Ten Lessons for ICT and Education in the Developing World

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The skills to productively transform knowledge and information into innovative products and services will define successful knowledge economies. Because knowledge and information have become the most important currency for productivity, competitiveness, and increased wealth and prosperity, nations have placed greater priority on developing their human capital. Governments around the world are thus focusing on strategies to increase access to and improve the quality of education. Decision makers find themselves asking key questions: What defines a quality education in today's global information-based economy? Has education kept pace with a rapidly changing world? Are there good models for reform that we can follow?

A Changed World with Unchanged Classrooms

If you compared our world today with the world one hundred years ago, you would encounter amazing advances in science, commerce, health care, transportation, and countless other areas. But if you were to compare the classroom of a hundred years ago with an average classroom today, you would recognize it immediately: students lined up in rows, paper and pencil in hand; a teacher at the blackboard jotting down important facts; students furiously copying all that is written and said, expecting to memorize the facts and spit them out on an exam. While much has been changed by the advances of science and technology, education and the way that students learn and teachers' teach have remained largely unchanged. However, in today's information and knowledge-driven world, a whole new set of skills is required.

New Skills for the Networked World

A relevant education is more important today then ever, because today's Networked World demands a workforce that understands how to use technology as a tool to increase productivity and creativity. These skills include "information reasoning," a process in which reliable sources of information are identified, effectively accessed, understood, contextualized, and communicated to colleagues. Furthermore, employers require workers to have the skills necessary to collaborate, work in teams, and share information across global networks, that is, to analyze issues from a multidisciplinary perspective. Because these networks are international, employers seek out individuals who have the capacity to effectively interact with others across

cultures and languages. Finally, knowledge workers need to be flexible and able to learn quickly as work environments continue to change dynamically. Workers must learn how to learn, and quickly acquire new skills. The skills discussed here are not easy to find and, indeed, are a challenge to develop. How do nations prepare students for such a world?

World Links—A Model for Networked Learning

In 1997, the World Bank initiated the World Links program (www.worldbank.org/world links) in response to developing countries' demand for strategies to prepare their youth to compete in a world increasingly driven by information, technology, and knowledge. World Links is one of the most innovative and successful grant programs initiated by the World Bank to assist developing countries in bridging the "digital divide." Its principal capacity-building objective is to provide developing country schools and ministries of education with sustainable solutions for mobilizing the necessary technologies, skills, and educational resources to prepare students and teachers to enter the Networked World.

Over the past four years, World Links has worked with twenty-one countries[1] to bring underprivileged schools into a global school network. The network links thousands of students and teachers around the world for collaborative learning and helps ministries of education pilot and learn from this implementation of Networked Learning in schools. World Links is bridging the gap in skills, knowledge, and educational opportunities between students in industrialized and developing nations, as well as between rich and poor students within developing countries.

In developing its program, World Links drew lessons from the successes and failures of technology education programs throughout the world and designed customized pilots for each participating country. One of the key failures of many past programs was that schools were provided with expensive equipment but with little or no support for teachers' professional development, national ICT-in-education policies, or community involvement. Since World Links launched its first program in Uganda almost five years ago, a number of lessons regarding the constraints, as well as the potential of integrating technology into education in the developing world, have been learned. While getting schools wired to the Internet is the first step, a whole host of other factors need to be considered, ranging from teacher training to assessment to sustainability. The following are ten lessons that World Links has learned in its efforts to help developing countries span the knowledge divide.

Lesson #1: Computer labs in developing countries take time and money, but they work

Establishing a working computer lab and a reliable connection to the Internet remains a dream for most schools around the world. In a recent survey of teachers in developing countries conducted by SRI International for World Links, the majority of teachers in African and Latin American countries reported that the lack of adequate hardware and software as well as unreliable Internet access were significant barriers to using computers in instruction. This report reflects the fact that many schools in developing countries have a student-teacher ratio as high as 80:1, and must contend with a computer lab of ten to twenty computers for the entire school—if they are lucky. Moreover, most schools with computers can only afford dial-up connectivity, which in many cases runs over old lines and antiquated telephone exchanges. With this level of connectivity, a lab with ten to twenty computers in Uganda is like a fire hose dangling over a thirsty traveler in the desert that releases only drops of water into his parched mouth.

