ONE LAPTOP PER CHILD OVERVIEW

The status of OLPC and its iconic XO-1 laptop in 2009

OLPC News

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GOAL: CHANGING EDUCATION

Across the developing world, the reduction of child mortality rates in the last two decades has led to a dramatic increase in the number of school-age children. This growing cohort of children need more and better educational opportunities to engage in a global economy that is increasingly technology-oriented. Yet the way education is currently delivered cannot possibility cope with the population surge. It is estimated that across Africa alone, 64 million additional teachers are needed just to maintain a 45 student per teacher ratio. This outstrips the financial and human resources of almost every government in Africa.[1] Consequently, African policymakers are desperately searching for alternate ways to educate the next generation of African society.

Now imagine a simple, effective, and affordable educational tool for children that came with its own almost-unlimited resources for students, teachers, and parents. A tool that radically changes the pedagogy of educational systems, from rote memorization to creative problem solving in collaboration with others, from the absorption of given data to the creation of new knowledge, from teacher-centric to child-centric. Then make this tool open to the children in every way - from the content and activities to the very code and construction that the tool uses to present the content and activities.

SOLUTION: LEVERAGING CHILDREN

This is the challenge that Nicholas Negroponte - a professor at Massachusetts Institute of Technology, co-founder of its Media Lab and of Wired magazine, and author of "Being Digital", sees as an opportunity for change. An opportunity to leverage the very children themselves to teach each other through experiential and trial-and-error learning on a rugged yet cheap educational tool. He believes that if he can enable children to learn the very skill of learning, he can leverage education as a force to eliminate global poverty.[2]

Negroponte wants children in the developing world to "learn learning" through a controversial learning methodology called "constructivism" in which the learners construct new knowledge from their experiences. Based on the pioneering work of his friend, Seymour Papert, author of such books as *Mindstorms: Children, Computers, and Powerful Ideas* and *The Children's Machine: Rethinking School in the Age of the Computer*, Negroponte believes knowledge is constructed by the learner through activities not supplied by a teacher.

Constructivist theory methodology promotes the act of self-motivated, self-directed learning to begin a lifelong quest for new skills and knowledge. Teachers are no longer classroom leaders who traditionally direct memorization or repetition drills that lead to objective testing. Teachers become facilitators who engage and guide their students in exploration and discovery.[3] Papert and, in turn, Negroponte believe constructivist learning can be enhanced by youthful experimentation on computers with software programming that form the basic building block of logical thought and lifelong learning.

Papert even developed the highly influential Logo programming language for children to express constructionist teaching using computers. The idea behind Logo is simple: Children like computers and computer programming because they like games and all three are related. Give

children a math, science or language skills-enhancing computer program that lets them create games and traditional classrooms will be obsolete.

Both Papert and Negroponte have experimented with computer-facilitated constructionist learning since their Minitel project in Dakar, Senegal in 1982. There, they used early Apple II computers with Logo to educate children.[4] Their experimentation has been controversial for its "de-schooling" effect, the reduction of teaching as a top-down educational model and even a disregard for the need of an actual school.

ORGANIZATION: ONE LAPTOP PER CHILD

In 2000, Negroponte - who is a technology visionary, not a computer designer - took this idea of computer-facilitated learning to design experts at his MIT Media Lab and came up with a radical idea: computer-facilitated constructionist learning on a mobile platform-one learning laptop per child. He then experimented with Panasonic laptop computers in a Cambodian village school and quickly realized that while his idea was revolutionary, the technology required for his vision did not exist.[5]

Negroponte's "one learning laptop per child" concept needed a new computing platform with specifically designed software and hardware to enable constructionist learning in the dusty, hot, un-electrified rural schools of the developing world. A laptop rugged enough to survive a day in the life of kids not accustomed to electronics ownership, a laptop cheap enough to be purchased in the massive quantities required for a one-to-one distribution ratio, and a laptop so child-centric it would not be usurped by adults.

