Subversive Change:
Empowering Educators to Lead Innovation from Within

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ABSTRACT

Improvement of the quality of education, and even educational reform is goal for most the educational systems in the world. But, it has been proven historically that changing and improving an educational system is probably one of the most difficult and complex tasks in our societies specially, if it is externally and top-down imposed. My proposal here is that change and reform in an educational system must empower educators to take the lead and prove we are able to change and promote change. And to do so, we need show innovation and be credible. We need to empower ourselves from within. In this paper I will present the case of the Faculty of Education of the University of Costa Rica that, with its project LUMEN is leading an impressive innovation process, not only among its different departments and faculty members, but amongst other Faculties at the University such as Engineering and Medicine, for example. I will present also the vital role that the constructionist vision and very new digital technology have played in this case.

Keywords: Improving Education, Innovation, Leadership, Constructionism, Digital Technology, Modular Technology.

1. CHANGING EDUCATION

Improvement of the quality educational systems around the world, and even educational reform is goal for most the educational systems in the world. Countries – mainly but not only the developing ones - must quickly find creative ways to take advantage of new approaches, theories of learning and methodologies and of the new digital technologies that are now available This new reality requires fundamental transformation in the way education is conceived and organized, not only within the educational systems, but also in all activities of life. We see efforts in many places around the world being made to transform education and to take advantage of the new technology to do it. Nevertheless, based not only on poor results of standardized tests, but also—and, more importantly— on people's general perception (commonly and repeatedly expressed in parent meetings, the mass media, and educational conferences), it is fair to conclude that in most places (certainly, but not exclusively in the developing world) educational systems are not being fundamentally improved.

I think that there are some basic conditions that are needed to start seriously moving towards change in education.

- Growing Change from Within. Change will not have a real impact if it comes top-down or externally. Change must grow from within
- Learning Constructively: Learning will be more permanent if it is approached constructively
- Using Technology in Creative and Relevant ways

1.1 Growing Change from Within

History has proven that development is not permanent if it comes from outside; that innovation is not linear; that change does not have a real impact if it comes top-down.

As Claudia Urrea reminds us, following the interest on poor nations after World War II, economists rapidly developed a top-down approach to promote economic growth in mostly agrarian societies. The goal, was, to implant, from outside, modern values and information through literacy, education and media technology, and the adoption of innovations and culture originated in the developed world. The assumption was that, all countries passed through the same historical stages of economic development and that current developing populations were merely at an earlier stage in this linear historical progress. But this linear-stages theory failed. It created dependency and did not promote development.

In analogy with this example, I also believe that change and development in an educational system -including educational systems in the developed world

- generally fails when it is linear and top-down.

I rather stand by Paulo Freire's[1] ideas of a constant action-reflection-action cycle that leads to learning and development. Freire's model in general proposed a human-centered approach that valued the importance of interpersonal channels of communication in decision-making processes at the community level. (Freire, 1970).

Thus, we believe that change has to grow from within.

1.2 Learning Constructively

I am of course standing on the side of Jean Piaget's Constructivism[2] and Seymour Papert's Constructionism[3]. I endorse their theories and believe that knowledge is constructed within, in interaction with the social and physical world - and not merely transferred from outside- and that learning will be more meaningful if it is constructed in a context where the learner is consciously engaged in the making of a public entity.

And, as well as Edith Ackerman, I believe that integrating both Piaget and Papert's views can enrich our understanding of how people learn, develop, improve and change. According to her, Piaget's theory describes how children's ways of doing and thinking evolve over time, and under which circumstance children are more likely to let go of-or hold onto- their currently held views. Papert's Constructionism, in contrast, focuses more on the art of learning, or `learning to learn', and on the significance of making things in learning. Papert stresses the importance of tools, media, and context in human development.

In fact, Papert and his collaborators think that the new digital technology offers unprecedented opportunities for constructing knowledge. For them, the digital technology can make accessible concepts that before were too abstract for many (children, for example). In Mitchel Resnick words…"Just as advances in biotechnologies made possible the "green revolution" in agriculture, new digital technologies make possible a "learning revolution" in education." (2002)

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[1] See http://www.paulofreire.org/
[2] See http://www.piaget.org
[3] See http://www.papert.org/

