, motivated to implement the OLPC program, and provided teachers with pedagogical-didactic support. An interesting finding of the ISE evaluation was that the two rural schools used the XO laptops in a much more advanced way in their classrooms than the two urban schools did, despite more challenging entry conditions; the report attributes this to the administrators of the rural schools being much more open, involved, and supportive to the OLPC program. Educational impact was not an objective of either study, but it was noted that the laptops did bring a spirit of spontaneous sharing and collaboration. Further evaluations are necessary to fully assess the educational impact of the OLPC program in Paraguay thus far.[9]

Further Information

Official website: http://www.paraguayeduca.org/

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[9] Consolidation of ALDA Foundation and ISE reports provided to the IDB by Verónica Villarán, December 2010.

Peru

Project Description

The *Una Laptop Por Niño* program was launched in 2008 by the Peruvian Ministry of Education's DIGETE (Dirección General de Tecnologías Educativas) with the following objectives:[10]

1. To improve the quality of public primary education, especially that of children in the remotest places in extreme poverty, prioritizing multi-grade schools with only one teacher.
2. To promote the development of abilities recommended by the national curriculum through the integration of the XO computer in pedagogical practices.
3. To train teachers in the pedagogical use (appropriation, curricular integration, methodological strategies and production of educational materials) of portable computers to improve the quality of teaching and learning.

In line with the program's goal to benefit the most marginalized populations, the program started in the most remote and poor areas of Peru, in schools that were public, primary, and either multigrade or one-teacher schools.[11] Beneficiary schools received an XO laptop for each teacher and student; laptops ran the Sugar desktop environment in Spanish that includes games, productivity software, measurement tools, programming environments, and digital content. Given the very low availability of Internet access in beneficiary schools, DIGETE produced digital content for a USB drive to be distributed to teachers; digital content included manuals on how to use the laptops for subjects such as geometry, poetry, and basic health education. During the deployment, the main focus was on the distribution of computers and teacher training. The training sessions were expected to last for five days upon arrival of the laptops for eight hours a day. The content of the training sessions focused mainly on how to operate the laptops, with little pedagogical or technical support.

During its first phase in 2008, the program was launched in approximately 560 schools and 40,000 students received laptops. By the end of 2009, 170,000 laptops were distributed. To date, there have been 300,000 XO laptops distributed in Peru, with plans for the government to purchase and distribute 260,000 more laptops in 2011.

DIGITE has announced that they plan to buy an additional 300,000 XOs to build labs for secondary students. They plan to reach 2 million students with these labs.

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10   http://www.perueduca.edu.pe/olpc/OLPC_Home.html
11   One-teacher schools have all students receiving instruction together in one room by one teacher. Multigrade schools are characterized by having at least one classroom in which students of two or more grades are taught by the same teacher. These types of schools are predominately rural.

Highlights

a) The program's main **focus is on the rural sector**. The participating schools are multigrade or one-teacher schools in the most remote areas of Peru. The motivation for this preference is of social importance, as it seeks to address populations that traditionally have been marginalized from other educational improvement programs, but poses important logistical and technological challenges.

b) As a result of the aforementioned point, the program also attends populations with **great ethnic and linguistic diversity**. This has relevant cultural implications and presents challenges with regards to the provisions of digital educational resources (such as books, software, etc.)

c) The program worked with schools that had almost **no connection to the Internet** (only 1.4% of schools had Internet connectivity) and some that also had no electricity. This means that users only have access to the content and activities pre-installed on the machines.

d) The program opted for **high autonomy of schools and teachers**. Training was brief and emphasized the use of the machines, allowing students and teachers to discover their own ways of using them for their educational benefit.

e) **Preliminary results**: To date, the only formal evaluation of the OLPC Peru program is a randomized control trial (RCT) on short-term impacts by the IDB in collaboration with the Peruvian Ministry of Education (Santiago et al, 2010).[12] The Ministry of Education fully supported the evaluation, allowing it to be embedded in the 2009 deployment plans. The goal of the evaluation was to assess the impact of the program on school attendance, classroom time use, motivation, expectations, Math and Language test scores, cognitive skills, and non-cognitive skills.

Implementation of the program faced a number of challenges, in the first place related to infrastructure. Laptops arrived later than expected and when they did arrive, there was often no Internet access available in the schools due to geographic isolation. Electricity was available in 95.2% of beneficiary schools; connectivity was available in 1.4% of schools.

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[12] The IDB is developing a randomized evaluation to measure the short term impacts of the OLPC program on the educational practices and learning in multi-grade rural elementary schools. The evaluation is comprised of both qualitative and quantitative components. The qualitative component makes it possible to document the implementation and responses to the distribution of computers in some schools and shaped the design of study instruments. The quantitative component was used to measure the program's impact in the short term (between 12 and 18 months). Data was collected in 320 schools over the course of three months and then, one year after. Given the paucity of rigorous, quantitative studies on One-to-One initiatives in Latin America and the Caribbean, the IDB sees the evaluation as an important contribution to the understanding One-to-One education initiatives in the region.

By November 2009, when the first data collection began, 99% of schools had had the laptops for 3 months and 87% of teachers had been trained. This implies a very high capacity to implement what was proposed in the plan. However, teachers believed that training was not as robust as intended and focused mainly on basic ICT skills such as how to operate the XO laptops. 7% of teachers were visited by a specialist who provided them with pedagogical support.

Preliminary results showed that over the course of the three month evaluation period, use of laptops decreased over time, probably due to lack of pedagogical and technical support. Ninety percent of teachers claimed to use XO laptops for pedagogical activities; sixty three percent used laptops to prepare for classes. There was no gender or age difference in teachers' use of the laptops. The most heavily used applications were the word processor, sound/video recorders, calculator, paint, and Wikipedia. 56% of students reported taking the laptops home; of those, 50.4% reported a family member using the laptop as well. Of the 44% that did not take the laptop home, the most common reason cited was fear of the laptop getting damaged, lost or stolen. Sixty five percent of students who brought their laptops home did so every day; of those students, 80% used the laptops for one to two hours a day at home. Female students had a tendency to use the computer at home more heavily.

With regards to very short term impact (3 months average), the evaluation showed: (1) a slightly negative effect on motivation in students towards attending school; (2) no impact on Math and Language test scores, which is to be expected given the short exposure; (3) improved parent and teacher views on the availability and adequacy of educational materials; (4) improved teacher-student and teacher-parent relationships, reported by teachers.

This first report corresponds to a first collection of data, which described the implementation process of the XO in communities and first reactions. Currently, the IDB is processing data from a second data collection period done a year later, to follow up on the observed variables.

Given the vast implementation challenges faced by OLPC Peru in deploying laptops to the most remote and poor areas, the next phase of the project will focus on more accessible schools with better infrastructure to support a laptop program.

Further Information

Official website: http://www.perueduca.edu.pe/olpc/OLPC_Home.html

IDB Experimental Evaluation: http://www.iadb.org/document.cfm?id=35422036

Uruguay

Project Description

Uruguay's One-to-One initiative, Plan Ceibal, is the first initiative to achieve ubiquitous One-to-One computing in its primary public school system in LAC[13] and is one of the largest One-to-One programs in the world. It was initiated in 2007 with a primarily social rationale to close the digital divide. More specifically, the current goals of Plan Ceibal are:

1. To diminish the digital divide on a national level.
2. Through school, for a family to gain access to global information services, regardless of their geographic location or social condition.
3. To amplify the country's original innovations in an international context, as a result of widespread ICT use.
4. To improve the quality of the learning and teaching process, increasing motivation to involve oneself with the knowledge in children and teachers, and ensure their information literacy.

