eLearn
MAGAZINE

Can the "$100 Laptop" Change the World?

By Laurie Rowell

Here's an outrageous idea: What if every child in the world could have a free personal laptop? Put some e-books on it, make it Web-capable, and add a palette of media tools so children could work on creative projects. Wouldn't that be incredible?

When Nicholas Negroponte proposed this idea at the World Economic Forum in Davos, Switzerland in January, 2005, it certainly seemed that way—like a noble dream. Two years later, that dream is an actual product that's just around the corner from delivery to the global schoolroom. This is not just any laptop, but one designed to challenge our pre-conceptions of what a personal computer can be, and of how it might be used to teach our children how to learn. Its influence may soon be felt far and wide, and in previously unimaginable ways.

The project, One Laptop per Child (OLPC), is a non-profit spin-off of the MIT Media Lab. The OLPC, working with academics, computer manufacturers and software developers across the industry, has been doing seemingly impossible things on a daily basis. Despite the head-shakings of the doubters and the teeth of common sense, this laptop is on its way to field tests with children as I write—and production models in the millions should be rolling off the lines this summer.

This success is not due to the clever employment of tried and true business techniques. *Au contraire*. These academicians have ideas and they aren't afraid to use them. One is that we learn by creating. Another is that education is a community-based effort and hierarchical institutions get in the way. And it looks as if the creative types on this project used these two principles to teach themselves how to build this remarkable machine, which is certainly something no one else knew how to do before.

A discussion of constructionist learning theories is way out of the scope of this article, but Walter Bender sums things up nicely this way, "Epistemologists from John Dewey to Paulo Freire to Seymour Papert agree that you learn through doing. This suggests that if you want more learning, you want more doing."

So let's take a look at what they've done. You might have heard it called The $100 Laptop, or The Children's Computer. In its current incarnation, it's the XO, and it is one impressive device.

The Impossible Doesn't Really Take Longer

The XO is designed to be engaging. Formed of brightly colored plastic with rounded corners, it opens like a standard laptop—only with antennae that fold up on the sides to form "ears." (These fold down again when you shut the case to cover the ports). The monitor twists and lies back down tablet-style for e-book ease. The new "Sugar" interface presents people-icons in a neighborhood metaphor, and a built-in camera and other media options offer scope for creative schoolwork. The 128MB of DRAM and 500MB flash memory (no hard drive) might seem shy by our standards, but the software is trim and elegant. And while the price hasn't yet been hammered all the way down to the target $100, these little guys are currently scheduled to roll out from a production facility at Quanta Computer of Taiwan for $135 each—when ordered in quantities of a million or more.

Not only were cost constraints fearsome, but the project aimed to deliver to a very wide user base that included remote areas for schools with no Web access, no power, and sometimes no roof. Laptops had to stand up to dust, moisture, and the occasional fall to the floor. The pieces simply didn't exist a year ago to build a computer like that.

Some people might find that a bar to success. But OLPC leveraged community involvement. And they learned by doing—including staying flexible.

It was clear the laptops needed a human-driven generator (or two) to recharge the laptop battery. At first the plan was to use a hand crank on the computer itself, similar to those on camp radios, but when that didn't prove viable, it was abandoned in favor of what did work: a pull-string power generator built by

Potenco that looks like a yo-yo. This might be good for all of us as Potenco plans to market these separately for those who might want to keep a lamp aglow—if not our power-munching laptops—should our own grid fail.

How do you get a tiny laptop powered by foot or string power to connect to the Web? Not with a router. The OLPC will use Marvell's 88W8388 wireless chip, an implementation of the emerging 802.11s standard for mesh networking. The mesh network model allows laptop-to-laptop connection, making each device, in effect, an access point. Peer laptops connect to the server at the school for Web service. Since the Marvell chip doesn't access the laptop's CPU, there are savings for the power bottom line as well. Field tests in mid-January using two XO laptops in the Australian outback show impressive connectivity for distances of over a kilometer. (A simulation of the mesh network available on the OLPC Web site lets you drag the peer laptops to connect them to one another and to the "world.")