1.3 Using Technology in Creative and Relevant Ways

The word "technology" derives from the Greek techne (art, skill, craft), and logos, knowledge (giving order and meaning to the cosmos). As defined by the Encyclopedia Britannica (www.eb.com), technology is the application of scientific knowledge to the practical aims of human life or, as it is sometimes phrased, to the change and manipulation of the human environment. It is the systematic study of techniques for making and doing things. Thus, technology is established as a social phenomenon and as such, cannot possess complete autonomy, unaffected by the society in which it exists. A simple look at the word "technology" in any common dictionary and the following words will come up: knowledge, expertise, skills, know-how, equipment, machinery and tools. But somewhere along the way, that knowledge, skills, know-how and expertise were left behind, reducing the general understanding of "technology" as merely equipment, machinery and tools. Moreover, it is generally understood that "technology" only refers to the newest machinery, placing any previous machinery in another category. (Badilla-Saxe, 2001) Unfortunately, leaders and the general public do not understand technology as a social phenomenon, and this fact may be very relevant to the development of our societies. Due to this generalized misconception, most of the political decisions regarding the ways in which technology can enhance development are taken independently of the society in which such technology will exist.

In the case of education, digital technology that has been designed with other purposes and for other contexts, is installed and connected in educational settings, regardless of the culture and the social environment. Moreover, and as Papert and others have been denouncing, it is being used to do the same traditional things we have been doing in education for centuries, with a total waste of its potential and possibilities.

On one hand we think that the digital technology should be used in different and creative ways in education. As Resnick (2001), I think that we need to help learners, teachers and people in general to be fluent with the technology, meaning that beyond knowing how to use it, the key is to know how to construct things of significance. On the other hand, we also believe that there is a need to rethink the technology itself, to make it more relevant to the context and the culture in which it will be used. And, we need to develop the tools that allow people to create and modify their own digital technologies.

2. THE RESEARCH CONTEXT

Dr. Bakhtiar Mikhak[4] at the MIT Media Lab has proposed the project The Learning Independence Networks[5]. He believes that developing nations typically settle for approaches and technologies that were designed elsewhere, with other purposes in mind. In pursuing the improvement of education and community development, and with the conceptual framework described above, he designed a Research Project: Learning Independence Networks that is being developed with collaborators in different regions and countries. According to Mikhak's vision, Learning Independence Networks supports participants in their capacity building to develop their own approaches and technologies appropriate for local needs. He has in mind a true transference of technology (in the broad sense of the word, also explained before), that promotes a sense of self-sufficiency and independence. Collaborating with Mikhak in the research he has proposed we are working with networks of organizations in developing nations (including universities, foundations, companies, and NGOs) In July 2001, we established the first Learning Independence Network in Costa Rica, Esperanza[6], and we are in the process of starting other research networks in México and El Salvador.

For our research, we identify with the principals of Participatory Research as alternative paradigm of research. Participatory research aims to engage the members of the participant groups in the collective

[4]http://www.media.mit.edu/people/bio_mikhak.html
[5]http://gig.media.mit.edu/projects/lin/[1]

analysis of their problems in an effort to understand and address them.

We also believe, as Donald Schon, (in Urrea, 2003) that we are learning from the study of our practice and that our learning is based on prior theories and used to construct new theories that can be used to test future observations.

3. PROJECT LUMEN[7]: EMPOWERING EDUCATORS

Improvement of the quality of education starts and goes back to the improvement of teachers' education in a constant virtuous cycle. Educators need to take the lead in an educational change in proving we are able to change and promote change. So first, we need to show innovation and be credible. We need to empower ourselves from within. With this convincement in mind, and also thinking of the larger goals of Esperanza, in July 2001 we also approached the Faculty of Education at the University in Costa Rica. In the Dean of Education, Dr. Sandra García, and a team of her collaborators gathered in a program called Protea[8], we found an inner will to rethink with us the role of teacher education in the country and to take the lead in innovation in education using digital technology. Dean García and her team were conscious of the need of a change in teacher education and they were searching for innovation with the use of digital technology. Still, they did not have a clear vision on how to proceed and their concerns were not shared by other faculty and students. We all agreed on starting a joint research project, that we called LUMEN9. In delimiting our research, we decided to focus on the use of digital technology within the Faculty of Education. We would then take a look at new digital technologies available; think on innovative ways of using it in education; and based on what we learned from there, would propose changes in the way digital technology was being understood and used in teacher education. LUMEN started in July 2001 in a very subversive way. It was not officially recognized as a formal research within the bureaucracy of the Faculty until July 2002.I t is an ongoing research.