Plan Ceibal had also developed a set of educational goals for the program, which included:

1. To contribute to the improvement of educational quality through the integration of technology in the classroom, with the school and nuclear family in the center.
2. To promote quality of opportunities for all students in primary education, giving a laptop to every teacher and student.
3. To develop a collaborative culture along four lines: child-to-child, child-to-teacher, teacher-to-teacher, and child-to-family-to-school.
4. To promote literacy and electronic criticism in the pedagogical community adhering to ethical principles.

Plan Ceibal began deploying XO laptops in 2007, with a pilot in Villa Cardal. Subsequently, they proceeded to distribute laptops in the interior of the country first in 2008, then Montevideo in 2009. An emphasis on partnerships is a central characteristic of the program. For instance, to provide all students with Internet access, Plan Ceibal partnered with ANTEL, a government-owned telecommunications company that provided WiFi at a subsidized price. To provide teachers with resources and training on how to use the laptop, they created a television channel called *Canal Ceibal* that features different

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[13] As an anecdote, Uruguay was in fact the second country in the world to achieve XO saturation in primary schools. The first country to this educational goal was the Pacific Island of Niue, which has a total of 1,400 inhabitants and 500 students concentrated in one primary and one secondary school, all of whom received laptops in 2008.

uses of the XO laptop. With regards to repairs, Plan Ceibal trained repair staff and partnered with existing repair shops.

To date, there have been 420,000 XO laptops deployed in the country, as well as some Intel Classmates. Now that nearly 100% of primary school students own an XO laptop, Plan Ceibal is in the process of implementing a One-to-One laptop program for secondary school students.

Highlights

a) Since its inception, Plan Ceibal had broad **political support** from the Presidency of the Republic and leading authorities of the country. This was key in overcoming the initial difficulties and criticism that the program faced, and the early resistance from the education system. Over time, the project became a national consensus. All subsequent electoral candidates promised to preserve and continue the plan, which was a product of the citizens themselves perceiving the program as a symbol of progress in the education system.

b) Uruguay developed the plan with **ad-hoc institutionalism**, led not by the Ministry of Education or ANEP, but by LATU, the agency responsible for technology and innovation, and directives in which educational agencies also participated. This involved a steady advance of logistical and technical aspects and lastly, educational aspects.

c) Uruguay's **logistical implementation** has been admirable. Without a doubt, the country's geographic characteristics and size helped, but the management, distribution, tracking, and connectivity of laptops demonstrated tremendous efficiency.

d) The **technical support** system to respond to non-functioning laptops, however, is under revision. At the end of 2010, one study found that 27% of the laptops did not function. This problem has become a top priority. Explanations for this high percentage of broken machines could include the lack of care for the laptops at home or schools, or lack of clarity regarding repair mechanisms.

e) One central aspect of Plan Ceibal is that every participating school has **Internet connectivity**. Other public spaces were also given connectivity. Most recently, the country established Internet access as a basic public service, allowing every home to have basic Internet access for free (only paying for the router).

f) Although Plan Ceibal was initially an educational program, its leaders placed an early emphasis on its **social impacts** to lower some of the pressure on schools and teachers. In the medium-term, the project hopes to be an investment that is best reflected in improved educational outcomes.

g) **Preliminary results:**[14] In 2009, Plan Ceibal released a report on the Monitoring and Evaluation of the Social Impact of Plan Ceibal, led by LATU and ANEP, which began in mid-2008. The primary focus of the evaluation was Plan Ceibal's effect on social inequity reduction through the implementation of ubiquitous ICT access nationwide. Data was collected on primary and secondary students, teachers, principals, and parents using quantitative and qualitative methods. Taking advantage of the different implementation times between Montevideo and the interior of the country, the evaluation separately looked at Montevideo and the interior of the country. The report was released in December 2009.

The 2009 evaluation reported that Internet access increased significantly between 2006 and 2009. The percentage of students who access the Internet at school increased from 19% to 28% and 32% to 67% in Montevideo and interior of the country, respectively. Survey results indicated that 73% of all public schools had Internet connectivity, with 75% of respondents claiming the connection was adequately stable. More recent data suggests that by 2010, 95% of primary schools had connectivity, with the remaining 5% being in geographic areas that were remote or had little electricity. In addition, public outdoor WiFi spots are being installed so that the majority of children will be within 300 meters of the nearest WiFi spot.

Computer breakage was a problem initially, with almost 27% of the laptops not being usable in mid-2010. To address this, Plan Ceibal has collaborated with OLPC and local repair groups to improve their repair service. While laptops could always be sent to Montevideo to be repaired, Plan Ceibal began sending mobile repair teams to the schools themselves so that most problems with laptops can be repaired on site.

In terms of usage, the evaluation revealed that 55% of teachers use the XO for pedagogical purposes. 52% use it to teach mathematics; 46% use it to teach language. When asked why they did not use it more, many teachers felt that greater teacher support was necessary with regards to specific use of the laptop as it aligned with the curriculum. For the most part, teachers, students, and families favored the introduction and integration of XO laptops.

With regards to the change in educational practices, the most change was found in the interior of the country, with 61% of teachers reporting that the XO has changed their ways of teaching. This was less so for Montevideo, where 47% of teachers surveyed reported that the XO had changed their ways of teaching. From an educational perspective, however, the plan has had

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[14]   http://www.ceibal.org.uy/index.php?option=com_content&view=article&id=165&Itemid=58

some unique challenges in its implementation. The initial resistance of teachers added to the challenges faced with the introduction of a model that proposed change in educational practices, and not mere reinforcement of traditional practices.

It is important to note that in addition to the evaluation commissioned by Plan Ceibal, there are a number of independent evaluations already published and others still in progress. One example is the "Second Report of Cultural Images and Consumption in Uruguay", which surveyed 3,421 citizens on a series of questions, including some on their perception of Plan Ceibal. The University of La República has also committed funds to further study Plan Ceibal.

Further Information

Official website: http://www.ceibal.edu.uy

Official Plan Ceibal Evaluation:
http://www.ceibal.org.uy/docs/evaluacion_educativa_plan_ceibal_resumen.pdf

Other Latin American and Caribbean Projects

Argentina

Argentina has a number of large-scale One-to-One programs for primary and secondary students in the country; the main objective of each of the projects in Argentina is to close the digital divide.

The largest One-to-One deployment is *Conectar Igualdad*, a program launched by the government in 2010 to provide every public secondary school student and teacher with his or her own laptop. Nearly 3 million Intel Classmates are to be given over the span of two years. Students will have full ownership over the laptop, a 2 year warranty, and free 3G connectivity until graduation. The investment in this project is more than $750 million USD.

The province of San Luis has begun a province-wide One-to-One initiative as part of their investment in education, science and technology. Within the next 20 years, the province aims to achieve full digital inclusion and WiFi accessibility from any point within the region. As a secondary goal, the government seeks to increase math, reading, writing, science, and ICT skills to train more future engineering and science professionals. In 2007, a pilot project in collaboration with La Punta University deployed 500 Classmate computers to provincial schools in the region. Many positive effects in terms of student achievement and digital inclusion were found, prompting the government to purchase roughly 7,000 more Classmate computers. Over the next 10 years, the government plans to purchase 10,000 Classmates each year until all 104,000 school-age children have a Classmate. San Luis evaluation results have demonstrated notable improvements in language, math, and science achievement following the integration of One-to-One programs in their classrooms.[15]

The La Rioja province has also invested in a large-scale One-to-One program, committing 60,000 XO laptops to primary school students and their teachers. The first laptops were distributed in late 2010, with the rollout planned throughout 2011.