Despite many limitations, schools make these labs work. Schools squeeze as much use as possible out of poor connectivity through technical solutions such as store-and-forward e-mail, caching Web pages locally, extensive use of CD-ROMs, and pulling Web pages through e-mail. Teachers have also learned to manage their classes to work with these limitations. Many teachers divide their classes into groups to allow some students to work off-line while others use the computer to either search for information, input information, or create information for a project. For instance, in Ghana, Edward Tetteh from Accra Academy brings his students to the computer lab to work on a collaborative project focused on HIV/AIDS (http://www.world-links.org/aidsweb/testing/index.html). While one group of students researches the HIV/AIDS statistics for Ghana online, another group reviews e-mail messages from partner schools in South Africa, Zimbabwe, the United States, and Uganda, and yet a third group begins to write a response to one of the partner schools in South Africa. While Edward manages his class creatively to ensure that all students are on task and have some access to the computer, Edward and his students are in the minority in his country. The small number of students who touch a computer in his classroom and his school is indicative of a greater challenge—information and computer technology needs to become more readily available to a larger number of students and teachers. Existing computer technology is still not appropriate in terms of complexity and cost for a school environment—particularly in a developing country. Cheaper, easier-to-use technology must be developed and implemented in schools to allow for greater use among students and teachers.

Lesson #2: Technical support cannot be overlooked

Getting computers into schools is relatively easy; keeping them working is a greater challenge. A myriad of problems ranging from electrical spikes, to viruses, dust, heat, and normal wear-and-tear can bring activity in a developing country computer lab to a screeching halt. Most schools lack the funds for a full-

time computer technician, and when one is hired and trained, he is often lured away to a more lucrative job elsewhere, leaving the school to start the search over again. Moreover, most ministries of education are ill equipped to effectively service a large number of schools. Most schools are therefore left with very little technical support when inevitable technical glitches arise. However, a few innovative solutions have emerged in countries around the world. One solution is to give students more responsibility for maintaining the labs. Many students are as or more adept with the technology than the "professional" technicians who are often hired. An example of such a program is the "Kids on the Block" initiative in Namibia, in which Schoolnet Namibia works with youth to provide them with the technical training necessary to refurbish, install, and maintain the school computer labs. Providing students with some basic training and a whole lot of trust can save a school and a school system time and money. Other solutions, however, must also be evaluated, such as additional training for technical staff in schools and administration offices and outsourcing this technical support to private organizations.

Lesson #3: Noncompetitive telecommunications infrastructure, policies, and regulations impede connectivity and sustainability

Because most developing countries charge by the minute even for local calls, reluctant principals with tight budgets limit the amount of time on the Internet throughout the day. Results of the aforementioned SRI study do suggest, however, that when schools or ministries of education invest in high speed Internet access, there is an increase in satisfaction, use, and integration into the curriculum. For instance, in Mauritania the ministry of education has made a commitment to connect the six pilot schools participating in the World Links program with dedicated leased lines providing high speed access twenty-four hours a day, seven days a week. Because these schools have fast connectivity with subsidized costs, only a small minority of the teachers listed unreliable Internet access as a major barrier and the evaluation results for Mauritania were higher than any other World Links participating country.

Ministries of education can also make a more concerted effort to partner with their local or national telecommunications company. Such partnerships can lead to a win-win situation in which not only educational aims are furthered, but also telecommunication company goals—such as an expanded user base. In Chile, for instance, the ministry negotiated a deal with the Compania de Telecomunicaciones de Chile (CTC), a prominent telecommunications firm, to provide free Internet connectivity for up to 6,500 schools for ten years. In addition to the Internet connectivity, CTC offers the schools digital or analog lines and provides service, an e-mail account, Web hosting up to five megabytes, Web browsing and e-mail software, Internet blocking software, installation, and technical assistance—all free of charge. Governments need to follow this example and

work more closely with telecommunications providers to show them the benefits of providing subsidized access for education. In the long run, it makes good business sense as well for the companies as they build their future user base, potentially reach parents through students, and accrue the public relations benefits of providing a social service.

Emerging wireless technologies is another regulatory area that needs attention. Because reliable fixed line connectivity is still mostly limited to only urban areas in developing countries, wireless options are attractive to rural and peri-urban communities. As wireless technologies continue to develop and become more ubiquitous, however, governments need to evaluate their spectrum allocation and licensing policies to ensure that satellite connectivity options allow for a broad range of choices for the connection of underserved areas of the country.

