Bread and Brain, Education and Poverty
Pontifical Academy of Sciences, Scripta Varia 125, Vatican City 2014
www.pas.va/content/dam/accademia/pdf/sv125/sv125-battro.pdf

A DIGITAL EDUCATIONAL ENVIRONMENT IN POOR POPULATIONS

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We are facing an education emergency and we need to take urgent measures to ensure the right to education. Millions of children around the world are excluded from a proper education as a result of dramatic conditions of poverty and social inequity but, for the first time in history, we have the tools to bridge this intolerable gap. In fact, the formidable expansion of the digital environment is covering the whole world and can be used to the benefit of education. And education is the way to overcome poverty. We need to proceed as epidemiologists and cover very large populations, close or remote, to prevent ignorance and to unfold in the child the required neurocognitive skills to become an educated person in our century. In this sense digital tools are rapidly scalable and may reach millions in a short time. Recent digital deployments that cover marginal communities are showing ways to improve education even in extreme situations without schools or teachers. I will offer several successful examples of a large spectrum of digital deployments and educational interventions in poor communities, based on eight years of international experience by OLPC, The One Laptop per Child Foundation and Association.

Emergencies in education

The notion of "emergency" is not a frequent term in education, it defines instead a whole discipline in medicine. Physicians are trained for emergencies, educators are not. And this lack of conceptual tools and of practical means is not helping in the case of the enormous challenges we face in education today. The Millennium Goals of the United Nations stated that by 2015 every kid should attend elementary school. Unfortunately we are still far from this objective (Battro, 2007b). We are facing an emergency: millions of children are not educated because of the lack of schools and teachers or access to them. How can we proceed? We cannot wait for another generation to eliminate ignorance. We need a kind of "vaccine" to prevent it and a sound "epidemiological" strategy. Jonas Salk in his remarkable essay *Man unfolding* made a thoughtful analogy between immunology and education (Salk, 1972, Battro, 2009a). I quote: "It is possible to induce a temporary effect of immunity by transferring antibodies from one host to another; but long-term immunizing

effects can be induced only by the active participation of the host in developing his own antibodies as a consequence of his own interaction with the antigen. This phenomenon is not dissimilar to the effect observed in the individual who acts passively in response to what he is told but who has not, through engagement, learned in a way that would result in understanding and hence in more durable effect of active experience" (p. 26).

Incidentally, following Salk's analogy between immunology and learning we have recently observed the effects of "passive learning" on the student brain during a sequence of questions proposed by the teacher in the demonstration of a theorem of geometry. To our surprise, this classic procedure, a Socratic dialog, is not always helping the student to "understand" the problem, but we could predict, using online brain images of both student and teacher, who will be the student that really understands the problem in a "durable" and constructive way (Goldin *et al*, 2011, Holper *et al*, 2013). This is a promising neurocognitive experiment that opens new ways to understanding the complexities of how teaching and learning interact in an educational setting at the brain level. The problem is to find the best pedagogy available and we have proposed a "Teaching Brain Consortium" to contribute to this objective (Battro *et al*, 2013a). Perhaps in the future we can dream of brain/computer interfaces that will facilitate the work of the educator, also in the most remote and deprived communities. In fact, the urgent search for a sound strategy to educate in the absence of schools and teachers is envisioned by the recent proposal of the Global Literacy Initiative (see Maryanne Wolf, this volume, 2013). At the moment, the digital tools are the only "vaccines" we can imagine to combat ignorance at a very large scale in deprived communities, in particular with mobile equipment of very low cost using alternative sources of energy.

The "One to One Model"

Nicholas Negroponte presented the idea of a low-cost laptop for the education of poor and deprived communities in November 2005 at the joint meeting of the Pontifical Academy of Sciences and the Pontifical Academy of Social Sciences on "Globalization and Education" (Negroponte, 2007). This idea became the core of *OLPC, the One Laptop Per Child Foundation and Association,* now active in 47 countries with a deployment of some 2,400,000 laptops. (www.one.laptop.org) See Figure.

A successful program must take care of all the components involved: in the first place a sound digital pedagogy in school and at home, teacher and family training, software, deployments, repairs, connectivity, maintenance, Internet, etc. OLPC follows five principles: the program starts at early ages

(today, with the new tablets, in pre-school), the laptops are owned by the user, all laptops are connected to the web, the software is free and open source, and the community is "saturated", every student and teacher has a laptop. From the point of investment the most difficult task is to support a sustainable plan that will permit the healthy growth of the entire system during the school years, in particular in the poor regions of the world. The unit of intervention is a whole "cohort" of students (some 6 years in primary schools). Not only do we need to provide good equipment and software, a sound connectivity network (Internet, wifi access, servers), give rapid solutions to repair or replace equipment, etc, but we also have to pay special attention to develop the required educational skills in teachers and students, by permanent courses, workshops, competitions, etc.