For more information, please visit:

http://conectarigualdad.gob.ar/ and

http://developer.intel.com/assets/pdf/casestudies/itc_edu_cs_wa_sanluis.pdf

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[15] Information presented at the IDB Seminar on Reinventing the Classroom, September 15, 2009, Washington, D.C., www.iadb.org/document.cfm?id=35158692

Chile

In 2009, the Chilean Ministry of Education launched an initiative called *Laboratorio Móvil Computacional* (LMC); this initiative is part of a greater government-run program that focuses on the incorporation of ICTs in schools. The LMC program aims to provide all 3rd Grade students in public schools with portable computers. Its primary objective is to improve the quality of education through the incorporation of technology into classrooms, especially in reading and writing abilities. Rather than students owning the laptops, the devices are placed on mobile carts that students are able to use in classrooms as they pertain to the lessons.

For more information, please visit: http://www.enlaces.cl/index.php?t=78

Ecuador

The Ecuadorian Ministry of Education signed an agreement in September 2010 for *Mi Compu*, a One-to-One pilot program in schools. The plan aims to distribute laptops to 3,200 students and 172 teachers in the city of Cuenca and 622 students and 26 teachers in the city Santa Elena. XO, Classmate, and HP laptops will be deployed and compared in terms of their technical and pedagogical advantages. The pilot will also offer robust technical support, computer maintenance, connectivity, and software for teachers and students; it is complimented with 120 hours of teacher training which consists of three modules: familiarization with hardware and software, pedagogical use of ICTs in the classroom, and an introduction to digital media tools such as specialized software for teachers, Internet research, and educational digital content. The objective is to study the impact of laptop computers on students and teachers, taking into consideration laptop deployment, capacity, and technical support.

For more information, please refer to: "Se Entregarán Laptops en Cuenca y La Libertad, Boletín informativo Pizarra, Ministerio de Educación, November 2010, No. 35.

El Salvador

The distribution of laptops is part of the Salvadorian Ministry of Education's *Cerrando la Brecha del Conocimento* (Closing the Knowledge Gap) program. In 2009, the Ministry of Education in El Salvador began a pilot program consisting of 400 XO laptops in the northern department of Chalattenango. After the pilot program, the government hopes to provide laptops to 800,000 primary school students in poor schools and low academic achievement. They plan to begin their large-scale deployment in 2011, so that 77,757 primary school students across 411 schools can have their own XO laptop. The maintenance and

development of this program over the next four years has been estimated to cost $246.2 million USD. The details of this program are yet to be confirmed by the Ministry of Education in El Salvador.

For more information, please visit:

http://www.olpcnews.com/sales_talk/countries/olpc_el_salvador_begins_with_4.html

Jamaica

At the end of 2010, OLPC Jamaica received 115 XO laptops to pilot. The program is still in its very early stages, but has selected three participating schools thus far: August Town Primary School, Providence Methodist Basic School, and Moneague College. Moneague College will use the XO laptops and software in their teacher training programs. The program will require teachers to use the XO in their Technology in Education course, and hopes to contribute lesson plans to the bank of Sugar lesson plans.

For more information, please visit: http://olpcjamaica.org.jm/

Mexico

There are a number of One-to-One programs in Mexico. The TELMEX Digital Education and Cultural Program and Carlos Slim Foundation purchased 50,000 XO laptops and 50,000 Classmate laptops for the *Digital Backpack* initiatives. To date, 80,000 have been deployed to students in the country. In addition, the General Office of Indigenous Education is supporting One-to-One programs for indigenous communities in Mexico. The State of San Luis Potosí has received 1,940 XO computers for the Pames and Huastecas communities. The State of Nayarit has received 1,800 XO laptops.

For more information, please visit: http://www.telmexeducacion.com

Trinidad and Tobago

In 2010, the Ministry of Education of Trinidad and Tobago launched a government-run program called *eConnect and Learn* (eCAL), which aims to provide laptop computers for secondary school students. The purpose of the program is three-fold: "(1) to arm each student to succeed in a knowledge-based world; (2) to narrow the national gaps and level the playing field giving each child an opportunity regardless of his or her circumstances; and (3) to equip the country with the tools it needs to become more developed".[16] Thus far, the ministry has been in the planning phases of the project, working with cross-disciplinary teams to implement the program in a manner that is educationally, logistically, and

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[16]   http://www.moe.gov.tt/spotlightPDFs/MOE_LAPTOP_PROJECT.pdf

politically sound. The Ministry has also been in the process of training over 2,000 teachers on how to use the laptops. The project cost a total of $83 million USD. Laptops are due to be rolled out in 2011.

For more information, please visit: http://www.moe.gov.tt/laptop_home.html

Nicaragua

One-to-One laptop programs were first introduced in Nicaragua in 2008, when TELMEX donated 3,000 XO laptops to the country; subsequently, the Waveplace Foundation helped with the piloting and integration of the XOs. In 2009, the LaFise BanCentro Financial Group invested private funds to create the Zamora Teran Foundation (ZTF), an organization dedicated to providing tools to underserved communities for a better quality education, specifically by supporting OLPC programs in Nicaragua. Close to $4.5 million USD have been donated to the foundation via private funds. Thus far, the foundation reports that over 300 teachers have been trained in the use of the XO laptop and more than 1,000 laptops have been given to students throughout the country. Preliminary results demonstrate an increase in student motivation, school retention, attendance, and school conduct.[17]

For more information, please visit: http://wiki.laptop.org/go/OLPC_Nicaragua

Venezuela

In 2008, the Venezuelan government announced a plan called "Proyecto Canaima: Uso Educativo de las Tecnologías de la Información y la Comunicación (TIC)" (The Canaima Project: Educational Use of ICTs).[18] This plan aims to provide every primary school student in 1st Grade with a Linux-based Classmate laptop. Thus far, the Venezuelan government has purchased 500,000 laptops from Portugal, whose version of the Classmate laptop is known as "Magellan". The government plans to purchase 500,000 more Classmates, totaling 1 million laptops for students and teachers in the primary education school system.

North America

Maine, USA

In 2002, the U.S. state of Maine launched one of the earliest and best examples of a statewide One-to-One program to date. WiFi-enabled Macintosh laptops were provided to every 7th and 8th grade child in the state. What has been called the "Maine Approach" (Warschauer, 2010) is an example of the initiative being implemented with a balanced view of technology's role in education. Unlike many other

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[17]   http://www.fundacionzt.org
[18]   http://www.radiomundial.com.ve/yvke/noticia.php?29519

One-to-One programs, it gave equal attention to hardware, infrastructure, curriculum, support, maintenance, and professional development. The Maine program has been highly successful since its implementation eight years ago.