During the Davos World Economic Forum in early 2005, then-secretary general of the United Nations, Kofi Annan, joined Negroponte in presenting the children's learning laptop design to the world as the "$100 laptop".[6] Negroponte's idea of computer-facilitated constructionist learning on a mobile platform became an instant international sensation. Developing-world presidents from Brazil to Nigeria to Thailand were captivated by Negroponte's dream that they could revolutionize education, the very act of learning, with an inexpensive yet rugged laptop specifically designed for children that negated the need to construct schools or hire teachers.

Over the next several years, Negroponte's idea has grown into the non-profit organization, One Laptop Per Child, an international consortium of leading technology companies and gifted computer programmers and designers who have produced an actual working laptop, the XO-1 based on constructionist learning. Looking at its software and hardware, it is very much a revolution in computing and learning.

TECHNOLOGY: XO-1 LAPTOP

While now costing $200 per laptop[7], the OLPC XO-1 contains an impressive array of technology advances that are not found in the most expensive commercial laptops. Each advance is tweaked to facilitate the constructionist goal of children's collaborative learning:

Sugar Learning Platform

The laptop user interface, the software that children navigate to interact with the computer, is called Sugar. It doesn't look like Microsoft Windows, Apple OSX, or any flavor of Linux, but it is Open Source software, where any user can customize the code. Based on the Linux operating system, Sugar's every aspect is designed to encourage collaboration. It starts with a circle of activities, not programs, and promotes the sharing of the activities both online and through the physical interaction a child has with the computer.[8] Take the classic computer game Tetris. Sugarized for the XO-1, it is now called Block Party, a collaborative spatial manipulation learning tool where multiple players work in concert to place irregular-sized blocks in congruent, solid lines.

Mesh Networking

To facilitate this constant collaboration, OLPC is implementing a new wireless Internet protocol called 802.11s, which allows each XO-1 to directly and instantly connect with another. This mesh network eliminates the need for a traditional central computer router - each laptop automatically becomes a router - and allows every computer access to any other computer's Internet connection without a lengthy or complicated network formation process.[9] The mesh network is further enhanced by its connection through antennas on the top of the laptop, its signature bunny ears, which allow the XO-1 to talk to XOs up to a kilometer away.[10]

A Library of Alexandria

Activities and connectivity are well and good, but there is already a wealth of human knowledge in the printed word. The OLPC XO allows children to access this knowledge through electronic books in its eBook mode, a tablet-style laptop form factor that presents printed matter in a landscape format perfect for recreating the actions of reading text. An eBook takes up a fraction of digital space, each XO-1 can hold several hundred eBooks and a community server can hold a few thousand more, so the XO-1 becomes an eBook reader with access to an entire Library of Alexandria worth of information, in any language and on any subject.[11]

Reading in Daylight

Even the world's greatest collection of eBooks would be useless if children could not read them easily so the XO-1 comes with an innovative dual-mode screen that makes reading enjoyable anywhere. The screen seamlessly switches from a high-resolution color mode for a clear and crisp visual experience to a power-saving black and white mode that can be read in direct sunlight, just like a newspaper.[12] Children will be able to explore literature in the classroom, at home, or outside, where they spend much of their day.

Energy Efficiency

The XO-1 takes the greatest challenge of rural community computing, reliable electricity and makes it an asset. The XO-1 is one of the world's most power-efficient computers, using only 3-6 Watts of power in normal operation. This compares to 100+ Watts for traditional computers.[13] With such a low power draw, the XO-1 can be recharged with small solar panels or other alternate energy sources. Combined with a multi-battery charger, an entire classroom of XOs can be recharged for home use, even if homes do

not have electricity.

Rugged Computing

One XO-1 laptop is designed to run for five years, even in the harsh operating environment of a child's life in the developing world.[14] The computer is one of the most rugged technology platforms yet developed. It has a sturdy hard-plastic frame, shock-resistant internal technology, a thick, protected screen, and even a rubberized, waterproof keyboard to help it survive heat, dust and even a rainstorm. If an XO-1 is eventually damaged, its designers say it can be repaired by the children, the act of repair being another constructionist learning opportunity.