Lesson #4: Lose the wires

World Links has found that the most effective technology for connecting schools in developing countries is wireless. The telecommunications infrastructure is so poor in many African countries, for instance, that fixed line dial-up connectivity will never be a viable solution. Developing country schools are now bypassing their local fixed line infrastructure and establishing wireless Internet access. In Uganda, there is a telling case of the schools' evolution to broader band Internet connectivity using wireless solutions. Five of the original ten schools selected to participate in the World Links pilot project in 1997 could not use the Internet due to antiquated exchanges. These schools were moved to a cellular telephone connection through Celltel, a local company that donated one hour of free airtime per day. This allowed students to send e-mail only, at a speed of 9.5 Kbps. In order to overcome the deficiencies of the existing fixed line infrastructure and the slow data rates of the cellular telephone link, a number of schools moved to a broader band wireless connection. Makerere College School established the first line-of-sight spread spectrum wireless Internet link (this technology has a limited distance of around 20 km because the sender and receiver must have a clear path or "line-of-sight between them) with a capital outlay of US$1,500. The connection has worked flawlessly, and has given the school connectivity twenty-four hours a day, seven days a week. The school paid AFSAT, the local Internet Service provider, US$250 per month in recurrent costs; this was equivalent to payments made to the local telecommunications provider for the slow, unreliable, limited Internet access over the dial-up connection.

The World Links program is now experimenting with wireless satellite or VSAT (Very Small Aperture Terminal) technology in rural areas in a wireless connectivity pilot. If successful, the solution will be replicated in other rural areas throughout Africa and elsewhere. With the assistance of a donation from

the Gates Foundation, fifteen schools in the most rural areas of Uganda will be connected with satellite-provided Internet connectivity, teachers and students will be trained in use of the equipment, and the results of the pilot will be monitored and evaluated to determine the technical and financial sustainability of the satellite solution. Thus far, the pilot has provided a wonderful learning experience. Additional funds, for instance, were required to fence in all of the satellite dishes to keep monkeys from jumping on the dishes to eat the cables.

Lesson #5: Get the community involved

Lack of financing is one of the greatest challenges to connecting schools in developing countries to the Internet. How does a school in a country like Uganda, with a per capita income of US$310, afford US$250 per month for an Internet connection? Part of the answer is to share the facilities and the costs with the broader community. The rural pilot mentioned above in Uganda will be used to test a number of sustainability models for schools to recoup the recurrent costs of Internet connectivity. With fifteen schools participating in the pilot, the monthly recurrent costs for sharing a 256Kps space segment come to around US$400 per school, per month. The World Links program plans to subsidize half of this cost for two years, while the communities participating in the pilot will need to pay the other US$200 per month. In order to support these costs, poorer rural areas that participate in the pilot will need to develop an innovative plan. Some of the resources will come from a community education tax, and the remaining resources will be raised by opening the school after school hours, on weekends, and during holidays to the community to provide training and information access. World Links has provided the participating pilot schools with a forty-hour training course on the use of schools as community learning centers. The training helps schools identify services, market these services, staff the center appropriately, and manage the finances of the center. This strategy not only accomplishes the objective of spreading the recurrent costs across a larger number of users, but also engages the community in the activities of the school and provides a venue for adult and life-long education.

World Links first piloted this concept in Zimbabwe. At the Bindura-World Links community learning center in Zimbabwe, over half of the "clients" are adult learners who come to receive basic computer literacy training. Another important user group for this facility is the Zimbabwe Open University, where over three hundred students use the center to access their course material and interact with professors online. Finally, approximately 70 percent of the users of this center in Zimbabwe are women. The success of these pilots suggests that developing countries should encourage schools to open up to the community as a means of bridging the digital divide between urban and rural areas of the country, between in-school and out-of-school youth and, finally, between girls' and boys' access to education.

Lesson #6: Private-public sector partnerships are essential

A ministry of education cannot take on the task of equipping schools alone. It is simply too big a job. Governments will need to form strategic partnerships if they are to succeed. India presents a wonderful example of an effective partnership between the public and private sectors. A number of states in India have implemented a variation of the community learning center concept by partnering with private sector computer training companies. The state government of Karnataka, for instance, has equipped seven hundred schools with ICT labs in an astonishingly fast time frame—only forty-five days! How was this feat accomplished? Through a partnership with NIIT, a private computer training institute. The Karnataka government contracted with NIIT to equip and maintain the school computer labs and provide an instructor for technical training for students during school hours. In exchange, the training institute is compensated with a five-year contract for providing the training, and is allowed to use the facilities after school hours for delivery of its private training courses to the community. The initiative also created some unforeseen externalities. As Ravi Kiran, the manager for the project, indicated:

> In some districts, there was nothing before we started this project. We brought power and telecommunications services to these areas where none existed before. We hired 1,400 trainers, mostly from the local communities. We would ride through town with a bullhorn announcing these job openings and the people would flock to us. When we drove into a community to set up the school lab, the kids would run after the truck and the whole community helped with the installation. The whole company is very proud of this project.