Alabama, USA

In 2008, the Birmingham, Alabama school system decided to invest over $4 million dollars in an OLPC program, with the goal of reducing the digital divide that existed between suburban and inner-city students. Over 15,000 laptops were provided for every child in first through fifth grade. Little pedagogical support was given surrounding the laptop, resulting in very little use of the laptop. Only 20% of students reported using the laptops frequently and 31% of students reported learning more in class with computers. Since the children had full ownership over the laptop, when they graduated, the Birmingham school district held the financial burden of purchasing laptops for incoming classes. Funding for the OLPC Birmingham program has since been discontinued and the program has been labeled a "failure" by most stakeholders.[19]

Quebec, Canada

In 2003, the Eastern Townships School Board deployed 5,600 Apple wireless laptops to students and teachers in Grades 3 – 11. The program was implemented using the provincial curriculum in a socio-constructivist approach. The lessons learned from this early deployment are invaluable. Some of the observations included: (1) that while children do possess natural curiosity towards using the machine for learning, the integration of technology into their learning patterns was less smooth than anticipated; (2) that much teacher support was needed; (3) that One-to-One laptop deployments often go in phases with regards to the flux of excitement and frustration with the program.[20]

For more information, please visit: http://etsb.karsenti.ca/

Worldwide

Afghanistan

In 2010, an OLPC pilot project in Afghanistan was launched, deploying 5,000 XO laptops to Afghani students and teachers. This project is a collaboration between the OLPC Foundation, the Afghani Ministry of Education and Ministry of Communication and IT, PAIWASTOON (an IT company, USAID's Afghanistan Small and Medium Enterprise Development. Thus far, the focus of the program has been on

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19   http://blog.al.com/spotnews/2010/07/study_shows_majority_of_birmin.html
20   http://www.olpcnews.com/countries/canada/technology_in_education_integr.html

content, with the goal of providing teachers and students with a tool that allows them to develop interactive lessons. There is also an effort to evaluate the OLPC Afghanistan program alongside other, non-ICT educational interventions.

For more information, please visit: www.olpc.af

Australia

Australia was one of the first countries in the world to pioneer a One-to-One laptop program in schools, beginning in 1990. Currently, there are laptop initiatives on the state and national levels to incorporate laptops into schools. In 2009, New South Wales implemented a policy in which all public school students in grades 9 through 12 were to be given netbooks. Thus far, 130,000 have been distributed; all netbooks are scheduled to be distributed by 2012. Laptops come preloaded with Microsoft and Adobe applications, Internet filters, and software that monitors students' computer use remotely. In 2009 Victoria began a three year pilot in which 100,000 students in grades 5, 6, 7 and 8 across 344 schools were given laptops. Students are asked to pay $52 AUS a year to lease the laptops. More recently, the federal government allocated $91 million USD to provide 141,000 laptops for students in grades 9 through 12. To support the program over the next six years, the Australian government has allocated $1.3 billion USD. On a much smaller scale, an OLPC Australia program was launched in 2008, targeted towards students in poor or remote areas of Australia. Thus far, 1,500 XO laptops have been deployed in Australia.

For more information, please visit:
http://www.deewr.gov.au/Schooling/DigitalEducationRevolution/Pages/default.aspx

Austria

Austria is one of the few European countries to have experimented with one-to-one laptop programs in the classroom. In 2008, a small pilot was launched with 25 1st Grade students, as a collaboration between OLPC Austria and Graz University of Technology. Lessons learned from the pilot highlighted the importance of the role of the teacher when implementing laptop programs into classrooms.

For more information, please visit: http://olpc.at/pilot/?setlang=en

Nepal

The Open Learning Exchange (OLE) runs an OLPC program in Nepal. To date, approximately 2,200 XO laptops have been distributed in 26 schools in 6 provinces in Nepal. One of the main focuses of the OLPC Nepal program is educational content; the program has two main bodies of content: (1) E-Paath, a body

of interactive learning materials developed to align with Nepal's national curriculum and learning objectives available for school subjects in English, Mathematics, and Nepali; (2) E-Pustakalaya, a digital library containing literature, newspapers, maps, and photos.

For more information, please visit: http://wiki.laptop.org/go/OLPC_Nepal

Portugal

In 2008, the Portuguese government invested in a One-to-One program for primary school students ages 6 to 11 so that each child have his or her own Classmate PC. The objective behind this investment was computer literacy, so that every member of the future workforce would know how to use a computer, which ultimately can benefit the country's economy. To date, 500,000 Classmate computers have been deployed, loaded with educational software and WiFi capability.

For more information, please visit: http://www.portatilmagalhaes.com/

Rwanda

In 2008, OLPC Rwanda launched a One-to-One program, primarily led by the OLPC foundation. 100,000 laptops have been ordered, and 60,000 have been deployed. The nature of the OLPC Rwanda deployment is primarily offline, given that 96% of intended beneficiary schools do not have Internet connectivity. Little information is available regarding the current status of the OLPC Rwanda program.

For more information, please visit: http://wiki.laptop.org/go/OLPC_Rwanda

Spain

In Spain, the Escuela 2.0 (School 2.0) Initiative aims to foster a 21st Century classroom, where the use of technology is integrated into every day school work. Launched in 2009, the program aimed to give laptops to 400,000 students and 20,000 teachers over the course of the 2009/2010 school year. In addition, 14,400 classrooms will have interactive white boards and WiFi installed. Over the next four years, the program aims to convert all classrooms to digital ones for grades 5 and 6 of primary school and the first two years of secondary school. The program is estimated to cost $200 million EUR.

For more information, please visit:

http://www.educacion.es/horizontales/prensa/notas/2009/09/escuela2p0.html

A Model of One-to-One Implementation

Redefining One-to-One

One-to-One models are typically defined by the literature as the distribution of one digital device per child. However, this definition has at least three aspects that seem problematic to us:

1. From an educational viewpoint, it focuses the discussion on the relationship between the child and his or her digital device rather than the essence of the experience, which is how the child makes use of that device to mediate learning.

2. Along these lines, it establishes an a priori vision around the advantage that a child has administering their digital device (whether they own it or not), without considering the options that permit a shared or collaborative use of different technologies.

3. From a technological viewpoint, children are increasingly gaining access to a number of personal digital devices (such as laptops, home desktops, school desktops, mobile phones, tablets, etc.) that interact to form a cross-platform and coordinated experience. This makes the very notion of One-to-One, as the ratio of one digital device to one child, anachronistic.[21]

For these reasons, we propose a different way of understanding "One-to-One". This model is preliminary, with the intention of adding to the discussion surrounding pedagogical models appropriated to this kind of initiatives. Therefore, although based on the experience gained by the Bank, and the review of available knowledge, is an attempt open to review and dialogue.

Rather than referring to the relationship between the technological device and the child, we propose a One-to-One conception that describes the relationship between the child and his or her learning, hopefully resulting in an increase in academic achievement.

Image 1: The "One-to-One" relationship

| 1	:	1
digital device	⟹	one child
one child	⟹	learning

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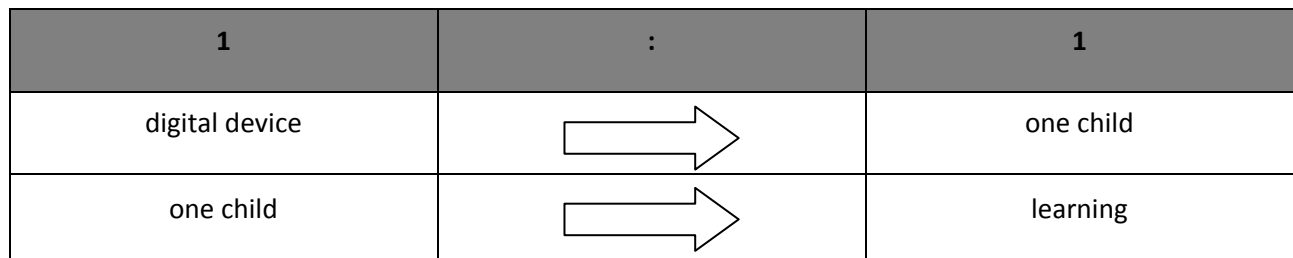
21   In Australia, for instance, some schools are now creating infrastructures that can support two devices per child, so that each child may use a combination of laptops, tablets, and mobile phones for educational purposes (Macpherson, 2010).

This new way of describing One-to-One models proposes the following:

1. The student's process of acquiring and constructing knowledge is at the center of the educational task. This can take place within formal and informal learning environments.

