

**THE ONE LAPTOP PER CHILD INITIATIVE:  
A FRAMEWORK FOR LATIN AMERICA AND THE IDB\***

**DRAFT, NOT TO BE QUOTED**

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## **1. Introduction and background.**

The One Laptop Per Child initiative is an educational program that aims at deploying millions of rugged, ultra low-cost, individually connected laptop computers to the majority of children in developing nations that today lack access to such devices. The initiative, originated by Nicholas Negroponte, Chairman Emeritus of the MIT's Media Lab, has been received with interest by several Latin American governments. This has prompted the Inter-American Development Bank to prepare the current Concept Paper, with the objectives of

1. providing a first-hand accurate and detailed description of the OLPC initiative, and
2. presenting a preliminary review of the actual conditions under which OLPC could be implemented in Latin America, within the larger context of a consideration of benefits and costs of the family of 1 to 1 computing models.

The backdrop for the interest that this program has attracted so far stems to a large extent from the acute awareness that countries in the region have acquired regarding the fact that globalization, the information and communication revolution, and the knowledge explosion are now the driving forces in economic growth. By 1999 the share of GDP of knowledge-based industries, defined as high and medium-high technology manufacturing industries and services such as finance, insurance, and communications share in developed countries, was already above 50 percent. Within this area, information and communications technologies (ICT) constitute the backbone of the knowledge-based economy.

The changes in the world economy require increasing numbers of workers with higher level skills who must update their knowledge on a regular basis. Methodological knowledge and skills, or "higher order learning," as well as skills such as creativity, communication, and the ability to work in teams, are today more important than the learning of facts and basic data.

There is increasing hard evidence that the cognitive skills of the labor force considered as a whole, and not only taking into account those with the highest education achievement, impact directly on economic development. A recent study of ten OECD countries shows that cognitive skills in possession of a nation's population—known as "knowledge capital"—are much more powerful predictors of economic development than the average number of years of formal education. According to the study, average skill levels explain over 55 percent of GDP per capita growth between 1960 and 1995, and a 1 percent rise in average literacy leads to a 1.5 percent increase in GDP per capita and a 2.5 percent rise in labor productivity.

While much progress has been made recently, the "knowledge capital"—the accumulated knowledge and skills in the population of Latin America and the Caribbean—is inadequate to the world challenge. The region does more poorly than would be expected given its current per capita income, and the weaknesses of the region's education and training system continue to constitute an obstacle to economic development.

Education is a key element in increasing productivity and improving personal welfare. A recent analysis of the factors which impacted on growth and productivity over the period 1972-2000 in Latin America estimated the relative importance of physical capital, labor, human capital, and the combined productivity of these factors (i.e., "total factor productivity," TFP) have for economic growth. In Latin America, labor remains the main source of growth, with TFP producing a limited effect. This scenario diverges from that observed in the East Asian economies, where TFP—which captures the contribution of technology and know-how, among other "residuals"—drives economic performance. The contribution of human capital to growth is low in Latin America as well, and

bears an obvious relationship to TFP. Human capital underlies the abilities of workers throughout a given economy to generate, apply or otherwise assimilate productivity-enhancing means, including technology, technological knowledge, and technical or institutional change. Among a series of factors behind the poor performance of Latin American economies in terms of productivity growth, the fact that information technology has had a limited spread relative to other parts of the world is often quoted as a likely source of competitive disadvantage.

## **2. An overview of information technology in education in LAC and around the world.**

The interest of Latin American countries in the potential of information technology for education dates back at least 20 years. Every single government and numerous private entities have undertaken large-scale programs directed at integrating computers in the school system. Just to mention two of the earliest examples, the programs of Costa Rica and Chile have achieved, after several decades of sustained efforts, computer availability in all schools and a considerable degree of penetration of information technology among both students and teachers. A look at the involvement of the IDB in supporting programs for the integration of technology in schools systems over the past 10 years conveys a snapshot of the extent and variety of national efforts in this field. (Annex 1 provides a brief overview of the IDB portfolio in ICT for education). There are powerful reasons behind such and universal drive towards making computers available in schools:

- The equity rationale: given that high-income families are very likely to own a computer at home in the region, low income children are placed at a considerable disadvantage, relative to their better-off peers. Governments, quite often complemented by corporate social responsibility initiatives, have taken to themselves the task to compensate for this particularly troubling aspect of the “digital divide,” in an attempt to level the playing field of learning for students across the socio-economic spectrum.
- The competitiveness rationale: other reasons are closely related to the larger motivations that have turned education reform in Latin America into a sustained top level priority over the past 20 years: in a world economy characterized by a growing weight of technology in the most dynamic economic sectors, the knowledge capital of a nations has become a major source of competitive advantage. In this context, information technology has been seen as the harbinger of modernity in education, not only as a transformational technology that aims at the core of the knowledge production and dissemination industries and brings the promise of a decisive change in the way schools function, teachers work and students learn, but also as a means to develop skills in knowledge acquisition and dissemination demanded by competitive economies.