All these technology advances were wrapped in a laptop form - bright green and white and child-like - designed to ensure that only children would use them, making the XO-1 a near-perfect learning tool for children in the developing world.

CHALLENGE: GOVERNMENT SALES

With all of these technological advances, One Laptop Per Child is still experiencing its own learning opportunity as it tries to distribute the XO-1 laptop to children. OLPC's original plan was to convince the presidents of countries to buy laptops by the millions through their national education systems and to pass them out like, or in lieu of, textbooks.

Unfortunately, OLPC overestimated the power of presidents to purchase goods directly or even to stay in office. To great fanfare, OLPC announced agreements with presidents in Argentina, Brazil, Libya, Nigeria, and Thailand for 1 million XO laptops each in 2006, only to have all those orders canceled. Brazil and Libya went with other computing options in smaller increments, and when presidents in Argentina, Nigeria and Thailand changed, the new governments distanced themselves from OLPC.[15] Other governments were hesitant to purchase XO laptops, for several reasons:

Incomplete Technology Ecosystems

The XO-1 laptop by itself is a technological marvel, but it requires a technology and education ecosystem to be truly effective. OLPC did not have a fully functional Sugar user interface, did not have significant educational content relevant to the deployment communities, and did not have supporting technology, like school servers,[16] to support large-scale rollouts of XO-1 laptops.

Lack of a Compelling Argument

OLPC did not convince Ministers of Education that constructivism through XO-1 laptops for every child would be more effective than traditional educational models. They relied on the commonly held assumption, still yet to be proven empirically, that children using computers increase learning outcomes, and proposed that individual ownership of the computers would lead to even greater learning opportunities, inside and outside of the classroom.[17]

Few Concrete Examples

OLPC dismissed the need for pilots or testing, believing that Negroponte's and Papert's work with Logo in Cambodia and Senegal was sufficient. Partly this was a desire to move past the slow, incremental diffusion of technology in the developing world, but it was also a ploy to have countries buy large orders, so OLPC could keep the XO-1 price low. The actual effect was to create a major barrier to entry - countries were asked to commit $200 million for computing hardware that had never been tested or used in progressively larger rollouts.[18]

No Defined Implementation Plan

Not only did the XO-1 laptop lack large-scale field-testing, OLPC did not have a defined implementation plan for countries to follow. Logistically, Ministries of Education were told to pass out the XO-1 laptops like textbooks, not realizing how few countries buy school supplies on a national scale.[19] Most school supplies are bought regionally, even locally. Technologically, OLPC dismissed the need for local support or maintenance, maintaining that the children themselves would intuitively be able to provide national XO tech support. Pedagogically, OLPC was promoting constructivism but did not provide ministries with the teacher training resources to move from their current practices to a XO-empowered constructivism model.

Faced with deteriorating sales projections on a global scale, OLPC kick-started its production line with a "two-for-one" sales plan called Get One Give One, or G1G1 at Christmastime in 2007 and 2008. G1G1 had mixed success, it certainly raised the profile of OLPC and was a significant fundraising success in 2007 if not 2008[20], but exposed the XO to the demanding developed world consumer audience who often did not appreciate their difference with the XO's target: children in the developing world.

OFFSHOOT: 4P COMPUTING

Nicholas Negroponte's "$100 laptop" idea - a rugged yet low-cost computing device - stunned the technology industry. While global telecommunications leaders were quick to dismiss his idea as folly, as OLPC News told The Economist in its article "The rise of the low-cost laptop"[21], they did not laugh long:

> *"By raising the very possibility of a $100 laptop, the XO presented the industry with a challenge. Wayan Vota, founder of OLPCNews.com, an independent website that follows the project, calls the XO a 'harbinger of an entirely new class of computers'."*

OLPC took the idea of a low-power, appropriate performance, highly portable, and low-priced computer, first conceptualized by the Simputer, and made it a reality with the XO laptop. Then, through the Give One Get One sales program, OLPC sold 160,000 XO-1 computers to the developed world market in the last 6 weeks of 2007.