2. Digital technologies should be viewed in a context by which they are part of the many inputs in the student's learning process. Along with other factors, technologies interact dynamically with the curriculum, school, teachers, school texts, libraries, infrastructure, and school nutrition programs, among others. The efforts within an education system should be oriented towards learning and the provision of the inputs that facilitate it.

3. Technologies in education can play a disruptive role in the organization of teaching and learning processes. They are an agent that can substantially modify the relationship within diverse inputs, and can be a catalyst for change.

4. The inclusion of personal digital devices allow, facilitate, and sustain the development of the personalization process for learning. It allows educational processes to respect the pace, interests, and abilities of students, in a way that they are protagonists in their learning process.

From this perspective, a One-to-One model refers to the relationship between each student and their learning, which generally occurs in school, but also in and during many other spaces and moments:

Image 2: New One-to-One model
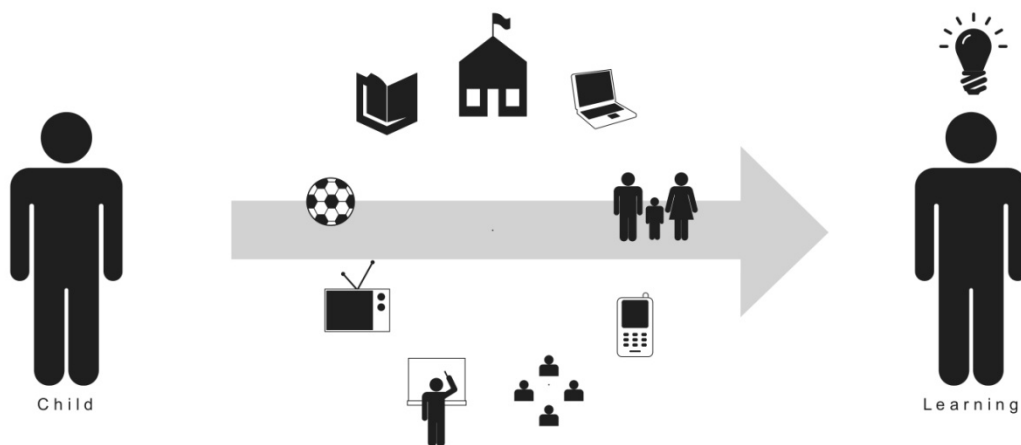
In this model, technology is not simply an input to be "added" to educational systems, but valuable precisely for the opportunity to reorganize educational offerings. If the introduction of technology, particularly a One-to-One model, does not fulfill the disruptive role of restructuring educational offerings, modifying pedagogical practices, introducing new learning experiences that go beyond the

school schedule and space, and putting the students at the center of learning, this large investment of resources runs the risk of being "assimilated" by the educational system, which will continue doing what it has always done, only now with technology. If educational change is intended, changing its production processes is indispensable.

The implementation of educational technologies is more than acquiring and distributing equipment. It requires a systemic integration of inputs, close attention to the costs, a specific strategy of monitoring and evaluation, and a long term policy that gives the effort sustainability. The following section reviews each one of these aspects, using lessons learned from the One-to-One programs underway.

Systemic Integration

Like all other types of educational technology initiatives, a One-to-One program requires strategic and holistic implementation.[22] While the mentioned components are simple to understand, share, and design, they are extremely difficult to implement. The history of educational technology is littered with experiences that have lacked integration in their implementation, resulting in programs with impacts that were lower than expected.

While the promises of One-to-One models are recognized worldwide, existing research shows that their potential impact varies drastically depending on implementation conditions. The implementation of a program that holistically integrates all components is very challenging and requires strong leadership of the project, in a way that they can overcome these adverse implementation conditions without abandoning this necessary comprehensive approach. We propose 5 critical components that must be considered *simultaneously*:

Infrastructure and equipment

One-to-One initiatives demand specific physical conditions for their deployment and by nature include the integration of different types of equipment (servers, local networks, wireless routers, computers, printers, electrical installations and connection, etc.). Quality and reliability of infrastructure are critical to a program's success.

These types of programs require a demanding Service Level Agreement (SLA), so that the technologies (hardware, software, connectivity, etc) are available every time educational experiences

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[22]   The following components of a holistic One-to-One initiative are based on the Inter-American Development Bank's conceptual framework for incorporating ICTs into education (Severin, 2010).

require them to be. Each failure leaves a school, class, or group of students outside of the full educational process. If such failures happen repeatedly, the entire One-to-One experience will underperform.

One-to-One projects that have proven to be most efficient tend to incorporate the following components in their design and implementation:

1. Physical infrastructure. The deployment of a One-to-One program in education systems requires a minimum condition of physical infrastructure. Designs and implementations should be particularly sensitive to:
   a. The quality of the electrical installations
   b. The physical security of servers and laptops
2. Equipment. A number of challenges may be encountered during the selection of appropriate equipment:
   a. Sustainability: the initial investment of equipment is a long term decision that will turn into a reoccurring budgetary cost and difficult to reverse. Once there has been an initial distribution of equipment, it is necessary to replace students' laptops approximately every four or five years, and to deliver laptops for new cohorts that enter into the system.
   b. The type of equipment that will be offered to the different beneficiary groups (such as primary and secondary students, teachers, and principals). Until now there are examples of implementation in which the same equipment was given to everyone, and examples in which different equipment was given. Results thus far recommend that teachers and students work on the same platform to facilitate collaborative work, interchange, and technical support.
   c. Local services. To optimize the use of Internet connectivity, access to content, and security, each school should rely on one content and application server, local application, and a wireless local network.
   d. Additional services. In conjunction with local services, investments in servers and networks at the national or regional levels should be installed to exchange information and content with the local server of each school.
3. Connectivity. A fundamental advantage of One-to-One models is access to content and services available over the Internet. Evaluating the most cost-effective solution of the options available (ADSL, 3G, LTE, WiMax, Satelital, etc) should be planned as a key part of the initiative, even considering the enormous difficulties that this presents in rural or geographically remote

communities. An implementation of One-to-One that does not consider Internet access offers few advantages with regards to the costs involved.

4. Support. Ongoing support is necessary to maintain functional hardware, software, and networks. The scale of these projects, however, makes this a critical issue. Laptops typically have 1 to 3 year manufacturing warranties; not only is the time frame insufficient, but the warranties usually only cover problems related to preexisting conditions and not those that occur during use. Therefore, it is critical to:

    a. Be explicit with students, their families, and the communities, creating a culture that takes care of the equipment.

    b. Support services close to each school and community that solves common technical problems.

    c. Have a regional and/or national system where more complex technical problems can be resolved.

    d. Develop a clear policy with respect to the costs of replacement or reparation. The decision surrounding who pays for it (the state, school, community, or family) has a bearing on the ownership and operations of the project.

5. E-waste: Given that the equipment purchased will eventually become obsolete or damaged raises the need for a responsible recycling and disposal policy. The environmental impact of widespread devices for children and teachers is often overlooked. While school-related hardware will not likely be a dominant contributor to the region's e-waste (defined by the OECD as "any appliance using an electric power supply that has reached its end-of-life"), it is something that needs to be considered once hardware is phased out. Studies executed in Colombia, Peru, Chile, Argentina, and Mexico, have all found IT waste produced by the public and private sector to be over 50% of devices consumed (Boeni et al., 2008; Ott, 2008; Steubing, 2007).

    While e-waste can present economic and social opportunities, in many instances no action is taken against e-waste. It is possible for the recycling and refurbishment of IT devices to create jobs. For instance, the project "Computadores para Educar" in Colombia created nearly 100 jobs (Marthaler, 2008). Some countries, including Costa Rica, Argentina, Brazil, Peru, and Colombia, have made policy measures to address e-waste challenges. However, the initiatives in the region are very new and solutions to this massive issue are not yet widespread. Interesting recycling solutions worldwide exist and should be considered.