This meant that, from the beginning, the highest expectations have been placed on how the introduction of information technology in schools could lead to a forward leap in learning. Such expectations have not yet been fully satisfied, in part given the incomplete and problematic implementation of the programs, and also due to the difficulty in observing their impact on test scores on language, science and math. Even on the equity front, most countries are still behind (see Box 1).

## **3. What to do with ICT in schools: lessons from experience in Latin America and the Caribbean:**

Even though education technology programs have often not been successful, the accumulated experienced is very valuable. The mere availability of hardware turned out to be just one of a

complex series of interconnected elements that, as it has been learned the hard way by several countries, had to be put in place in order to have an education technology program in good working condition. Critical among these are:

- a. Clarity of educational goals: was the objective “computer literacy and skills”, or rather an improvement in learning of traditional subjects such as math or language, or perhaps the encouragement of critical thinking in general? (implementation strategies may vary substantially for programs aimed at any of these final objectives).
- b. Provisions for timely maintenance and trouble-shooting of the equipment (the capability for this should not be assumed to exist at the school level).
- c. Availability of age-appropriate software and digital content (properly adapted to hardware capabilities, properly licensed and user-friendly).
- d. Extensive and effective teacher training activities (children turned out to be naturally far ahead of teacher in their ability to use computers, while teachers stuck to their old teaching habits, unable to take advantage of technology. Teachers remain, however, the final arbiter of what happens to technology in the classroom and its environment).
- e. Access to critical infrastructure, which, in the case of the less developed areas included regular electrical service, and, as the Internet entered the picture in the mid-nineties, connectivity.

#### **BOX 1. COMPUTERS AND EDUCATION IN LATIN AMERICA: HIGHLIGHTS**

Systematic and updated information about computers in schools in Latin America is very scarce. What follows is a snapshot of the situation of a few countries for which more substantial information exists.

##### ***Computers in schools***

Chile: Schools with computers near 100 per cent, yet more than half the children have access to computers only in schools, and this figure goes up to 80 percent for children from households in the poorest quintile (2005).

Mexico: 44 percent of primary schools, 61 percent of lower secondary schools and 82 percent of upper secondary schools had computers in 2001. The ratio of students per computer was 44 in primary schools and 20 in lower secondary schools, reaching 12 in upper secondary establishments. Average number of computers in the Telesecundaria modality—concentrated in rural areas—was 2 per school. Less than 10 percent of these computers are located in the classroom. The majority is in a computer lab. Out of all these computers, about half are connected to the Internet. 20 percent of students had access to computers at home (2001).

Uruguay: 72 percent of 15 years old have access to a computer at school (this figure goes up to 82 percent for the top income quartile and down to 69 percent in the lowest income quartile). Share of computers connected to the Internet was estimated in 27 percent in 2003.

##### ***Teacher access to computers***

Brazil: 50 percent of teachers have computers at home. Out of this group, 75 percent have access to the Internet (2004).

Chile: 80 percent of teachers have a computer at home. 15 percent of them received ICT training at the pre-service stage. 48 percent have received short course as in-service training (2005).

Mexico: 57 percent of teachers had access to computers at home in a survey dated in 2003. Only 20 percent had access to the Internet. About 50 percent of teachers have received in-service ICT courses.

#### ***Computers at home: the digital divide***

Brazil: 17 percent of households have access to a computer, yet the figure in the highest income quintile is 89 percent while in the two lowest quintiles drops to 2 percent. 57 percent of households in the highest income quintile have access to the Internet, 6 percent in lowest income quintile do.

Mexico: 51 percent of 15 year olds have access to a computer at home. 91 percent is the figure for the highest income quartile and 11 percent for the lowest income quartile.

Uruguay: 63 percent of 15 year olds have access to a computer at home, 94 percent and 24 percent are the figures for the highest and the lowest income quartile, respectively.

#### **4. From computer labs to ubiquitous computing.**

Beyond difficulties commonly faced in implementation in real school settings, the high costs of hardware dictated that most programs failed to secure access to computers which was sufficient to produce an impact. About the best ratio achieved was 1 computer for every 30 children. Computers would, almost without exception, be housed in a special room, the computer lab, the use of which would be strictly rationed according to the total number of children in each school. This was not an exclusive Latin American problem: very similar conditions held around the world.

Now, technological advance has changed the cost equation. The recent evolution of education technology initiatives directly reflects a response to this state of affairs. This is particularly evident in the family of programs that have come to be known as “one to one computing” or “ubiquitous computing”. They consist of massive distribution of laptops to every single student in a particular school, district or even larger jurisdiction, so that all teachers and students have personalized and direct access to information technology and at the same time they share common hardware and software standards, which facilitates collaboration. Ubiquitous computing in schools can be traced back to a handful of small experiments about 15 years ago. It has recently approached the mainstream, as a growing number of states and school districts in the US find inspiration in the statewide initiative taken by Maine<sup>1</sup>.