3.1 A Starting Point

LUMEN research group (including researchers from Protea and the MIT Media Lab) started with selfreflecting meetings and came to understand where we were standing. In July 2001 (García, 2002):

- Initiatives for the use of Digital Technologies within the Faculty of Education were isolated and weak;
- There was a lack of a theoretical framework;
- There had been no political support for the few efforts that used Digital Technology in courses;
- Professors, researchers and students were not motivated to use digital technology in their administrative or academic activities;
- Lack of computer laboratories and other digital technologies;
- A Think Tank had been created - Protea –to reflect on the use of digital technology within the Faculty Education.

3.2 Our Quest

Our quest then was oriented towards endorsing a theoretical framework, and understanding new digital technologies as tools for learning.

a. The Theoretical Framework:

LUMEN research group started to build the theoretical framework upon the robust knowledge that as a team we already had on authors like Jean Piaget, Paulo Freire, Lev Vygotksy[10], Ivan Illich[11] among others, and about learning theories like Constructivism and Social Constructivism. We then gain a deeper understanding of Seymour Papert and his collaborators, and of his theory of Constructionism. And

also, we participated in international forums to reflect with others, about the theory beneath the use of digital technologies in the learning process. In particular, at the MIT Media Lab Dr. Mikhak and I, designed a theoretical workshop called Actions, Reflections and Powerful Ideas[12], with the goal of gaining a deeper understanding of the constructionist approach underlying the actions projects. The workshop took place in Costa Rica in May 2003, and our colleagues from LUMEN had a very active participation, along with other international educators and community development activists interested in a critical engagement with theoretical and conceptual issues.

b. Digital Tools for Learning

In parallel, LUMEN research group is taking another look at the digital technology trying to see beyond traditional settings, computers and educational software.
We did look in schools and classrooms in the country and elsewhere. But now we are looking in different and creative environments: how is technology placed and used in an architect's or artist's studio; in a research lab (like the Media Lab) in a community center?
We did think of computers and software as we know them today, but we tried to imagine non traditional approaches to the use of digital technology to support learning. LUMEN participated in international workshops particularly in one organized by the MIT Media Lab and that took place in Panama in March 2003, called Creativity, Constructionism, and Community[13] . In this workshop we looked at digital technology in refreshing ways, exploring a combination of storytelling and digital video as a methodology for personal and community expression and learning.
And also, we are carefully looking at the appearance that digital technology will take in the near future and at the educational potential it offers. In particular we are exploring with The Tower a fully modular computational construction kit, developed in Dr. Mikhak's Grassroots Invention Group at the MIT Media Lab. For this technology, Dr. Mikhak's student, Christopher Lyon won the 2003 Ernst A. Guillemin Award for best master's thesis in electrical engineering at MIT: "Encouraging Innovation by Engineering the Learning Curve".
The Tower is comprised of a variety of hardware modules, which can be easily interconnected based on the needs of specific applications. As described by Lyon (2003), more than just a prototyping tool, the Tower exemplifies the ideals of tool building and transparency in a context that allows it to reach a wide audience both domestically and abroad. Physically, the Tower is comprised of a foundation module containing a core processor, and other layer modules that stack on top of it. These layers provide a wide range of functionality including sensing, actuation, data storage, visual and audio output, and communication. In addition to the growing set of layers created by the Grassroots Invention research group, they have also provided the necessary prototyping tools to make it easy for anyone to create their own layers for the system as specialized applications demand[14].
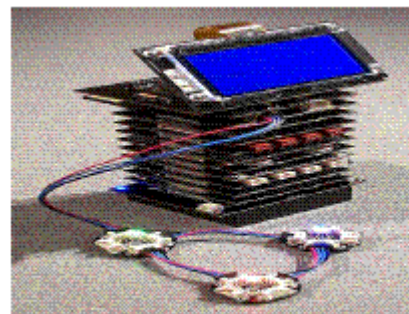

Image 1[15]

In developing the Tower System, Dr. Mikhak, Lyon and his collaborators set out to build a tool that would be powerful enough for professional developers but accessible to people (particularly children) with little technical background. Their goal, as evidenced by their early experiences to date, is that it will be empowering to children –and teachers - to know that they are using genuinely powerful development tools, and this will inspire and elevate their work.[16]

Image 2[17]