Where do you find a monitor for an inexpensive child's laptop when conventional LCDs cost $130 apiece to manufacture? A new technology might be problematic, as the monitors have to be churned out by the millions once production gets a green light. To top it off, the monitors have to operate in full sunlight because that's where some developing countries hold class.

Some solutions you just have to build yourself. Mary Lou Jepsen, Chief Technology Officer at OLPC, took on the challenge. She decided she needed to stay with LCDs to leverage that manufacturing base. Because the color filters accounted for a third of the cost of manufacture and a large hunk of power usage, she replaced this conventional technology with a refraction grating that splits the backlight into its component colors. The result is a brighter display with less power drain.

The redesign itself was a coup, providing a power-efficient brightly lit display for a mere $35 in production costs. But consider that this new monitor went from concept to working prototype in a matter of months, with all boards cleared for mass production. When was the last time you worked on a large project that introduced a radical technology improvement on a grand scale that went from concept to solid form in less than a year with no outstanding bars to production and distribution?

Yeah, me neither.

Something has gone radically right here. And that's been done despite the overall complexity of the project. When so many folks think outside the box, getting everything back into the box so it works right requires serious tweaking.

Jepson agrees, offering an example of back-and-forth that happened when her monitor turned out better than expected. It seems the monitor was "higher resolution in color mode than the UI people really understood or the standard Web page style sheets or standard way of doing displays account for. The UI people were skeptical that the resolution would also be high in color 'backlight on' mode."

Original designs were based on these more modest expectations and surprise meant revisions. "The fonts were initially much bigger than need be and didn't show off the high resolution of the screen—five times higher resolution than a standard LCD screen," Jepsen explains.

This ten-second window into OLPC's process suggests unexpected results and necessary reworking occur for them as they do for developers everywhere. But somehow on multiple phases of this project the OLPC team has been delivering in months what takes others years to complete. It suggests things are things going on behind the scenes at OLPC that companies across America should consider.

The "Free" Software Affray
Despite the importance of this project to everyone involved, it has run into its fair share of conflicts. A significant one involves the included software, which is all "free"—meaning "to be used and modified without restriction"—with one exception.

The fly in the ointment is the firmware in the Marvell mesh network chip. According to Richard Stallman of the Free Software Foundation (FSF) "the wireless chip needs non-free firmware that needs to be installed as a file in the computer so it can be downloaded into the wireless chip when the system boots." This was not a simple matter of choice; no other chip could provide wireless networking at power- and price-levels that suited OLPC. But this chip was built using a proprietary microkernel that Marvell does not own, resulting in the non-free firmware.

Now this might seem like a fine point, but to Stallman and others at the FSF who are dedicated to the

notion of software for and by the people (including rights to use, modify, and share code as necessary), this is no small matter. "A non-free program denies the user's freedom," says Stallman, "and my conscience forbids me to recommend the use of one. This means that as long as the OLPC requires use of that non-free firmware, I can't promote use of the OLPC as I would otherwise wish to." He acknowledges how far the project has come toward meeting what he sees as an essential goal, but for him it doesn't make it to the finish line. "The OLPC gets 99 percent of the way to rejecting freedom-trampling software. I hope that someday they will get all the way there," says Stallman.

The 99 percent figure could represent an uneasy truce between Richard Stallman and Walter Bender, OLPC President of Software and Content. The open atmosphere of software development for OLPC has let contributors examine, revise, dogfood, re-examine, and streamline code until what goes on the XO is incredibly trim—and, well, free.

Again, this project is supported by the philosophy of education that underlies it, which is not just an idealistic stance in this case, but a concrete commitment to principles—like listening to dissent, communicating with all those involved in the project, and refining work as it evolves.