This new approach to information technology in schools seems to share with the “computer lab” strategy some shortcomings—mainly its limitations in having a clear positive impact on test scores in traditional subjects—, but it has shown some strong benefits:

- a. Consistently, evaluation studies report substantial impact of the introduction of technology in several important dimensions of schools activity, such as student motivation to learn, student autonomy and diversification of sources in which to seek information, engagement with school initiatives, parental support for the school and, if and only if effective teacher training is in place, changes in teachers classroom behavior and pedagogy.
- b. Regarding learning itself, and even if computer use at school seems neutral to learning outcomes in traditional subjects, it has emerged that when a computer is used frequently at home—even for such regular uses as surfing the Internet and e-mail—some positive impacts can be detected on learning.

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<sup>1</sup> Intel has recently advanced that it will be in position to produce fully capable laptops for US\$ 400 for educational use worldwide. Dell is currently offering basic laptops directly to consumers for a similar price. Unit costs of laptops for US programs are estimated to be even slightly below such price level. So there are reasons to believe that the market seems to be evolving rapidly towards low-cost laptops. It is impossible to be more precise about time horizons and product characteristics implied in this trend without in depth market research beyond the scope of this paper.

- c. In addition, the evaluation literature finds positive effects on the acquisition of computer and “information age” skills that could be presented as a benefit on their own, assuming they also lend a comparative advantage to the individual’s productivity—and thus, earning potential—in the labor market.

All this should be extremely relevant above all when it comes to defining expectations regarding ubiquitous computing programs, or, alternatively, when it comes to designing monitoring and evaluation plans. Saul Rockman, one of the most knowledgeable experts on 1 to 1 computing programs in the US, has these balanced words that explain the point:

*“The answer to whether giving every student a laptop will enhance student achievement on tests is—and always has been—a strong “it depends.” Those administrators and [education authorities, JCN] who insist on a specific test score gain as the return on investment are, more likely than not, going to be disappointed. Authentic assessments may be a more realistic strategy for measuring the value that laptops bring to the classroom...”*<sup>2</sup>

## **5. Ubiquitous computing and new millennium learners.**

New generations of school children and teenagers in OECD countries are becoming known as “digital natives” in contrast with “digital immigrants” (their teachers and all adults). They are being raised in an environment characterized by the omnipresence of digital technology. Cell phones, MP3 players, CDs, DVDs, personal computers, e-mail, video games are configuring a cognitive landscape that seems to be qualitatively different to the one faced by today’s adults at an early age. Multiple sources of information, available instantaneously everywhere, fast-paced and permanent communication with friends—and sometimes unknown counterparts-, access to tools that allow creativity and personalized projects in music, visual or textual formats, multi-tasking, a “browsing” approach to knowledge. These are all features attributed to these “new millennium learners” that are growing up in the context of advanced economies.

One of the most important implications of the emergence of new millennium learners is that they seem to represent an upset of the traditional role of the school as the distinctive venue for learning. Home and Internet-café web access exceeds considerably the time dedicated to traditional text-based study. Use of personal computers outside of the school becomes a preferred source of information about all matters, school-related or not. Generally, pace of adoption of technology outside schools has been observed to be considerably faster than within them. In the process, new skills start to develop, skills that will allow new generations to cope with the digital-rich environment in which they will live and work, but that remain in stark contrast with most of what is demanded at the school.

Three prominent issues emerge from these developments in connection with education in Latin America and the Caribbean. First, it is questionable whether such a new type of learner is also appearing in any significant number in the region, given the relatively low levels of access to Internet and digital technology for the majority of the population (see Box 1, above). If new millennium learners are emerging in advanced economies but developing economies are left without a critical mass of them, the conclusion has to be that a new and particularly worrying source of disadvantage is incubating in the region.

Second, and closely linked to the former point, if it is accepted that the emergence of new skills needed to operate in the modern economy is happening, at least to a considerable extent, through the exposure of new generations to digital technology outside of the school setting, it

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<sup>2</sup> Authentic assessment refers to an assessment method focused on skill acquisition that asks students to perform tasks rather than complete standardized tests as a way of evaluating relevant learning.

automatically follows that accelerating the access of children to computers—as implied in the ubiquitous computer programs—becomes a first order priority.