In order to gain a deeper understanding of this very new technology and its potential to improve education and community development. Dr. Mikhak at the MIT Media Lab, designed an international workshop and we invited our colleagues from LUMEN to be part of it. The workshop Rapid Prototyping Solutions to Representative Community and Educational Challenges[18] took place in Puebla, Mexico in January 2003. During this workshop, participants worked on developing and implementing solutions for a number of representative problems (educational, agricultural, and environmental) that had been identified by rural communities. These problems provided an excellent context for learning about the Tower System, and for developing with it, rapid prototyping computational solutions.
And finally, we are using the CMapTool[19] developed by Dr. Alberto Cañas[20] and Dr. Joseph Novak[21] at the Institute for Human and Machine Cognition, for organizing, managing, representing and sharing LUMEN's information and knowledge. CMapTool is a very flexible platform that empowers users to construct, navigate, share, and criticize knowledge models represented as Concept Maps

LEADING INNOVATION

So far, the ongoing research at LUMEN Project has triggered many different changes and reactions within the Faculty of Education and outside. As we are currently finding the best ways of introducing innovation into the teachers' education formal curriculum, innovation has already permeated in many other ways:

Looking at Digital Technology as a Creative Tool
At LUMEN we have gained a different perspective towards digital technology and teacher education. Digital technology is seen now as playing a much more creative role in education. While we still think that technology is useful and can support many administrative and academic tasks we see the huge potential of allowing people to create, and express themselves with the new technology.

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[9] This Project has two names. LUMEN is the "common" one.
It has also a "scientific" name in order to be accepted by the traditional establishment at the Faculty of Education.
[10] See http://www.kolar.org/vygotsky/
[11] See http://philosophy.la.psu.edu/illich/profile.html
[12] http://web.media.mit.edu/~mikhak/workshops/dn-may-2003/english.htm
[13] http://www.senacyt.gob.pa/otros/mit/
[14] The Tower Technology http://gig.media.mit.edu/projects/tower
[15] The Tower. Picture from Lyon, 2003
[16] "This approach to research and development is a natural extension of the MIT Media Lab approach in developing the "Cricket system that is the foundation of two other NSF funded initiatives, the Beyond Black Boxes Project and the Playful Invention and Exploration (PIE) Network , in both of which Dr. Mikhak, has been centrally involved". (Lyon,2003)

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[17] Workshop in Puebla, Mexico. Picture from Lyon, 2003
[18] Rapid Protoyping Solutions to Representative Community and Educational Challenges http://www.puebla.gob.mx/tower_workshop/
[19] http://cmap.coginst.uwf.edu/
[20] http://www.ihmc.us/users/user.php?UserID=19
[21] http://www.cals.cornell.edu/dept/education/faculty/novak/novak.html

Looking in Different Directions

Researchers at LUMEN are exploring with different and new digital technologies (like the Tower System), and also learning from the ways technology is used in other creative environments (architects' studios, graduate schools, etc).

Looking Further

Other research projects have been launched at the Faculty of Education since LUMEN started:

- Digital Technology for Educating All;
- Toddlers learning with Digital Technology and
- Digital Technology for Counseling

Looking at ourselves as Designers

As a research group, we have abandoned the view of educators as consumers of "educational technologies" designed elsewhere and are seeing ourselves as designers of innovative resources. We think we can provide the design specifications that are needed to produce high quality digital technology that supports constructionist learning.

New Ways of Looking at Places

Not only digital technologies have been brought into the actual building and connected to internet, but, more important, there has been a thoughtful process of re-thinking where and how it would be placed. Labs turned into very flexible learning environments with wireless connections and wheeled chairs and tables.

The Potential of a Multinational and Interdisciplinary Network

Replacing traditional stereotypes such as "only educators know about education" and like "educators only need to know about education", a strong sense is growing within the members of LUMEN about the potential, the benefits - and the difficulties - of being part of interdisciplinary and multinational networks of people and organizations.

As members of the Esperanza Network in Costa Rica and as an educational organization, we are working and learning with other educational organizations such as the Ministry of Public Education (see MEP) and the Cientec Foundation (see CIENTEC) but also with organizations an professionals coming from different areas such as business (see INCAE), bio diversity (see INBio) and engineering see (see ITCR).

And, as part of the Learning Independence Networks, and specifically through the opportunity of participating in the international workshops organized by the MIT Media Lab, a robust network of international collaborators is emerging with colleagues from Mexico, Panama, Brazil, and Colombia. And LUMEN is part of it.

Empowered to Lead

And most interesting, in an unprecedented turnout, other Departments and Faculties at the University are interested in the Faculty of Education. They are intrigued with the evident changes happening and watching carefully how innovation grows from within.

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