This heretical bombast and sales coup upset the longstanding computer manufacturing tradition to keep adding functions to maintain high prices in the developed world, while ignoring the developing world. Realizing an untapped market existed for low-cost laptop computers, and fearing the XO would capture this market, companies such as ASUS, Acer, and Hewlett Packard

rushed in to satisfy the demand that One Laptop Per Child awoke.

The emergence of 4P Computing - *appropriate* power, performance, portability, and price - as a driver of technology innovation[22], is best seen in the "netbook" computers, which are the fastest growing sales category in personal computing - 14.6 million netbooks were sold in 2008, 11% of all laptop sales.[23]

Still, these netbooks are not targeted at educational markets in the developing world[24], they're designed as secondary computers for developed world consumers to access the Internet, and are too delicate and power-hungry to be useful in rural areas.

COMPETITION: CLASSMATE PC

With its initial sales projections of millions of XO-1's to governments, One Laptop Per Child quickly drew the attention of Intel Corporation, a major computer component manufacturer. The XO-1 laptop uses the Geode microprocessor from AMD Corporation, a direct rival to Intel, which wants its own microprocessors in the world's computers. In response, Intel produced the Classmate PC, its own educationally focused computer adhering to the 4P Computing requirements of appropriate power, performance, portability, and price, and positioned the Classmate as a direct competitor to the XO-1.[25]

While the Classmate PC was not a revolution in computing like the XO-1, Intel did have a better sales and implementation process through the World Ahead program. Governments could buy small lots of Classmate PC's and roll them out in pilot programs, reducing the initial purchase commitment form OLPC's millions to tens of thousands. Intel also developed the Classmate to work within existing educational models, unlike OLPC, which designed their computer be used with constructivism learning practices. In addition, Intel provided extensive administrative and training support to Ministries of Education.[26]

At one point, Intel and OLPC joined forces, recognizing that their public sniping was not conducive to the success of either organization. Sadly, this partnership did not last long, as OLPC, as a start-up nonprofit, and Intel as a very competitive for-profit, did not share the same long-term goals[27]. Subsequently, the two companies have played down their public differences as they realize the governmental sales process will take years to reach the scale OLPC first expected.

STATUS: SLOW GROWTH

As a result of the imperfect government sales plan, and the attention received by its competitors, One Laptop Per Child is nowhere near its initial projections of 5-10 million XO-1 laptops deployed by 2008. In fact, OLPC has reduced its minimum purchase amount to 1,000 XO-1 laptops to stimulate smaller government purchases.

To date, there are small-scale XO laptop deployments in 20-30 counties, but only Uruguay, Peru, and Rwanda have placed solid orders for large-scale deployments of XO-1 laptops,[28] and

then in 100,000 laptop batches. Currently OLPC has major (10,000+) XO-1 computer orders with the following countries:

XO Laptop Deployments

- Uruguay: 300,000 for every child in the school system
- Peru: 260,000 for every child in rural schools
- Rwanda: 110,000 for primary schools
- United States & Canada: 67,000 through Give One Get One
- Mexico: 50,000 for libraries in rural areas
- Mongolia: 20,000 for select schools
- United States: 15,000 for the Birmingham, AL school district

The two entries for the United States are for two separate programs. The Give One Get One program was not a government-organized purchase program; it was individuals buying XO-1's for personal use outside of any structured learning environment. In Mexico and Mongolia, XO-1 laptop purchases were subsidized by businessmen - in Mexico, Carlos Slim, a telecommunications billionaire, bought all the XO-1's[29] and in Mongolia, half of the XO-1's were bought by John L. Thornton, a retired Goldman Sachs executive, and the other half were donated by OLPC itself, through Give One Get One donations[30].