Third, if a noticeable learning effect produced by intense interaction with digital technology outside the school is observable in nations in which schools for the most part work reasonably well, with abundant resources and highly qualified teachers, there are reasons to believe that learning effects on children should be even stronger in a context characterized with a scarcity of effective schools and capable teachers, which is the case of Latin America and the Caribbean. In this regard, ubiquitous access to laptops has the potential to parallel the success story of other technologies, such as TV, in Latin American education: although educational TV has always remained marginal to the mainstream school system in advanced countries, it has been a powerful instrument to expand access and even improve teaching in countries such as Brazil or Mexico, in which the existence of a highly capable school system could not be taken for granted. New media and technologies may look redundant in typical OECD schools, yet they are far from it in a developing country setting.

All three considerations speak eloquently to the relevance of an eventual initiative aimed at mainstreaming 1 to 1 computing in Latin America and the Caribbean.

## **6. The 100-dollar laptop – a description<sup>3</sup>.**

The OLPC machines will be general-purpose laptops, sized for children and adolescents, with 500 MHz AMD processors, 128 megabytes of RAM, and 500 megabytes of on-board flash-based memory. They will run a pared-down “skinny” Linux (Red Hat) operating system and will be equipped with multiple USB plugs, wireless connectivity and Internet telephony. The laptops’ most noticeable technological advance will be their unique dual-mode screens, fully readable in direct sunlight, which will offer displays in both color and black-and-white at 3X resolution. They also will consume a fraction of the power necessary to run conventional machine. Power sources will include a standard AC connector, batteries or external devices, such as pedals or treadles. The laptops are anticipated not to be demanding in terms of maintenance and technical support. A fair amount of effort has been invested in making the machine user-friendly as well as resilient, given the challenging developing country conditions in which it is intended to be used: the keyboard is age-appropriate, moving parts have been reduced to a minimum, the plastic case has been made extra thick and sealed to make it as immune as possible to dust or other external elements, and so on. The target costs of US\$100 still remains to be fully achieved, and current estimates by the OLPC staff indicate that the first generation of machines may exceed such target price by an amount between 15 and 30 dollars per unit.

A critical component of the laptop will be its ability to connect to wireless networks and in particular to mesh networks. This is expected to significantly lower the costs of connectivity for the adopting schools or school districts, since in a mesh network each machine assists each other in transmitting information through the network. This feature also creates the requirement of massive distribution in particular locations, enough to create a dense connectivity environment in which most homes will end up having a machine that at the same time benefits from and supports the network.

The OLPC laptop with its permanent wireless connection is expected to be used at home as well as in school, and will be easily portable to places of play, culture and social interaction. Learning new things and thinking new thoughts occurs both inside and outside the classroom. The laptop

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<sup>3</sup> This section follows closely the description of the project available in the OLPC web site as well as information provided by Nicholas Negroponte, Walter Bender, David Carvallo and Stephen Michaud. The author retains as usual all responsibility for this particular presentation of the program.

will contain software designed with both kinds of use in mind, including word processing, browser, logo computer language, “skype”-like telephone over the Internet software, e-mail and tools that will encourage collaborative learning among children and children and teachers. Additionally, the laptop easy-to-read screen could be used as an instrument for the distribution and updating of textbooks and instructional materials at a low cost.

**BOX 2. THE IMPACT OF THE NATIONAL PROGRAM OF EDUCATION INFORMATICS IN COSTA RICA**

The incorporation of technologies in schools in Costa Rica over the course of the last 15 years constitutes the most ambitious effort in the region to develop a comprehensive education technology program within the constructivist framework developed by Seymour Papert. The program is computer lab-based and not 1 to 1, and invests 1 dollar in teacher training for each dollar of hardware investment. Although no drastic improvement in the test scores of Costa Rican children in traditional subjects has taken place over the period in question, the program is generally considered successful and authorities believe is closely related to the fact that Costa Rica occupies 30<sup>th</sup> place in the world as a leading exporter of high technology products.

Among the key findings taken from evaluations and research undertaken by the Omar Dengo Foundation:

-According to teachers, the Program improves motivation; the development of key skills, including critical thinking; and socialization

-According to secondary students, the Program contributes to the development of skills and learning: i) allows for independent research into areas of interest; ii) allows for a better understanding of key curricular areas; and iii) allows students to express their creativity.

-According to school directors and teachers, the Program serves as an incentive: it increases student motivation to come to school and to learn, and thus reduces student absenteeism.

-79% of parents believe that the Program is useful and that computer classes help their kids to learn science, math, Spanish, social studies, to work in teams.

-70% of parents believe that the Program has helped their kids study more

-96% of parents believe that the Program gives kids a reason to go to school

-93% of parents believe that the Program has increased their kids’ interest in computing

-83% of parents believe that the Program has piqued the interest of their kids to go into a computer-related field

-Qualitative data suggest that the Program facilitates the construction of ‘more refined cognitive processes’, such as anticipation, reflection, control of mistakes, differentiation and integration of actions, abstraction and generalization at different levels.