Digital Content

Only through new experiences and educational practices is it possible to expect technology to enrich the process of student learning. It is therefore essential that those involved have digital educational resources that are aligned and pertinent to this new context.

In order for laptops to be integrated into the curriculum holistically, the digital content and applications available on the laptop should align with educational goals. In early stages, tools such as encyclopedias, textbooks, books, guides, and videos can be used. In more advanced stages, tools such as specialized software or collaborative tools can be used. Introducing initiatives linked to the adoption of digital media (such as digital literacy initiatives) are also recommended, to encourage the pro-social and productive use of these tools.

It is important that digital educational resources be available for teachers and students at all times. Ideally, content should be available on local school servers to avoid overloading the Internet connectivity, and also on the national educational portal, so that it can be accessed from any geographic location.[23]

During design and implementation, it is helpful to establish technical standards for digital educational resources, platforms and tools for compatibility. To facilitate use, materials should be clearly identified and classified in relation to educational objectives. Their technical requirements should be consistent with the equipment available in schools.

Table 5: Digital Content

Digital Educational Resources	Platforms and Tools	Implementation Standards
Content Digital Materials References Productivity and creativity software	Content Management Systems (CMS) Learning Management Systems (LMS) Development Software	Licensing Standards (Creative Commons, GNU, OMC) Classification Standards (SCORM, IMS, RELPE) Accessibility Standards (W3C)

During design and implementation, it is helpful to distinguish digital educational resources, platforms and tools, and implementation standards:

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[23] An example of the is La Red Latinoamericana de Portales Educativos - The Latin American Network of Educational Portals (RELPE), www.relpe.org.

In the context of implementing One-to-One initiatives, the availability of at least three types of digital educational resources should be considered:

1. Learning and Teaching Objects: Teacher guides associated with a unified curriculum that contains all necessary materials for implementation (that the teacher can adapt to context).

2. Classroom Projects: Suggested educational experiences that promote autonomous student work (individually or in teams) around a given topic. These projects can include cross-disciplinary coursework.

3. Extracurricular Activities: Applications and resources to be used autonomously by students outside of the formal school day to reinforce proposed learning objectives. Games and Computer Assisted Instruction (CAI) are two examples of many such possibilities.

Training and Pedagogical Support

Many One-to-One programs are based on the premise that with the introduction of laptops, learning should be more student-centered and less teacher-centered than before. This does not negate the importance of the teacher in any way. In reality, the experience of One-to-One projects highlights and reinforces the role of the teacher, although it does certainly change it. Rather than simply imparting content, the teacher's new role is to facilitate the child's own construction of knowledge. Past experience show that teacher training for One-to-One programs should consider at least three components:

1. ICT competencies. Teachers should feel comfortable with the presence of technology in their work environment and with their abilities in using technology. Confidence in basic ICT skills enables teachers to effectively use their equipment and troubleshoot basic problems. References on ICT competencies for teachers are available.[24]

2. Educational Use of Technology. Along with basic technology abilities, teachers should have a space for their own pedagogical ownership. In the teaching and learning experience, many resources, instruments, and materials interact. Computers modify the relationship between these resources, permitting the development of different experiences (collaborative, interactive, multimedia, etc.) that requires new teaching capacities to develop and sustain this.

3. Pedagogical Support for Teachers. Teachers need to recognize the pedagogical potential that laptops present and should develop an increasing familiarity with educational strategies for

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[24]   UNESCO "Standards of ICT Competencies for Teachers" are available on the following website: (http://www.unesco.org/en/competency-standards-teachers)

their use. This requires more than initial classroom training, such as accompaniment in the classroom, co-teaching, learning communities, and online help. Incentives can greatly enhance these processes.

These components should be not only part of in-service teacher training, but also should be considered in initial teacher training so that new generations of teachers (many of which are digital natives themselves) can incorporate new strategies in a much more natural and appropriate manner.

It has been found that attitudes and beliefs towards technology in education can greatly influence the implementation and success of One-to-One initiatives (Penuel, 2006). Most of the literature on attitudes focuses on teacher disposition towards laptops. Factors that affect teacher attitudes include:

- The belief that the technologies being incorporated are relevant to their teaching and aligned with their curricula (Becker & Anderson, 2000; Kanaya, Light, & Culp, 2005).
- The amount of professional development that teachers receive, which often leads to greater confidence in using technology in the classroom (Kanaya et al., 2005).
- The ability of teachers to play active roles during professional development workshops. Teachers are more likely to use technology with their students if they use technology for their own learning and to teach their colleagues (Frank, Zhao, & Borman, 2004; Riel & Becker, 2000). This could have implications for teachers in multi-grade, or 'one-teacher' schools in rural areas, where teachers have little support and guidance from other teachers.
- The availability of technical support, should any problems arise. Many teachers do not use laptops in the fear that they will not be supported if the hardware or software were to malfunction (Blumenfeld, Fishman, Krajcik, Marx, & Soloway, 2000).
- The reliability of Internet access for classrooms using wireless technology. Even if network is consistent, any perceptions or beliefs that there is limited access to help should the network fail can preclude teachers from integrating technology into their curriculum (Molina, Sussex, & Penuel, 2005)

Community Involvement

One-to-One initiatives can increase opportunities for children's families and communities, especially when children have the opportunity to take their laptops home after school hours. In contexts of

poverty or isolation, this offers an original opportunity for laptops and connectivity to become part of a larger development initiative.

Educationally, One-to-One initiatives offer a new way of involving families with their children's learning. School-to-family communication is made easier, and parents can better track the academic progress and difficulties that their children face in school. It can also work to help educate parents, especially considering that the region has high gaps in educational coverage and quality for its adult population.

Socially, laptop initiatives offer all members of the community new mechanisms for organization and communication. Potential uses include access to state services and job markets. Connectivity can also be used to express political beliefs, associated with the modernization of the state and the strengthening of democracy.

Policy and Management

Supportive administrations and long term policies are critical to the success of laptop programs. The key factor is to consider the deployment of One-to-One initiatives as part of educational policies centered in learning, and not as isolated events. Projects centered in technology and the distribution of devices without roots in a larger educational strategy run a high risk of low impact and short life spans. Planning, a long-term budget, a complimentary legal framework, and incentives are necessary with regards to policy.

Support services should be provided from every level of administration (school, province, country, and region) and information should be disseminated accordingly. Political support and a long term budget are especially important when the initiatives face the difficulties of a complex implementation associated with cultural change.

The political sustainability of the intervention is also of great importance. Often, laptop initiatives are launched by a political administration that will change within only a few years, before the project is finished and much before meaningful impacts can take place. Creating an initiative that is able to withstand different political cycles is important. The development of public-private partnerships and of transversal consensus has been shown to contribute to long-term implementation of One-to-One initiatives.

In addition to political leadership and long term budget, these initiatives require a high degree of coordination with other institutions and organizations. Such collaborations can provide initiatives

with an appropriate legal framework that ensures child safety and the development of telecommunications and public procedures, among other considerations.

Cost

To date, there is still surprisingly little data on the costs of One-to-One models in developing countries and even fewer impact studies that incorporate a cost-benefit analysis of One-to-One deployments (Trucano, 2005). Studies regarding cost-effectiveness, opportunity costs, and the cost of ICTs in relation to other educational inputs are even more rare.

The investment in One-to-One projects is much more than the cost of hardware and software alone. It is essential to recognize that these initiatives extend over a large period of time, and that most of the costs are reoccurring and accompanying defined budgets as unlimited: connectivity, equipment renovation, development of educational resources, etc.

