8. ICTs FOR SOCIAL INCLUSION: A NEW CHALLENGE IN ENGINEERING EDUCATION

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Abstract

We, as engineers, are expected to solve human needs. Social inclusion is, undoubtedly, one of them. The ability to access, adapt, and create new knowledge, using new information and communication technology, is critical to social inclusion in today's era, but having access, doesn't guarantee that it is an access socially meaningful. Social inclusion requires not only a set of basic requirements, like health, food, living conditions, etc., but ICTs access, and education for making these technologies significant for living. The question is, how to solve people's problems through ICTs and, moreover, how this issue can be taught in an engineering course. The challenge is to get more engineers involved in these activities and the way to do it is, to promote them among our students. What I'm posing here, and that will be the central premise of this paper, is that we need to include this subject within the engineering education.

Keywords: *engineering education, social inclusion, information and communication technologies*

Introduction:

There's a video developed by the American Society for Engineering Education (ASEE) through its eGFI (Engineering, Go For It!) initiative[1]. In that video[2], some engineering students answer the question "What does engineering mean to you?" The most repeated statement is "engineering means problem solving".

When, we look for a more academic definition of engineering, we may find something like this: "It is the discipline dealing with the art or science of applying scientific knowledge to practical problems"[3]. There is an interesting and widely spread statement, attributed to Theodore von Kármán, a prestigious and well known Hungarian-American engineer, who once said that "Engineering is the application of science to needs of humanity".

The Accreditation Board for Engineering and Technology (ABET) defines engineering as "The profession in which a knowledge of the mathematical and natural sciences gained by study, experience, and practice, is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind"

We don't need many more quotes to reassure what we, as engineers, already know and that is that we are basically meant to be *problem solvers,* just as the students said in the video previously mentioned. But, what kind of problems are we, as engineers, expected to solve? As Kármán said, **we are expected to solve human needs**.

According to the United Nations Millennium Development Goals, the needs of humanity

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range from "End poverty and hunger" to "Global partnership", including "Universal education", "Gender equality", "Environmental sustainability" and so on. Of course, engineers are not supermen or gods capable of solving all humanity problems, but we are surely able, to cooperate in a lot of different ways, in solving those problems. Recently, UNESCO (2010) developed a report about engineering. In its preface, Gretchen Kalonji[4] describes the critical roles of engineering in addressing the large-scale pressing challenges facing our societies worldwide. Such large-scale challenges include access to affordable health care; tackling the coupled issues of energy, transportation and climate change; providing more equitable access to information for our populations; clean drinking water; natural and man-made disaster mitigation, environmental protection and natural resource management, among numerous others. Some of these challenges may be comprised in the concept of "social inclusion" but, what does it exactly means?

We may first look at the dictionary for a meaning; Social inclusion may be defined as "the provision of certain rights to all people in society, such as employment, health care, education, etc." (Collins). Another interesting approach is the one brought by the UK Development Trusts Association which has recently defined Social inclusion as "a process involving a range of policies aimed at promoting equality of opportunity, maintaining social cohesion, building social capital and minimising social exclusion" (Development Trust Association).

But let's go to the point, we are trying to discover the relationship between ICTs and Social Inclusion and, moreover, why this is a challenge in Engineering Education.

ICTs for Social Inclusion

In one of the most interesting and referred book, devoted to this subject, Warschauer (2004) states that the ability to access, adapt, and create new knowledge using new information and communication technology, is critical to social inclusion in today's era. There is a term usually related with this subject, and it is "Digital Divide". This term was originally used in the mid-nineties and gained popularity in a series of publications by the National Telecommunication and Information Administration (NTIA) and it did refer to the divide between those who "have" and those who "don't have" access to the information(McConnaughey et. al., 1995). Some years later, Castells (2001) said that the disparity between those who have and those who don't have Internet access, makes it even wider the gap of inequality and social exclusion in a complex interaction that seems to increase the distance between the promise of the information age and the harsh reality that is undergoing a major part of the world's population.

In both texts, and so many others that would be boring to include here, there is a direct relationship between ICTs and social inclusion.