-The Program has increased motivation to go to school and learn—this effect appears to be greater in ‘mixed’ and rural areas, that is, precisely in those areas where dropout tends to be the highest.

-The Program appears to have a particularly positive impact on ‘problem children.’ That is, it reduces their absenteeism, improves discipline and the school work of ‘slow learners.’ In addition, students participating in the Program appear to have higher self-esteem than non-participants.

The OLPC program is based on the constructionist educational theories of Seymour Papert. One component of Papert’s approach emphasizes *learning by doing* in which the classroom teacher becomes the students’ partner in learning, not just their leader (see Box 2 for previous applications of these ideas in Latin America). Also key to the constructionist model is the almost-instantaneous “viral” spread of new ideas and information from individual to individual throughout the group and beyond. The laptop is the pivotal part of this process, an instrument ideally suited for learning and sharing and for the creation of new learning. Hence OLPC’s

emphasis on *personal* and *portable* machines that will encourage self-directed and collaborative learning.

In this regard, OLPC initiative goes a long way into meeting the critical requirements of education technology programs outlined above (section 3): clarity of objectives, availability of age appropriate software, provisions intended to deal with less than ideally developed electrical and connectivity infrastructure and a clear effort to reduce the need for complex and expensive maintenance and service operations in support of the laptops. It clearly accepts the need for intensive teacher development activities related to the program, but it also emphasizes the primary value attached to opening an opportunity for self-directed learning, given the requirement that the machine becomes available not only at the school, but also at home.

## **7. Launching strategy and country response.**

The first generation of OLPC laptops, between five and 20 million machines, is being built by Quanta Computer, Inc., in China, by far the world's largest manufacturer of laptop computers<sup>4</sup>. The machines are scheduled to ship in the first quarter of 2007. A Generation Two machine, which will feature advanced electronic ink technology in its display, is planned for manufacture in 2008, with a projected total of 100-200 million units.

So far, OLPC's plan was to concentrate effort on a few large developing countries around the world (China, India, Thailand, Egypt and Nigeria. Argentina and Brazil in Latin America). This strategy seems to have been dictated by several reasons:

- a) The need to operate at a large scale, typical of cost-minimization goals of the program, required countries able to acquire large numbers of laptops;
- b) Constraints in the human capabilities of OLPC pointed to the need to focus on a number of engagements with a limited selection of potential clients, in contrast to the time and effort needed to coordinate a more demanding series of numerous small and medium country programs.
- c) The program's emphasis on full country commitment with the program in all its critical components, as opposed to the purchase of a small group of laptops that would only marginally add to education plans, minimizing the intended impacts on learning.

Both Brazil (at the Presidential level) and Argentina (at the Minister of Education level), have stated publicly that they are willing to participate and acquire one million laptops each. In addition to contacts at the highest decision-making level, mid-level technical teams of both countries have interacted with the OLPC team over the past few months.

Regardless of not being included in the initial OLPC plan, other countries in the region have been exposed to information about the program. An informal survey of their reactions indicate that most governments have developed a measure of interest in the possibilities of the 100 dollar computer, yet they have been discouraged by one or a combination of the following factors:

- A working prototype of the machine has not been available for them to see it operating<sup>5</sup>.

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<sup>4</sup> OLPC staff communicated that the manufacturing commitment to Quanta Computer establishes no exclusivity, so the program remains open to the possibility that some other countries could eventually partake into the manufacturing stage of the program, as some of them have signaled some interest in this regard.

<sup>5</sup> This is changing very rapidly. Members of the IDB Working Group were able to observe an operating prototype that had just been completed at the time of their visit to the headquarters of the OLPC in Cambridge, MA. Although the group was uniformly well impressed, there was little software available

- The rules and conditions applying to the use of the laptops are not well known. This includes concerns about proprietary designs, ability of beneficiary countries to customize the machine or the software to fit their needs, availability and user-agreements regarding software and related issues.
- The explicit focus on large countries and large volumes as a precondition for participation has led some governments in small and medium-sized countries to conclude that any benefit they could derive from the program was likely to arrive too late in time to make sense for their current plans (they would be sent to “the end of the queue” to the point of not been in position to receive the laptop before a waiting period of three to four years).
- Preliminary financial estimates indicated that total costs of operation for a program involving the machine would reach well above the 100 dollars per laptop. Sources of these extra costs include mostly two large categories: complementary educational expenses to be required so that the schools can get the most out of the program—teacher training, connectivity -, and fiscal and logistical expenses (transportation, storage, distribution, service, tax exemptions and so on and so forth).

A major factor related to this unavailability of the prototype is the innovative nature of at least three critical technologies involved in the design and manufacturing of the laptop: the screen, the power supply and the mesh networking capability. Satisfactory working design on these three fronts is however well advanced and should be fully developed, in the opinion of the OLPC team, in a few months. As a matter of fact, OLPC has agreed to make available soon a small number of laptops to some of the early adopters, for demonstration purposes. It is safe to assume then, that the first factor is about to be removed from the list of concerns above.