We already have some significant results of the effect of the one-to-one modality in education. A most important contribution of the digital environment is to add a new "longitudinal" dimension to the standard "transversal" evaluations provided by currents exams and tests. In fact, every student can be monitored day by day on his or her performance on the laptop and teachers may keep a continuous record of each student during

all the school years, a record which is a veritable treasure of information to build a sound pedagogy and continuous intervention. Moreover the digital environment may also help in transversal testing. In one day, all (connected) students may be tested on a given discipline, there can be many thousands at the same time and the results are automatically analyzed, statistics are deployed and will immediately reach each institution for comparison. This is a formidable asset for the entire community and of very low cost in relation to common evaluations.

Quantitative and qualitative evaluations are regularly done and are published online. We can see a summary of these results in many OLPC current deployments in the world (http://laptop.org/map).

These results are very dependent on the scale of the deployment. Normally OLPC deployments start with small rural communities (Nicaragua) and towns (Paraguay) and increase by steps covering whole provinces (La Rioja, Argentina) and even whole countries (Uruguay). We observe in general that in the digital school OLPC environment drop-out rate decreases, families become more integrated with the school, children improve in mathematics and literacy, teachers create new pedagogical resources and students show amazing capacities for innovation in the arts and sciences (music, design, programming, robotics). And most importantly the community is increasingly involved and supportive. Thousands of hours of voluntary work make it possible to reach remote and poor populations.

A first question is always about the cost of this intervention, in particular in some developing countries where the budget of education is very small. It is clear that the required investment varies from country to country. Many think that computers are designed for wealthy communities; the poor instead need all kind of essential goods "before" reaching a sophisticated technology, bread before connectivity. The answer is that of course no education is possible without healthy nutrition, and many other conditions, but poverty can only be eliminated by education; and education today is to become "connected to the web". In fact, a digital environment can provide formidable resources at very low cost for education of the poorest communities.

In Latin America, Uruguay gives a solid example with an investment of 100 USD per child per year, that provides a connected laptop to all children and teachers of public schools (more than 500,000) with all related pedagogical services included (www.plan.ceibal.edu.uy). This amounts to only 5% of the annual governmental budget for primary and secondary schools. It is interesting to note also that some governments are taking their educational programs on digital innovation as a symbol for the modernization of their country. Rwanda, for instance, has deployed more than 200,000 laptops

among teachers and students and has recently printed a new 500 franc bill with a picture of children using their laptops at school to celebrate this initiative (http://wiki.laptop.org/go/Rwanda). But private institutions are also greatly helping their communities, in particular the most deprived and poor. A good example is the Zamora Terán Foundation in Nicaragua (www.portaleducativofzt.org) that has provided over 40,000 laptops to poor communities and has developed an extended program on Health and Nutrition supported by the digital platform. Another successful "one to one model" is offered by the Paraguay Educa Foundation (www.paraguayeduca.org) that gave some 10,000 laptops to all children and teachers in public and private schools of the city of Caacupé, with a strong emphasis on teacher training and community innovation.

The process of digital deployment, however, is not simple because the new technologies frequently challenge the established pedagogy and may find great resistance. In our experience at OLPC, we have sometimes observed that a first burst of enthusiasm towards the "modernization" of education introduced by computers into the old structures of schools may evolve towards disappointment and even skepticism. Machines get broken, electricity and connectivity fail, teachers are not receiving sufficient support to become empowered in the new digital environment, students are not acquiring the necessary cognitive skills to thrive in the formidable world of opportunities offered by the digital systems. Accordingly, each OLPC team must deal with local political issues and with basic technical problems but the essential issue is always about pedagogy. We can affirm that "pedagogy defines the culture of a community" and we should now construct the new pedagogies of the digital era.

At the same time, the variety of cultures we contact at OLPC is a source of inspiration for all of us and opens a horizon of hope for education. We are experimenting the unfolding of a very rich array of new pedagogies. Moreover, many local initiatives in different languages and cultures are starting now to collaborate at the international level with the exchange of ideas and technologies, scholarships and common projects, working groups and seminars.

The details of the ongoing activities, evaluations, etc, may be checked on line and can be of great help. In particular, the impact of the digital environment to overcome poverty is great. A poor family with several children may now have several laptops at home, and this means a significant "expansion" of the school, without limits of time or space. Connectivity is also expanding in many poor regions, and of course schools are among the first institutions that take advantage of this accessible digital environment. Thousands of resources in the arts and sciences, books in many languages, and the possibility of social

networking are new dimensions that were completely inaccessible only a decade ago (Battro, 2002, 2004, 2007a, 2007c, 2009a, 2009b, 2013b, López Rosenfeld *et al*, 2013). Education is always about values, the values of truth, good, and beauty. We have the great responsibility of helping the new generations to construct and share these values that are the treasure of humanity in every community around the world.

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Salk, J. (1977). *Man unfolding*. Harper& Row: New York. Note: Jonas Salk wrote in my copy of the book: "To Antonio Battro, with hope for the unfolding of a nation of children". An inspiring program indeed.