Digital Divide is, nowadays, not just a matter of "haves" or "have-nots". Today, more and more people have access to Internet not only through computers but through phones and other kind of mobile devices. But having access doesn't guarantee that it is an access socially meaningful. The Web 2.0 brought a lot of possibilities to the users, to become an active member of the community rather than the passive participation that was usual during the first Internet times. But this active participation requires some level of literacy.

One century ago, literacy was a concept directly related with being able to read and write. Nowadays, literacy is a more complex concept that necessarily includes the ability to effectively deal with ICTs. An individual who is not able to access information through electronic means, analyze it in a critical way and eventually produce it using the new media resources, will surely be socially excluded.

Warschauer (2004) build a table to compare the previous literacy concept with ICT Access (Refer Table 1)

	Literacy	ICT Access
Communication stage	Writing, print	Computer-mediated communication
Main Economic Era	Industrial capitalism	Informational-capitalism
Organization of content	Novels, short stories, essays, articles, reports, poems, forms	Web sites, e-mail, instant messages
Receptive skills	Reading	Reading and multimedia interpretation, searching, navigating
Productive skills	Writing	Writing and multimedia authoring and publishing
Divides	A great literacy divide?	A digital divide?

Table 1 - Literacy and ICT Access

It, is, then obvious that literacy has a meaning in a social context rather than as a decontextualized cognitive ability and, having said so, we are able to state the idea that ICT access is a prerequisite for literacy and, consequently, to social inclusion. Furthermore, as it has been previously stated, it is not just a matter of access but an issue related with the ability to have a critical approach to information and technology.

Literacy is a concept closely bound to education but it cannot be confined simply to the acquisition of skills or the mastery of particular practices; it must also entail a form of "critical framing" that enables the learner to take a theoretical distance from what they have learned, to account for its social and cultural location, and to critique and extent it (Buckingham, 2008).

We are finally arriving to a point, in which we are able to conclude that social inclusion requires not only a set of basic requirements, like health, food, living conditions, etc., but ICTs access, and education for making these technologies significant for living.

ICTs in Engineering Education

Literally thousands of works have been written and published about teaching and learning aided by digital technologies (Learning Technologies). ICTs are frequently used as a support for education by means of simulations, virtual campuses, digital materials, etc. It is more and more frequent, especially in engineering schools, to find courses in which the students are required to fulfil tasks and activities using Internet and/or accessing digital learning platforms (also called Learning Management Systems – LMS). It is practically impossible to pass through any engineering degree without having to deal with one or several simulation tools. There are also a lot of research works and experiences, using digital technologies in very novel ways such us, mobile devices, ink writing tools, interactive boards and so on[5] .

But there is also a different approach to technology in education: **to be able to use the technology in a meaningful way**. It may be argued that the previously mentioned ways of using technology for teaching and learning are absolutely meaningful... and I do agree!!! But what I'm specifically speaking about is, how to use technology in a significant way for life, not

only for the student's life, but for the community in which they live.

ICTs are thoroughly studied in computer sciences and electrical engineering degrees courses and, more recently, there is a growing concern about the need for engineering students to master ICTs as a professional tool, but probably, in no undergraduate or graduate engineering courses are ICTs studied as tools for alleviating social exclusion. Sometimes, we, as educators, are neither aware of this issue nor able to teach our students how to cope with the abundance of resources and relationships made easily accessible via the Internet and how to take a useful advantage of them in our daily activity as engineers.

A very interesting example of how important ICTs is becoming in education, is the so called "National Mission on Education through ICT"[6] developed in India. This initiative is specially oriented towards utilizing ICTs to enhance the current enrollment rate in Higher Education and it recognizes, in its rationale, that "with an ever expanding field of knowledge, the knowledge and skill sets required by an individual to successfully lead life, has also expanded, throwing up challenges of learning more and more throughout one's life". It also includes a reference to "the challenges of pedagogy that are being faced by the teachers to package more and more for the uptake by the students within the same amount of time available".

Another important statement was included in a recent report prepared by the Committee on Prospering in the Global Economy of the21stCentury: An Agenda for American Science and Technology (Committee on Science, 2007), about the importance of new technologies in order to face the complex future of the education in general and of the technological education in particular.

But, let's get back to the focus of this work, this is: how to solve people's problems through ICTs and, moreover, how this issue can be taught in an engineering course.