While One-to-One initiatives are expensive, if implemented well they have the potential to reduce other costs. Once all students, teachers, and schools are incorporated, the investment in this type of initiative can imply a decrease of other costs associated with education system management such as:

- Communication and data registration between education systems and schools
- Communication between schools and families
- Printing and distribution of school texts
- Printing, distribution, and application of national or regional tests

According to an analysis performed by the Vital Wave Consulting Group, the Total Cost of Ownership (TCO)[25] that should be considered for laptops in schools of developing countries fall into 3 categories: initial costs (capital costs for acquisition and installation), recurrent costs (ongoing costs incurred over the lifetime of the equipment), and hidden costs (unanticipated or underestimated charges after the initial charges). Using this framework, calculated for five years, this work suggests that the initial costs (which include the laptops themselves) represent only 26% of the TCO over the span of five years, whereas recurrent costs and hidden costs represented 61% and 13% of the TCO, respectively (Vital Wave Consulting Group, 2009).

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[25]   Total Cost of Ownership (TCO) is a financial estimate of the direct and indirect costs of a system.

Table 6: Total Cost of Ownership (TCO)

Initial Costs (26%)	Recurrent Costs (61%)	Hidden Costs (13%)
• Hardware • Software • Cabling and wiring • Deployment	• Support • Training • Connectivity • Electricity • Subscriptions • Educational Digital Resources	• Replacement hardware • Damage or theft • Planning costs • End-of-life costs

Source: Adapted from Vital Wave Consulting (2008)

Interestingly, when this analysis was performed with different hardware and software configurations, it was found that the type of hardware and/or configuration had little effect on the TCO. Rather, the greatest cost differentials were seen between rural and urban areas. In rural areas where transportation, connectivity, and back-up power are more expensive, the TCO is higher.

Table 7: Rural vs. Urban Costs

5 year TCO	Rural Environment	Urban Environment
Energy	$2,600	$1,262
Transportation	$739	$0
Connectivity	$3,600	$2,100
Support	$3,326	$3,024
Downtime	$240	$245

Source: Adapted from Vital Wave Consulting (2008)

Following the methodology described, the following table shows existing projects in Latin America, using information gathered from official and unofficial sources, as projections and estimates of the authors of the present document. Therefore, this does not pretend to offer definitive information with respect to the cost of each initiative, but a preliminary exercise serving as a basic reference with respect to the factors associated with each implementation.

Table 8: TCO of IDB One-to-One Projects

Components	Colombia	Haiti	Honduras (in preparation)	Paraguay	Peru	Uruguay
Initial Costs						
Hardware						
Laptops	141,000	2,581,100	12,730,000	706,000	36,180,000	71,755,000
Servers	3,900	80,100	1,924,000	n/a	n/a	7,515,000
Other	1,800	16,020	n/a	n/a	n/a	1,881,000
Software	n/a		n/a	n/a	n/a	n/a
Cabling and Wiring	n/a		817,500	n/a	n/a	n/a
Deployment	n/a	436,064	573,158	n/a	5,427,000	8,831,200
Reoccuring Costs						
Support	47,600	71,200	2,012,000	204,000	3,618,000	6,672,800
Training	158,000	232,643	2,338,000	100,000	3,280,000	2,713,200
Connectiviy	9,000	170,880	1,182,000	n/a	n/a	1,456,180
Electricity	n/a	333,750	n/a	n/a	n/a	n/a
Subscriptions	n/a	n/a	n/a	n/a	n/a	n/a
Digital Educaitonal Resources	n/a	258.100	455,000	180,000	n/a	4,000,000
Hidden Costs	11,837	345,956	1,905,020	91,780	4,703,400	10,305,100
Replacement hardware	7,000	n/a	n/a	n/a	n/a	n/a
Damage or theft	n/a	n/a	n/a	n/a	n/a	n/a
End-of-life costs	n/a	n/a	n/a	n/a	n/a	n/a
Other						
Planning/Administrative costs	192,000	400,000	5,152,000	240,000	336,000	5,273,800
Monitoring and Evaluation	64,000	200,000	1,000,000	45,000	600,000	1,100,000
Contingencies	4,400	259,763		n/a	n/a	n/a
Audits	1,500	60,000	250,000	n/a	n/a	250,000
Total Cost	**642,037**	**5,445,576**	**30,338,678**	**1,566,780**	**54,144,400**	**121,753,280**
Total beneficiaries	750	13,700	57,072	3,756	180,000	380,000
Cost per beneficiary	856	397	532	417	301	320
Annual cost per beneficiary[26]	260	107	147	114	73	82
% Laptop Cost / Total	23.81%	53.75%	48.24%	50.92%	75.51%	67.40%

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[26]   This calculation considers the described cost to correspond to three years of implementation. The laptops value is divided by 5 for consistency with the life span proposed by the Vital Wave Consulting Group, 2010.

Although this is only a preliminary estimate, there are a few interesting observation**s** that can be obtained from this chart:

1. We do not have access to all of the associated costs, and many of them remain invisible. To fully complete this table, it would be necessary to include all of the components involved. The lack of this information has made it difficult to know its total cost.

2. According to the available data, the average cost of these initiatives when fully operational is $131 USD per year, per beneficiary. It is also important to remember that once starting such a program, it will be a reoccurring cost in the budget, and that the specific conditions of each country (rural areas, electrical and connectivity infrastructure, distance, etc.) impose variations on this value.

3. The scale of the initiative also impacts the cost per beneficiary. As the scale increases, the unit costs decrease, due to the use of the initial investments.

4. It is also interesting to consider the weight that the laptop investment has on students within the total costs and necessary investments (it is not infrequent that, for some people, this is the only cost associated with One-to-One models). On average, for the programs considered, the investment in laptops represents 53.3% of the total investment.

Considering that there are components in Table 8 that we do not know, when designing a program of this type in the region, it seems reasonable to consider a cost between $150 to $200 USD per year per beneficiary (students and teachers), considering that laptops represent approximately 50% of the total investment, depending on the inclusion of complimentary components, their quality, and implementation conditions. It is possible that this cost can decrease over time, as technology becomes less expensive and more efficient.

Monitoring and Evaluation

Despite lack of actual evidence with respect to the impact of One-to-One initiatives until now, it is very likely that governments in the region will advance their implementation. For this reason and the novelty that this model presents, it is especially relevant to consider permanent systems for ongoing monitoring and evaluation. These systems should permit formative evaluation, continually improve implementation conditions, and inform future efforts.

Monitoring and evaluation play a critical role in adding to the creation of knowledge of the components that constitute a "successful" (or "less successful") project. They also can inform budgetary

decisions regarding the allocation of resources. In order for an evaluation to be useful, it must take into consideration the context of an initiative, its primary goals, and the various inputs in the process of implementation, among other aspects.

Despite large investments in One-to-One initiatives for development, the number of high quality evaluations for such projects are few in number. While the number of evaluations since the turn of the century have increased compared to the number of evaluations done in the 1990's, the rate of deployments outpace the number of evaluations and the availability of rigorous experimental and quasi-experimental studies are low in number (Lei, Conway, & Zhao, 2007; Penuel, 2006; Warschauer, 2006).

Implementation studies are beneficial in describing the feasibility of an initiative; they describe the process of implementation and evaluate components such as the required infrastructure, human resources, attitudes, and administration. This is especially important given the diversity of One-to-One programs. They also measure the implementation fidelity of an initiative, or how closely the implementation adhered to the original proposed plan of operations. Such evaluations are a preliminary and important step in understanding the outcomes of a project. If a project is not implemented as planned, or welcome by the community and other stakeholders, the impact of a program is likely affected.