Regarding the second source of concern, the OLPC team has emphasized that, although OLPC will hold patents related to the technological developments that have been required to put together the laptop, the countries receiving the machine will have completely open access to such technology at no charge, something made possible by the OLPC non-profit status. It is clear however, that this kind of information and reassurance should be relayed in a clear and compelling way to potential participants in the program, in order to dissipate unnecessary concerns.

Recently, OLPC has introduced some modifications in its initial launching strategy. These modifications are in part a response to interests communicated by potential government-clients, and it is intended to respond to the third source of concern mentioned above, potentially opening for the first time a clear avenue for smaller countries to participate. The main element of the new launching strategy is the opening of a public call for proposals to join the program. Although the precise conditions of this public call are not yet known, the main idea is that it will contemplate a reasonable period for any interested country—or an association of countries—to put together and submit a proposal, probably including technical and logistical conditions, a schedule and financing needed for that particular country to participate in OLPC. The proposals would be considered on its merits from the viewpoint of which ones seem to lead to a feasible and effective deployment of the OLPC program. Upon acceptance, these proposals would be treated on par with those of the original countries in terms of the timetable for distribution of the laptops. Moving ahead in parallel with this process, OLPC in late January, 2006, signed an agreement with the UN Development Program (UNDP) to work with local and international partners to coordinate worldwide distribution of the laptops.

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other than the operating system, and we were told that the final screen was not yet available and the mesh networking capability had not been installed.

Such a new launching strategy constitutes a direct attempt at addressing the concern of countries not included in the initial approach advanced by the OLPC program. Whether it actually delivers on its promise will be heavily dependent on the timely dissemination of the new launching strategy among interested nations and the ability of governments to complete good proposals within the relevant time frame.

After this discussion, only one issue remains unanswered: total costs of the program, which includes in any case a substantial amount of resources beyond the cost of the laptop itself. This issue has to be evaluated in the context of one major consideration: practically all countries in the region are already investing in technology for education. As a consequence, they have planned spending in educational software, teacher training, connectivity and other complementary investments. Are countries wrong in investing in technology for education? Such investments no doubt represent a decision about the allocation of scarce resources that could have other potential uses within education systems, but they are widely believed to be justified from both an equity and a competitiveness perspective, as explained earlier in this paper. From this viewpoint, OLPC cannot be evaluated as an addition to current programs, but rather as an opportunity of lowering the costs of the hardware component of such programs. Given its technological characteristics (mesh networking), it will also contribute to lower the connectivity costs. Training, software and other costs would still exist but are only marginally specific to OLPC.

## 8. Ubiquitous computing for the majority: The One Laptop per Child Initiative.

OLPC contains elements of radical innovation: laptops for low-income children. A key element of the initiative is the technological breakthrough that has led to the design and manufacture of a laptop for under US\$100. The technological breakthrough makes possible then an “affordability breakthrough” for governments in the region concerned about the digital divide and the information-age literacy of their populations.

Thus, the purpose of OLPC puts this program in a class of its own, since the overwhelming amount of experience accumulated regarding one to one computing has dealt with children in affluent societies (see Table 1). Its intended scale—the target population is to be counted in millions—would also be unprecedented.

**Table 1: How OLPC is unique**

<b>Region/Approach</b>	<b>Computer Lab</b>	<b>1 to 1 computing</b>
<b>US</b>	Mainstream	Maine, numerous smaller scale experiences and pilot programs
<b>Latin America</b>	All programs	<b><i>OLPC</i></b>

The ultimate breakthrough, however, is expected to be educational: although the impact on schools as such is likely to be limited at first, given the need for complementary investments in teacher training that will take time to mature, the expectation is that massive distribution of laptops that can be used both at home and in the school will have an effect in learning independently of whether they play a role, at first, in the way classes are taught, homework is designed or assessments take place. This learning effect will occur via both self-directed and

collaborative learning, through the interaction between the children and the laptop and among children using collaborative learning tools.

In a context like this, it can be asserted that:

- a. The equity rationale for the program is overwhelming, to the point of making it attractive up front. Available evidence points to the fact that, given the right conditions, there is a strong demand–willingness to pay–from families at the bottom of the income distribution for access to computing. 59 percent of the Mexican households that do not own a computer pointed to a financial constraint as the number one reason for not having one in a recent governmental survey. Anecdotal support is also provided by the success of recent business initiatives to offer PCs at a discount–at about US\$300 to 400, to be paid in monthly installments of under US\$20–, which have prompted a strong consumer response in Chile. With support from the social inclusion policies of the Brazilian government, low-income families in Brazil are being offered desktop computers at a similar price. There is little doubt that, should the OLPC laptop be deployed in rural and marginalized urban areas, the boost to computer use by children and their families would represent nothing short of a quantum leap even for the relatively more developed countries in the region.
- b. The educational rationale is also compelling. All the Latin American and worldwide experience with technology in education programs–included 1 to 1, laptop-based initiatives–points to the fact that reaping all the benefits of an effort like this in the school setting will require substantial complementary investments on teacher training, connectivity and management (the provision of financial and technical assistance in this area has been traditionally an IDB strength, so it could become a primary channel for the Bank to engage countries that decide to implement OLPC). Yet, the educational impact to be expected from OLPC has to be assessed from the perspective of, first, the possibility of raising a new generation of new millennium learners that includes not primarily the elites but the majorities of Latin America and the Caribbean, and, second, the need to try radically new approaches in view of the limited results of traditional approaches to ICT in education and the limitations of the current capacities of teachers and schools. As a matter of fact, the main impact on schools may very well occur indirectly, by creating the outside pressure of having children–and teachers–with direct and permanent access to digital technology outside the school.
- c. Details of the program design and implementation plan will be crucial and should be finely tuned in advance to actual deployment. Recurrent costs could become a major issue that is indispensable to anticipate as accurately as possible. Teacher training will have to be, to the extent possible, mainstreamed upfront. Portability of the devices is sure to raise issues of responsible use and safety for children and families.
- d. A crucial decision would necessarily have to do with how to carry out the targeting of the machines, given that they are intended for poor children, and at the same time a key component of the program comes from the possible network externalities of having all children in a particular school or area interconnected. In other words, targeting the program to households in poverty–by, for instance, using eligibility criteria and distribution systems in place for Conditional Cash Transfer Programs–will likely produce schools in which some children have the

laptop and others do not, while targeting schools, even schools in depressed areas, will end up providing computers to a good number of children that do not live in poverty. Targeting through established methods and programs, in addition, may not produce users with enough proximity to each other, depriving them of the benefits of the mesh network. In balance, the characteristics of the program suggest that geographic targeting seems to be preferable, even at the risk of losing targeting accuracy.

- e. There is an element of novelty and uncertainty involved in OLPC that would necessarily require a “learning and assessment” approach to the implementation of the program. Although small scale pilots are ruled out by the very conditions of massive distribution and density that are an indispensable part of the program, the first generation of the program should be monitored and evaluated, so that countries to learn from experience and maximize the productivity of future investments. Although some—still limited—evidence exists regarding the impact of 1 to 1 computing in schools in the US, such knowledge represents a limited basis on which to assess key questions surrounding an eventual implementation under typical school conditions in Latin America. Chief among the differences between both environments are teacher’s characteristics, the school’s physical infrastructure, characteristics of the community surrounding the school, ICT literacy of parents and others. Specific issues of the highest interest to be clarified through the monitoring and evaluation activities suggested here should include the ability of teachers to handle classrooms where laptops are ubiquitous, actual use of the machines by the students, acquisition of skills and abilities due to participation in the program and many more. The OLPC program shares with the Bank an awareness of the need for this assessment-oriented approach to implementation and has declared its intention to work out—jointly with the IDB, should the Bank become involved—the details of an appropriate assessment framework for the program.

## **9. The IDB and OLPC.**

OLPC belongs to a family of education technology programs that is the most recent and innovative, one to one computing. Instead of the traditional “computer lab”, this type of program revolves around the concept of distributing one laptop to every student and teacher in each school. The expansion of access and interaction allowed by individual computers that can be moved around the school or even home if need be, connected through a wireless network, is expected, in the case of this type of program, to realize benefits far beyond those produced by more traditional approaches. Ubiquitous computing is moving fast forward into the mainstream of education in developed economies. It is bound to arrive to Latin America. OLPC opens the possibility of accelerating such arrival. As an innovation project, it has risks, but also large potential benefits.

Past approaches to technology in schools generated useful experience and lessons learned about the difficulties that schools have to integrate information and communications technology in their activity, lessons that should not be disregarded. At the same time, computer-lab-based programs failed to deliver significant exposure of children to computers. The fact that the evolution of technology has made now possible a fully operating high-concept but low-cost laptop opens the possibility to change that decisive limitation of traditional programs by giving one machine to each child, allowing full time exposure to technology and fomenting networking and collaborative learning.

High-income families in Latin America and the Caribbean are already raising their children as new millennium learners, in the middle of an abundance of digital media. In this context, OLPC may be offering an early opportunity for the majority of the new generation, that today lacks access to computers and connectivity, to catch up and also grow as “digital natives”. From this perspective, and in spite of its novelty, it is reasonable to expect that the widespread distribution of laptops to low income children in Latin America and the Caribbean will have educational impacts of significance. The main thrust of these impacts is likely to occur as a result of the direct and intensive exposure of children—and even teachers, individually considered—to computers, rather than mediated through the regular schools system and classroom activities.