As a result of these lower sales numbers, declining financial support from its sponsors, and the increased competition from other 4P Computing options, OLPC significantly restructured its operations in early 2009, implementing the following changes[31]:

New Software Options

To reduce costs, OLPC laid-off its software development staff that were working on the Sugar learning platform, passing it to a separate organization, Sugar Labs, which continues Sugar development. OLPC still ships XO-1's with its Sugar learning platform, but Microsoft now offers the Windows XP operating system for the XO-1 in government purchases.

New XO-2 Laptop Design

OLPC has announced its intention to design an XO-2 laptop that will have significant advances, among them a dual-screen design where one screen can be a touchpad keyboard or function as a second screen. OLPC will not manufacture or sell this design, but license it to other companies who could build and sell it independently.

New Implementation Focus

OLPC has rolled off its Central and South American operations to Brightstar, its preferred distributor, and to the Uruguayan and Peruvian governments, and its African operations to a team in Rwanda. OLPC will focus its sales efforts on the Middle East, Afghanistan, and Pakistan.

Combined, OLPC believes these actions allow it to maintain its focus on XO-1 sales and XO-2 development during the current, stressed financial climate.

IMPACT: ANECDOTAL SUCCESS

Despite the amount of interest OLPC has garnered in the technology and education circles, so far there are no in-depth empirical evaluations of OLPC's impact on education. This is partly due to the newness of the program - the first XO deployments happening in late 2007 - and due to the challenges inherent in evaluating technology's impact on education.[32]

There are initial evaluations from deployments in Nepal, Uruguay, and New York City that suggest an educational impact, but even their authors admit that these reports should not be considered comprehensive or exhaustive. The general conclusion of each report is:

Formative Evaluation of OLPC Project Nepal[33]

Almost all the teachers and parents think that there is positive relationship between laptop provision and student learning. Though it is hard to quantify, most teachers and parents also feel that the students who have been provided laptops have become cleverer. With this student-centered approach, students are interacting with each other more often. It has made students more curious and they are eager to learn new things. It has also helped in developing co-operative spirit, as students are willing to help each other learn new technology.

Early OLPC Experiences in a Rural Uruguayan School[34]

The impression we brought back from our visit to Villa Cardal was that the laptops appeared to have a very positive impact and transformed the way the children learn in spite of serious hardware and infrastructure problems. The spotty connectivity to the Internet and unreliable input devices did not get in the way of children accessing information resources that were previously unavailable, creating content for the world to see, and increasing their interest in reading and writing.

Evaluation of Kappa IV Pilot in New York City[35]

In general, the XO pilot at Kappa IV has been a success from the point of view of all the participants, including Teaching Matters staff, teacher, students, and parents. The XO's low cost, portability, and quick learning curve, as well as the fact that it was easily accepted by both students and parents, make it a viable candidate for a genuine one-to-one computing solution--a computer that students can not only carry with them around the school but can carry home to use there as well.

Until there is independent, empirical longitudinal studies on the impact of XO laptops in education, each OLPC participant must make their own judgment on the merits of implementing one laptop per child, and its benefits versus other investments in educational systems - from teacher training to additional chalkboards.

CONCLUSION: INFLUENCE BEYOND IMPACT

Nicholas Negroponte's idea to leverage children themselves to improve learning outcomes in the developing world, through a low-cost technology-driven intervention is both compelling and captivating. He assembled some of the world's foremost thinkers around computers and primary-age educational practices in the One Laptop Per Child organization.

In less than three years, OLPC has produced and distributed the XO-1 laptop, which is designed for children to learn in the developing world - the XO-1 is rugged, easy-to-use, and should improve educational experiences for teachers and students. The computers could open a window onto the world for the children and by extension their families and community. And once the children outgrow the laptops, the technology can be repurposed in ways we can only imagine.

Yet, both the "one laptop per child" idea, as well as the XO laptop itself is still unproven. While results to date show that introducing XO-1 laptops into schools can drastically increase learning resources available to students and teachers, lasting and measurable impact will only happen when classroom teaching methods and educational administration practices are modified to take full advantage of the technology - a maximum that applies to any new educational tool, but especially so with computers' high infrastructure requirements.