Implementation studies that have been published on student laptop projects tend to focus on objectives, attitudes, deployment, and use of laptops. A review of the literature on One-to-One programs suggests that:

- Most One-to-One programs prioritize one or more of the following objectives: (1) Academic improvement; (2) Equity; (3) Economic competitiveness; (4) Quality of academic instruction and a pedagogical shift towards student-centered learning; (5) Internet connectivity
- The characteristics of different One-to-One initiatives represent a wide variety of models in terms of the ownership, connectivity and scope (Light, McDermott, & Honey, 2002; Penuel, 2006).
- The attitudes and beliefs of stakeholders (teachers, parents, children, school administrators, and other community members) are critical to successful implementations. Gatekeepers who value the technology at hand and are informed on how to use them effectively can contribute to increased implementation fidelity. Conversely, gatekeepers who do not value the technology at hand or know their use can negatively affect the implementation and utility of a One-to-One program.

- Studies that assess classroom uses of laptops tend to provide data on the frequency of use and software applications used. Investigations on deeper interactions with laptops are far fewer in number.

- Students tend to use laptops the most for writing and Internet browsing when connectivity is available (Zucker & McGhee, 2005). The most common uses of laptops point to the notion that students and teachers are in the 'adaption' phase of technology adoption, adapting the new technologies to traditional teaching methods (Sandholtz, Ringstaff, & Dwyer, 1997).

- Professional development of teachers is an important component of One-to-One initiatives. Most instances of teacher training tend to focus on providing teachers with ICT skills and less so on the integration of technology into instruction (Harris & Smith, 2004; Lowther, Ross, & Morrison, 2001).

- Technical support is an important factor for a laptop program to succeed. Programs with a high reliability of technical support and maintenance show greater usage and integration in classrooms (Hill & Reeves, 2004).

- There is a disparity in the ways in which children of different socio-economic backgrounds and abilities use laptops in schools. Studies from the U.S., Peru, and Haiti show us that children who are already at an advantage tend to use laptops more frequently and more productively than children who are less advantaged.

- These studies also suggest that unlike the original belief of some initiatives that children will independently learn how to use laptops, it cannot be expected that children will learn how to use laptops and integrate them into curricula on their own (Näslund-Hadley et al., 2009; Warschauer & Ames, 2010).

- Laptops in schools tend to enhance attributes that already exist. In other words, "Laptops will make a good school better, but they won't make a bad school good." (Warschauer, 2005/2006, p.35).

Impact studies identify the results of an initiative by function of its positive and negative effects, desired or not. The most useful impact studies are those that provide information on impact with regards to cost. The IDB has placed special emphasis on the development of rigorous impact evaluations for these initiatives, in a way that helps governments take decisions based on empirical evidence.

Impact evaluations of One-to-One programs with rigorous experimental designs are few and far between. Evaluations with quasi-experimental designs and a pre- and post-tests are expensive and difficult to pursue. A review of existing literature on impact suggests that:

- The most consistent finding is the positive impact on technological literacy. Students who use laptops in classrooms show marked improvement in their ability to navigate hardware and the digital realm, making them more fluent and comfortable with their ICT skillset.

- Another consistent finding of One-to-One programs is their tendency to increase the quantity and quality of writing. Students who use laptops in the classroom or at home are more likely to consider laptops as their primary writing tool. Teachers also perceive correcting writing done on laptops to be easier, which encourages them to assign writing exercises on laptops. (Warschauer, 2006; Gulek & Demitras, 2005; Light et al., 2005).

- Research findings are inconsistent with regards to the effect of One-to-One programs on academic achievement marked by grade point averages (GPAs). Some indicate an improvement of grades, such as a quasi-experimental study by Gulek and Demirtas (2005), who found that laptop use improved students' writing, English-language arts, mathematics, and overall GPAs. Conversely, several studies have pointed to no impact or even negative impact on grades. Studies that point to an increase in student grades tend to incorporate a more holistic approach, including educational software and robust teacher training with curriculum integration.

- Similarly, literature is inconclusive with respect to standardized test scores. While a handful of programs have led to higher test scores, most have shown no impact on test scores. The state of Maine is one of the few initiatives to result in increased test scores, but only after several years of implementation. Positive impact on test scores is likely a longer-term consequence of holistically integrated One-to-One programs.

- There is an overall lack of impact studies that compare One-to-One programs with other interventions with regards to their cost effectiveness.

The number of rigorous studies on the implementation and impact of One-to-One initiatives are few in number and over a short time span. However, the studies that have been executed thus far point to the importance on holistic implementations. A successful laptop program requires much more than merely the purchase and distribution of laptops; it must simultaneously consider a number of other critical factors that we have described.

Conclusion and Next Steps

One-to-One computing in the region is a relatively recent phenomenon; it is still early to understand its impact on economic, social, and educational areas. However, One-to-One models will continue to gain traction in educational policies within Latin America and the Caribbean over the upcoming years. The rationales described are sufficiently attractive to maintain this momentum. The IDB has projected that by 2015, nearly 30 million students in the region will have digital devices for personal and educational use.

There is no silver bullet in education. There is no device or strategy that applied on its own resolves the complex challenges that education faces. Change in educational practices, student-centered learning, and personalized learning experiences can all be facilitated by technology when integrated holistically into an education system. One-to-One models in theory show an opportunity for these changes to happen, but their implementation requires enormous rigor. Innovative methods of assessment are also necessary in measuring the impact of these models.

The close monitoring of One-to-One models and their impact on learning, are critical and of high priority for the IDB. A new knowledge space has been created as a way of gaining knowledge about each one of these One-to-One initiatives. Lessons learned can ultimately improve the design, implementation, and efficacy of One-to-One projects. These knowledge spaces include collaboration networks, seminars, meetings, and online tools.

As we have seen, One-to-One models require much more than purchasing and distributing equipment to students. Their execution requires a long-term commitment to the conditions and components necessary to make them an integral part of education systems. Technology tends to augment pre-existing strengths and weaknesses. Rather than having an additive effect, the incorporation of laptops in schools often has a multiplicative effect. For instance, if a strength of a school lies in productive use of classroom time, then laptops will likely augment already productive classrooms. If a weakness of a school lies in unstructured or unproductive use of time in the classroom, then children are more likely to use laptops as an unproductive tool for distraction.

- There is much that we do not know about One-to-One models, especially with regards to their medium- and long-term effects, that can guide our next steps on this theme: At what stage in education (primary, secondary, or tertiary) are One-to-One initiatives most appropriate and beneficial?

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- What are the impacts on learning that these types of initiatives can develop and with what pedagogy?

- What profound changes will be required in the form of organizing educational offerings, considering that portable and connected devices are available 24 hours a day, 7 days a week, and 12 months a year?

- What distinct characteristics do students of the 21st century have, and what should be considered the responsibility of formal education systems?

- How much will the role of the teacher play in this context? And of families?

- How will educational systems take advantage of the increasing quantity of data that will be obtained with respect to schools, teachers and students?

- How will One-to-One environments accommodate devices already owned by students?

- What is the true lifespan of these devices, and what are the best ways to recycle them in an environmentally responsible way?

- How will the privacy and data of each student be secured?

The IDB will continue to monitor and support initiatives that strive to improve student learning and use a systemic approach in doing so. It will also advance in its commitment to supporting the use of robust evaluation tools to measure learning, especially those related to 21st century skills. In its work with other international organizations, countries, NGOs, and industry partners, the IDB will continue the dialogue and production of knowledge with respect to One-to-One models.

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