As far as the schools are concerned, extensive experience with programs that try to integrate technology in schools worldwide suggests caution before setting expectations too high when it comes to measure the impact of the program on learning within schools. A wide range of studies and evaluation work points to several benefits of the introduction of computers to schools—student, teacher and parental motivation, for instance—, yet the jury is still out in matters of whether school technology programs have a recognizable impact on test scores. Several Latin American and Caribbean countries are, as a matter of fact, acutely aware of past failures and will insist on their own on carefully drawn plans and safeguards before additional infusions of technology to schools. It can be argued, however, in connection with the several issues raised in the preceding sections, that the creation of a digital-rich environment could have a constructive effect in encouraging schools and teachers to accelerate the rate of adoption of computer technology, turning it into a more productive investment.

*In view of all this, this paper recommends that the Inter-American Development Bank take a proactive stance with respect to the deployment of 1 to 1 computing models in Latin America and the Caribbean. As a preliminary but essential step, the Bank should establish a dialogue with concerned stakeholders in Latin American and Caribbean countries regarding the potential of new computing models, a dialogue the arrival of the OLPC initiative has made timely and necessary.*

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## ANNEX 1

### SELECTED EXAMPLES OF EDUCATION LOANS INCORPORATING NEW TECHNOLOGIES

COUNTRY	LOAN NAME	YEAR APPROVED	AMOUNT (IN US\$ MILLION)	TECHNOLOGIES INCORPORATED
<b>Regional</b>	University of the West Indies Development Program	1992	23	Installation of fiber optics in each of three universities
<b>Brazil</b>	Secondary Education Improvement in the State of Paraná	1996	100	Installation of computers and basic software packages for students and teachers
<b>Costa Rica</b>	Preschool and Lower Secondary Education Program	1997	28	Extends country's successful experience with computers and Internet in schools
<b>Panama</b>	Education Development Program	1997	58	Computer-aided learning facilities to complement classroom learning
<b>Barbados</b>	Education Sector Enhancement Program	1998	85	Investment to make all primary and secondary classrooms computer and network ready; provision of hard- and software to schools; computer training for teachers
<b>El Salvador</b>	Educational Infrastructure Program	1998	73	Infrastructural improvements in schools to enable connectivity and the introduction of new technologies
<b>Nicaragua</b>	Preparation of the Educational Reform Program	1999	9.4	Introduction of computers and the Internet to support self-contained learning modules for students and teachers in select secondary schools
<b>Trinidad and Tobago</b>	Secondary Education Modernization Program	1999	105	Financing for multi-media learning centers in every secondary school
<b>Peru</b>	Improvement of Secondary Education Program	2000	120	Infusion of new information technologies in 300 secondary schools; support for the International Virtual Schools Network (financed by the Bank via a TC)
<b>Argentina</b>	Education System Improvement Program	2001	600	Incorporation of ICTs to support teacher training; financing of infrastructure, equipment and connectivity in general basic and composite schools and teacher training institutes; training in ICT to support sector management

<b>Honduras</b>	Expansion of Technological Capabilities in Poor Communities Program	2001	8.5	Financing of community-based projects that use 'technology packages,' including computers and ICTs, to improve education and links to the market
<b>Jamaica</b>	Primary Education Support Program	2001	4	Introduction of technology-enhanced teaching and learning models
<b>Dominican Republic</b>	Multi-Phase Program for Equity in Basic Education	2002	50	Expansion of connectivity to strengthen school management and administration; creation of a competitive fund that would finance technology-based projects in schools
<b>Guyana</b>	Basic Education Access and Management Support Program	2002	30	Introduction of new technologies in teaching, learning and administration
<b>Uruguay</b>	Secondary Education Modernization and Teacher Training Program	2002	75	Installation of technology in secondary schools; creation of a competitive fund to finance pedagogical improvements, including the incorporation of ICTs; incorporation of ICTs throughout teacher training processes; linked network of teacher training institutes; networked sector management system
<b>Mexico</b>	Community Education Program	2003	210	Financing of solar panels needed to support the introduction of education technologies
<b>Mexico</b>	Multi-Phase Skills-Based Human Resources Development Program	2004	50.4	Curricular revision and infusion of technology into vocational curricula
<b>Bahamas</b>	Education and Training for Competitiveness	2005	18	Introduction of technology and international standards for technology into all secondary schools, teacher training to infuse technology throughout the curriculum; introduce a IT career at Bahamas Technical Vocational Institute; incorporation of technology into sector management
<b>Regional</b>	Latin-American Network of Education Portals	2005	2.1	Development of education portals for 15 countries in the region under compatible protocols, so that all content in each portal becomes automatically available to all others. Proactive search and adaptation of educational digital content around the world, to be made available to Latin American countries.