The OLPC organization has abdicated the design of the systematic change and educational infrastructure required to the implementing countries, which have responded with varying degrees of success. In fact, it's the opinion of OLPC News that there is a misplaced impression that the XO-1 is a finished product or that OLPC delivers a "school in a box" through XO-1 deployments. OLPC deployments are more like experimental projects, requiring long-term investments in teacher training, local content, and technology support.

So even with a compelling idea and a revolutionary technology, the overall adoption of the XO-1 has fallen well short of initial expectations due to a challenged sales strategy and inadequate implementation support. There are only three large-scale XO-1 deployments in educational systems - Peru, Uruguay, and Rwanda - all of which are still in infancy and without published independent evaluations.

Despite the setbacks, OLPC dramatically changed the computer industry and the whole debate around technology in education. The XO-1 introduced technology advances now emulated by mainstream computers and the "$100 laptop" moniker has now become a rally cry for all consumers - from individuals to governments - to put *appropriate* power, performance, portability and price at the forefront of computing design.

With the intense focus on one laptop per child levels of computer saturation in education, conversations around introducing technology in the classroom have shifted from "if" to "how" and spawned innovation in both technology and pedagogy. So no matter the future of OLPC or its iconic laptop, we are seeing only the beginning of their long-term influence on technology and education.

AUTHOR: OLPC NEWS

This report was prepared by the editors of OLPC News, the independent blog of record for the One Laptop Per Child project. OLPC News (http://olpcnews.com) was founded in 2006 to track the One Laptop Per Child program, celebrating successes, questioning failures, and suggesting improvements to expand the idea of one laptop per child.

With over 5,000 readers a day, each spending an average of 4 minutes on the site, and combined with the OLPC News Forum, which has over 3,700 members and 28,000 posts on every OLPC-related topic imaginable, these platforms lead the discussion of OLPC's revolution in computing and learning. In fact, OLPC News has become a recognized voice in the OLPC community, even by Nicholas Negroponte himself.

The OLPC News editors who contributed to this report are:

Wayan Vota, Publisher, OLPC News

Wayan Vota, is the founder and publisher of OLPC News, the complimentary OLPC Talks and OLPC News Forum, and was a co-founder of the OLPC Learning Club DC. In addition, Mr. Vota has coined the phrase "Clock-Stopping Hot" to refer to the XO-1 hardware and "4P Computing" to refer to the new class of computing solutions spawned by the XO-1 for the developing world. Mr. Vota has commented on the OLPC program for 60 Minutes, National Public Radio, the Economist, and numerous other mainstream media outlets.

Christoph Derndorfer, co-Editor, OLPC News

Christoph Derndorfer was one of the first members of OLPC Austria, a non-profit group based in Vienna, which supports the One Laptop per Child project via various efforts. Among other things he has co-authored the Activity Handbook that helps people get started with software development for the XO-laptop. He has also held presentations on the OLPC project at various events such as Chemnitzer LinuxTage and CeBIT. Previously he co-published a Web site dedicated to small, low-cost and power-efficient computing solutions.

Bryan Berry, co-Editor, OLPC News

Bryan has been involved in OLPC since 2006 as a grassroots organizer. He was one of the founding members of the OLPC Nepal community and helped found Open Learning Exchange Nepal, the Nepali NGO that is implementing Nepal's OLPC pilots. He is currently the Chief Technology Officer for OLE Nepal on Nepal's pilots at Bishwamitra and Bashuki schools. Prior to moving to Nepal, he worked for 4 years in the Middle East and China on technology deployment for government agencies.

Wayan, Christoph, and Bryan are supported by over a dozen OLPC News writers and thousands of committed community members who write, comment, and discuss all aspects of the One Laptop Per Child program on OLPC News. You can reach them through editors@olpcnews.com and the entire community on http://olpcnews.com

ENDNOTES

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