The Educational Sticky-Trap
Walter Bender has been clear in saying that education could benefit from a paradigm that allows more critical evaluation from people at all levels, and he's frank in suggesting that the traditional school hierarchy is a barrier to quality improvement. In his words, "the education community, because of the way school and (perhaps more significantly) school systems are structured, typically top down, tends to suppress the spread of best practice as it is developed bottom-up in the classroom."

It's hard to argue with the idea that a top-down hierarchical structure suppresses good ideas from inspired practitioners (like students and teachers), as it short-circuits criticism of prevailing conditions that might make the system self-correcting. The problem is, many existing school systems might refuse to accept that philosophy. So as children across the planet suddenly have access to one another and to a rich mine of information through the XO, will education and schools conflict—as so often they do? How will the changing educational landscape fit with existing schoolroom models?

Ethan Zuckerman is an activist and researcher based at the Berkman Center for Internet and Society at Harvard Law School. He has traveled widely in the developing world and has studied OLPC in depth. He sees places the OLPC laptop might meet resistance as it bumps up against cultural practice, physical considerations, and teaching styles. "Some—not all—classrooms in the developing world work under a very authoritarian model, where the teacher uses techniques like recitation, repetition, and lecture to the entire class to maintain tight control of student behavior," says Zuckerman.

Some of the problems he sees in schoolrooms in the developing world are echoed here in our own halls of learning. "Educational systems that teach to standardized national tests mean that the emphasis is on making sure a percentage of students learn enough information to pass the national exams, and less on learning through self-guided exploration, which is what the OLPC project is designed to enable."

Classroom issues that might conflict with laptop use are not limited to the developing world, which is something that becomes clear as Zuckerman talks about what he calls "less-direct ways in which OLPC might prove subversive within the classroom."

Unfortunately some of the most innovative and education-supportive features of the laptop could cause the greatest problems. "The operating system of the laptop is designed around the idea of 'presence'—you're aware of every other laptop in your proximity, and you can send messages to each of these other laptops. Imagine a room filled with students capable of passing digital notes to each other at every point during a lesson—many teachers would find this a potentially troubling development," Zuckerman suggests.

You think?

And if that's not enough to unnerve a teacher who isn't sure how to integrate technology, Zuckerman has more. "I'll offer a third concern based on my own experience teaching at one of America's top law schools —students armed with Internet-connected laptops can be very intimidating to teach. Any assertion you offer as a teacher, they can challenge with Google. (And believe me, when you're teaching lawyers, they want to challenge you.) I can imagine some teachers finding this experience of being challenged on facts sufficiently frightening to heavily constrain computer use in the classroom."

Students busy using these computers as learning tools, say in small groups in competition with one another to solve problems on a joint project quickly, would have no time to challenge a teacher with Google searches or distract each other with private e-notes. But organizing that kind of activity requires a huge up-front investment on the part of the teacher, while saying "put away your laptops" does not.

I worked in education back in the days when computers entered the curriculum in this country. I walked kids through the Logo curriculum developed by Seymour Papert, and for the most part the children got a creative kick from programming the little triangular character, controlling what it did. But creative use of computers did not become a classroom staple. Within a few years of my teaching experience, my own children went to schools where computers only ran applications that supported schoolwork as it had always been done. In other words, the old paradigms won that round. But the education specialists working with OLPC are way ahead of me here. Their writing on the subject of what went wrong has been penetrating and thorough. They have kept up.

Learning to Learn

Walter Bender recognizes these devices could devolve into electronic worksheets, but the hope is that these laptops will give everyone involved in education a chance to do something different. "We are working from a foundation that all children (all humans) are (1) teachers and learners; (2) social; and (3) expressive," he says.

The laptop is designed to facilitate these processes. "By focusing on tools of exploration and expression—rather than instruction—in an environment that emphasizes collaboration, sharing, and critique, we think the laptop will become the agency for engaging children in constructing knowledge—to 'learn learning.' "

In this regard, Bender is enthusiastic that they are able to empower young learners with creative opportunities that I never was able to offer to my students twenty years ago. "In practice this means wikis rather than just document viewers, music composition tools rather than just MP3 players."