The initiative in Karnataka has received high marks thus far from both government officials and the private training institutes.

Lesson #7: Link ICT and education efforts to broader education reforms

These examples of private-public partnerships to equip labs and provide cost-effective Internet connectivity represent very good models of innovative public sector leadership, but installing the physical infrastructure is the easiest part of the battle. While many ministries of education around the world have made the commitment to computerize schools, few have developed coherent strategies to fully integrate the use of computers as pedagogical tools in the classroom. One of the significant bottlenecks that World Links has encountered is the lack of a clear policy in ministries of education with regard to use of computers in education. Many ministries of education view computers as a stand-alone subject requiring a curriculum focusing on basic computer literacy skills. While computer literacy represents a start, the integration of computers and the Internet into the broader curriculum is where real learning

gains will be made. Results of the SRI-World Links evaluation show that teachers enthusiastically engage in collaborative projects and constructivist pedagogy, but school administrators offer very little structural support and incentives to effectively use the technology in the classroom. First, the curriculum that teachers in most developing countries need to follow is rigid and overloaded, leaving little time for innovative classroom practices. Second, exams represent the greatest incentive for the majority of students and teachers. The common view is that "if it's not going to be tested, then it must not be important." Ministries must make a commitment to helping teachers effectively integrate computers and Internet technologies into their schools by aligning curriculums, exams, and incentives with the educational outcomes that they hope to gain. Computers by themselves bring very little to the learning process—they are only tools, like many others. Linking computers and the Internet to learning objectives is a challenging goal, but is one of the most important that education policy makers can achieve.

Lesson #8: Training, training, training

The professional development of teachers sits at the heart of any successful technology and education program. Teachers need not only formal training, but also sustained and ongoing support from their colleagues to help them learn how best to integrate technology into their teaching. Training must go well beyond basic cutting-and-pasting. Teachers need to be able to transform their classrooms from places where a static one-way flow of information from teacher to student occurs, into dynamic, student-centered learning environments in which learners interact with peers in teams, both in their own classroom as well as with virtual classes around the world through the Internet.

Most teachers, however, are intimidated by technology and are comfortable with their own teaching styles. Any teacher-training program should help teachers see past the technology to the pedagogical and educational gains that use of the technology will bring to the classroom. Furthermore, teachers need to be transformed from information consumers, using the Internet to access resources, into information producers, adapting the information for their particular cultural and educational reality. Some countries have established online networks or communities-of-practice, in which teachers share resources that enhance their curriculum, get peer reviews of lesson plans they have created, and exchange ideas and good practices with other teachers of their subject.

World Links has focused its training on helping teachers to use technology as a tool, and to transform their classrooms into interactive, inquisitive learning environments. According to a physics teacher in Peru, "After the training, I now learn with my students and often from them. They enjoy it and I take pride in it." Indeed, the SRI evaluation of World Links shows that as a result of training, three quarters of participating teachers stated that computers and the Internet enabled them to greatly improve their knowledge of a subject matter. Over 80 percent of surveyed teachers said that their interest and enthusiasm for teaching had increased greatly under the World Links program—and it is well known how important a motivated, enthusiastic teacher is for improving student outcomes. Teachers need support, examples of good practice, and leadership from their school principal to receive the necessary time for professional development, in order to truly transform teaching and learning in the classroom.

Lesson #9: Technology empowers girls

A small Muslim girl from Mauritania states, "We get our freedom from the Internet, since in our society girls are not allowed to go wherever we want…the Internet takes us out to other people, places and realities…it is our way of escaping from our closed society. It is vital to us, it gives us liberty."