The challenge

Two important documents have been recently released regarding **what engineering is** and what it is expected to be in the near future. The first one, developed by the US National Academy of Engineering (2004) clearly states that, "The steady integration of technology in our infrastructure and lives, calls for **more involvement by engineers in the setting of public policy and in participation in the civic arena".** In the same work, and specifically speaking about the social context, it establishes that "The future is uncertain. However, one thing is clear: engineering will not operate in a vacuum, separate from society in 2020 any more than it does, now. Both on a macro scale to the micro scale **consideration of social issues is central to engineering".** The second one, developed by UNESCO (2010), explains that **"engineering** and technology **and the social sciences are more closely connected".** "Apart from a degree or related qualification in one of the engineering disciplines and associated skill sets **engineering education also seeks to develop a logical, practical, problem-solving methodology and approach that includes soft, social as well and technical, skills".**

It is surely possible to find more and more similar statements, but these two are clear and significant enough, to understand that we, as engineers, have to have a deeper social awareness. From my point of view, we are able to find in ICTs, a very important tool for alleviating social exclusion, at least, the kind of exclusion related with access to education, information and participation in the civil society.

A very interesting initiative is the global alliance called "Engineering for Change (E4C)"[7], originally conceived by the American Society of Mechanical Engineers (ASME), and which now includes Institute of Electrical and Electronics Engineers (IEEE) and Engineers Without Borders-USA (EWB-USA) as founding partners. This organization has several areas of interests and one of them is Info Systems. Here, the digital

divide is mentioned as a problem to be solved, pointing out something that is, as real as cruel: the most under-served-the rural poor-live and the most expensive-to-reach areas. In this case, it is absolutely true that information access leads to community empowerment.

Some of the projects carried out in this area are:

- Open-source cellphone networks to bring low-cost service to remote communities on every continent
- Mobile games teach HIV prevention. A fun way to deliver information to hard-to-reach people in developing countries
- A new Android app and monitoring system that portrays information visually and improves how development organizations do their work
- Mobile phones used in an affordable way to combat drug fraud in Africa
- Educational programs offered through mobile devices

Another outstanding initiative is the one called "Network Startup Resource Center"[8] which works directly with the indigenous network engineers and operators who develop and maintain the Internet infrastructure in their respective countries and regions. The end goal in this work is, to make it easier for local scientists, engineers and educators to collaborate via the Internet with their international colleagues by helping to connect communities of interest.

These are two outstanding examples of what can be done using ICTs for social inclusion and how engineers may apply our knowledge and expertise in doing so.

Then, **the big challenge here is, to get more engineers involved in these activities and the way to do it, is to promote them among our students.** What I'm posing here, is that we need to include this subject within the engineering education. It may not probably be necessary to include it, as core content in the undergraduate majors, but surely as an elective course or a graduate specialization, for those interested in it.

Another way to get students involved in these kinds of activities, is to offer them credits for those activities. The projects should be structured as research projects and previously approved by a faculty committee considering not only the usual criteria for a research project, but its potential to produce any kind of measurable impact within their own communities.

Conclusions

Our students are members of new *generations accustomed to use ICTs in a quasi-*innate way and to take advantage of them to modify the way, in which they interact with their peers, access information and knowledge, work and, in general, participate in society life (Cukierman, 2009).

Tapscott (2009) calls this generation as the "Net Generation" and says that "they care strongly about justice and the problems faced by their society and are typically engaged in some kind of civic activity at school, at work, or in the communities".

If we combine these two facts with engaging activities and the proper academic recognition, we will surely have lots of students engaged in helping their communities, and specially the most underserved part of them, by using and applying technology in a proper way and we will surely be able to cope with this **Engineering Education challenge,** that is to use **"ICTs for Social inclusion".**

[1]http://www.egfi-k12.org/

[2]http://www.egfi-12.org.whats-new/e-tube/-strong-what-does-engineering-mean-to-you-strong-

[3]http://wordnet.princeton.edu/

[4]UNESCO's Assistant Director-General for Natural Sciences

[5]This author has done several research works about these issues. More information available at http://cukierman.name/5178.html

[6]http://www.sakshat.ac.in

[7]https://www.engineeringforchange.org

[8]https://www.nsrc.org/

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