SJ Klein, the OLPC Content Director, elaborates, "One of the next activities to be finished is going to be an application for recording video, and taking a set of videos and choosing different ways to splice them together." Such options certainly comprise a better palette of tools for integrating these computers into general curriculums. And the fact every child in a school has access to the same toolset offers an opportunity for the synergy of healthy competition in creative categories.

The very design of the device—small, portable, and personal—makes it a more effective educational tool, too. Spokespeople for OLPC have been vocal in their insistence that the computer lab, being an isolated learning environment, cannot be integrated usefully into the curriculum as a whole. The laptops, by contrast, remain with the children all day and can go home with them to be used not just by the students, but by their parents and siblings.

Zuckerman agrees the form factor is significant. "They'll be integrated into students' learning in a way that computers rarely are in the developed world. Even if schools don't use the full potential of the devices, it's likely that some students will teach themselves—and each other—how to use the machines at home." He's enthusiastic, too, that texts are delivered using wiki technology. "While I suspect we're not going to see many classrooms rewrite the texts distributed by the ministry of Education, the ability to comment on these texts, to collaboratively take notes and to challenge facts in a text, is a critical skill set that the technology is likely to encourage."

Content is designed to involve students in their education on several levels. SJ Klein talks about offering students the tools to connect "with communities of creation within their culture and elsewhere in the world." This means offering more than text. "We are currently working with the Free Culture movement, who are curating a collection of free music," says Klein. "We are working with the world digital library and a number of museums around the world both to make digitized snapshots of world culture available to laptop users, as inspiration and to provide a sense of the world's diversity."

Zuckerman touches on a final point that really never was a factor when computers were introduced to students the first time around. "I think the idea of making the machine an e-book reader and making libraries available by creating document caches at schools is quite important. Access to texts is a huge problem in many developing nations. It's important to realize that the laptop project is also a library project."

The OLPC laptops are scheduled to ship with the equivalent of 100 e-books on board. And that's a learning

opportunity that everyone can get behind.

A little while ago I took my lunch break, walking down to the coffee shop at the end of my street. When the lady at the lunch counter asked me what I was working on, I told her about the OLPC project. I ran on for a bit about how it worked as I fumbled to put my credit card back in my wallet. When I looked up at her again she was smiling.

"That's awesome," she said.

Yeah, isn't it?

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From: fbonzo (email) none	**Brilliant!** Date: 02/22/2007 09:10:25	**Comment on this article** Note - your email address will be kept confidential and will not be visible to other users.

Regarding both the OLPC and this writeup--truly brilliant and awesome.

From: Roger Chrisman (email) Founder of Wikigogy.org

Time stamp?
Date: 03/03/2007 06:37:12

I love this article. When did you publish it here? (Comments show dates but your article shows not its own). Could you take this matter up with your publisher? Thanks! :-)

From: Jimbo (email) educator

Really?
Date: 03/06/2007 09:50:13

Really? What every kid needs is a laptop with 100 books on it? Many of the kids in underdeveloped countries would certainly appreciate this and would very likely come up with a million uses that I could not even imagine for the thing. But how do we really know this is what they need? Maybe they need a good pair of runners, or a ball, or a hug everyday? I'm not convinced that computers are the answer to the world's children. I always remember the cardboard box the toy came in was the best toy.

From: Bismillah Kader (email) Internexia Institute

How do we take this forward?
Date:

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03/09/2007
03:18:10

We are keeping a close eye on this project, not least because a bunch of these machines in the hands of school kids in developing countries (or anywhere) will require teachers who have been through our teacher training project which provides skills and content just right for enhancing learning. It's an astonishingly close match, I believe. Please provide us with information on how to take this forward. Bismilla Kader

OLPC Inquiries

From: Ken Korman (email)
Executive Editor, eLearn Magazine

Date: 03/12/2007 09:04:04

We're not sure what you mean by "take this forward," but you can direct any OLPC-related inquiries to information@laptop.org. Thank you!

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