Among international development practitioners, female education is recognized as one of the critical factors in promoting social and economic development. For instance, an educated woman is more productive at work—studies suggest that an extra year of schooling will increase a woman's future earnings by about 15 percent, compared to 11 percent for a man (UNICEF 1996). Also, because women are the primary caregivers in developing countries, it is often said that, "when you educate a woman, you educate a whole family." While 80 percent of girls attend primary school in Mauritania, the gross enrollment rates drop to only 11 percent at the secondary school level (World Bank 1998). In other developing countries, the statistics are worse. Educating girls, therefore, is a top development priority. A recent World Links study on the differential impact of the program on boys and girls showed that in areas such as academics and communication skills, girls have benefited more, while in the area of technological skills, boys have benefited more. Moreover, once online, girls appear to do extensive research on teen-related information that is often taboo in their cultures, such as sexually transmitted diseases, teen pregnancies, and AIDS and its prevention. Seventy percent of girls in World Links schools in Mauritania, for instance, emphasize the fact that the Internet provides freedom to them as women since they no longer need to limit themselves to the controlled information given by their society and family. A girl from Ghana states, "Our self-esteem has really improved because of the World Links program. Now we can rub shoulders with boys that want to step on our toes. We walk with our chests out! Anytime we are confronted with questions we feel confident answering, even with older people we come boldly!"

Lesson #10: Technology motivates students and energizes classrooms

When schools are connected to the Internet, teachers taught to rethink their teaching methods, and students empowered to use technology, the impact can be profound. Teachers quickly see how the use of computers energizes the students and makes the classroom a more interactive learning environment. In the SRI-World Links evaluation, two-thirds of teachers, for instance, reported that the World Links program had a "large or great impact" on students' attitudes toward schools. One teacher in Peru said, "I learned to break the routine of using the chalk and the blackboard. World Links forced me to make my classes more interesting, more tangible—students are more interested and attentive." Teachers have also reported that World Links has helped students develop confidence, a sense of responsibility, the ability to work as team members, think creatively for solutions, and share knowledge (Kozma 2000). In a focus group of teachers in the Palestine Authority, the greatest benefit of the use of computers and the World Links training was that it broke down the barriers between teachers and students in the classroom. As one Palestinian teacher stated, "There is now a more collegial environment and less hierarchy—students feel comfortable asking teachers questions and teachers are less intimidated to seek help from students." Many teachers, however, initially feel threatened by the loss of control in the classroom as students, who are usually more adept at using technology, can quickly access information and challenge the teacher's role as the sole font of information. Teachers who receive professional development, however, learn how to more effectively manage their classroom and use the technology to create a more stimulating learning environment. A student in Senegal noted that, "Our teachers, because of our participation in collaborative projects and Internet access, have to do a better job. They carefully prepare their lessons before coming to class. We challenge them; we are no longer passive receivers of information. We analyze and question things."

Conclusion

While limited in scope because of the fact that it is a pilot, World Links has, in five years, shown the effect that a carefully thought-out, integrated approach to introducing computers and the Internet into learning environments in developing countries can have on teaching and learning. In countries where learning resources are limited and teachers never dream of having a fully stocked library, let alone the Internet, teachers and students have been introduced to a new world of learning. As a result, those participating in the pilot have been greatly empowered, and now believe they can compete in a global knowledge-based economy because they know that their knowledge, ideas, culture, and passions are as valuable as any in the world. In order to more effectively prepare its youth to participate in this Networked World, greater commitments and willingness to share and adopt innovative solutions are needed from all aspects of society—from governments, the private sector, communities, donors, parents, and students. Schools should be transformed into active learning environments open to their communities; telecommunication and power infrastructure policies should focus on schools as starting points for rural transformation; teachers and students must be empowered to be creative agents for change in their schools; and leaders must embrace a vision that will prepare their youth for tomorrow's challenges.

While the world has fundamentally changed over the past hundred years and will continue to do so at an accelerating pace, the classroom has not. But it will, soon. The issues outlined in this paper are not unique to developing countries. Schools around the world face the same challenges and by and large the same lessons apply. It is time to collectively change our approach to the learning process, and particularly, take advantage of the power of technology to improve learning outcomes, enhance economic opportunities, foster greater creativity, and realize the dreams of disadvantaged youth in developing countries. If together we can begin this transformation, schools a hundred years from now will sit at the heart of a learning society and allow youth from any country in the world—rich or poor—to have the same opportunities to create a better world.

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Endnotes

1   The twenty-one World Links countries include Botswana, Brazil, Burkina Faso, Chile, Colombia, Costa Rica, El Salvador, the Gambia, Ghana, India, Mauritania, Mozambique, Palestine Authority, Paraguay, Peru, Senegal, South Africa, Sri Lanka, Turkey, Uganda, and Zimbabwe; the program is in a preparatory phase in Cambodia, Jordan, Indonesia, Laos, the Philippines, and Vietnam.