WCES 2012

ICT4D projects as a tool for Service Learning

David López *, David Franquesa, Leandro Navarro, Fermín Sánchez

UPC- Barcelona Tech, Mòdul C6 Campus Nord ,C/Jordi Girona 1-3 08034 Barcelona, Spain

Abstract

In this paper, we describe how Information and Communication Technologies for Development (ICT4D) projects complemented by the participatory learning process of Service Learning contribute to the sustainable development in developing countries, while exposing our students to real techniques in the practice of engineering. Developing ICT4D projects has several clear advantages, but requires an enormous effort that is only affordable with the help of the University. We will describe the structure available at UPC-Barcelona Tech, which includes the Institute for Sustainability, the Center of Cooperation for Development, the TxT organization and the RIMA-VISCA group. In 15 years, people from the Barcelona School of Informatics have participated in over 50 ICT4D projects in 18 countries. With our initiative, the University can move closer to society, while at the same time society will improve its opinion of the University.
© 2012 Published by Elsevier Ltd.
Keywords: Service Learning, ICT4D projects, Engineering Education, Sustainable Development, Livelong Civic Engagement;

1. Introduction

Information and Communication Technologies (ICT) can be key elements for social development, especially in developing countries. Projects on Information and Communication Technologies for Development (ICT4D) are an important tool for incorporating positive changes in these communities. ICT4D processes are characterized by the design of intertwined processes (understanding the social and technological environment, learning about diverse technical and social aspects, software development, decision making, introduction, adoption, redesign of social processes and software) in coordination with multiple stakeholders (students and teachers at a university, a partner local organization and members of the target community).

Software systems and ICT infrastructures can be key elements in fostering the social development of communities, as computer-support enables or facilitates certain processes, empowering people to learn, coordinate, work effectively and reshape their own communities in social and economic terms.

Service Learning is a method of learning that integrates meaningful community service with instruction and reflection to enrich the learning experience. In the Barcelona School of Informatics of UPC-Barcelona Tech we use ICT4D Projects as tools for Service Learning. Working on ICT4D projects forces students to work under real constrains, offering a new perspective on life, values and the real impact of technical solutions, beyond our well-known and comfortable environment. In these projects, engineering students offer time and knowledge to develop the projects, usually refurbishing old-fashioned or broken computers, or developing new software as part of their

---

* Corresponding Author. Tel.: +34-93-4017001
  E-mail address: david@ac.upc.edu

Bachelor's or Master's theses. In return, they receive the broad education necessary to understand the impact of engineering solutions in global, economic, environmental and societal contexts.

But ICT4D projects require a big infrastructure. They cannot be developed without help from the University and the work of the volunteers who devote part of their time and knowledge to these projects.

In 15 years, we have participated in over 50 ICT4D projects in 18 countries. In this paper we will show how we use Service Learning principles, which kind of projects are carried out, and what infrastructure is necessary to support this initiative.

2. Theoretical Framework

Our work is based on the principles of Service Learning. Service Learning (Jacoby, 1996; Duffy, Tsang, & Lord, 2000) is a method of teaching and learning that combines an academic classroom curriculum with meaningful service throughout the community. As a learning methodology, it falls within the philosophy of experiential education. More specifically, it integrates meaningful community service with instruction and reflection to enrich the learning experience, learn civic responsibility, encourage lifelong civic engagement and strengthen communities for the common good.

Service learning has been widely studied in relation to engineering (Tsang, 2000) and applied in some programs such as those at Purdue University (Coyle, Jamieson, & Oakes, 2005). Real-world problems presented through Service Learning help students to engage in active learning and problem solving, which allow them to develop knowledge on sustainability, create new perspectives and provide them with exposure to real techniques in the practice of engineering. In the Barcelona School of Informatics of UPC-Barcelona Tech, we use ICT4D projects and Service Learning techniques because we believe that they hold the potential to provide a rich education experience to students. Service Learning allows us, teachers in developed countries, to offer a real experience to our software and computer engineering students. Working on ICT4D projects forces students to work under real constrains, in terms of time, resources and a target community with some real and specific requirements. Moreover, it offers a new perspective on life, values and the real impact of technical solutions, beyond our well-known and comfortable environment.

In these projects, engineering students offer time and knowledge to develop the projects. In return, they receive new skills such as a knowledge of contemporary issues, work in multidisciplinary teams, the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context, or the ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability. All these skills are part of the ABET Criteria, a set of eleven skills that are extremely important for achieving the US curricula quality accreditation (Shuman, Besterfield-Sacre, & McGourty, 2005).

3. Our Experience

In the Barcelona School of Informatics, we have developed several ICT4D projects to implement Service Learning. Most of these projects help local communities and NGOs, but about one third of the projects (the more complex ones) are oriented to support communities in developing countries with ICT access and used to contribute to their sustainable development. In these international projects, the receptors receive: (1) Hardware, when required; (2) Software, mainly tailored to the receptor's needs; (3) Training in ICT; and (4) Our students' time and dedication with the guidance of faculty. All four elements are necessaries to develop these kind of projects.

3.1. The Reuse Workshop

Hardware is provided through the "Reuse Workshop" that is held twice at year at our school. In this workshop, students and teachers refurbish and repair second-hand PCs and install free software to be used in solidarity projects (Franquesa et al., 2010). Our students dedicate their time to refurbishing these computers and installing free

software. Sometimes, the software requirements are quite simple, so no new software is required. In this case, Free an Open Source Software (FOSS) is installed in these computers, adapted to the final users. For instance, in 2007, we donated several computers to a school in Morocco. In this case, we installed Ubuntu and FOSS educational software for children under 14, in both Arabic and French. On the other hand, if the project is more complex, and it requires new or adapted software, some of our students develop it as part of a Bachelor's or Master's thesis.

3.2. Selected examples

During the past 15 years, we have participated in over 50 ICT4D international cooperation projects in 18 countries: Angola, Algeria, Bolivia, Burkina Faso, Colombia, Cuba, Ecuador, Equatorial Guinea, Gambia, Guatemala, Haiti, Morocco, Mozambique, Nepal, Paraguay, Peru, Senegal and Togo. Some projects have been quite simple, like installing a computer classroom in a school, or our participation was very small. Other projects were of great complexity, lasting several years, and involving the development of several Master's theses. At this point, we will focus on some ICT4D selected projects with a brief fact sheet for each, just to have a taste of the kind of projects we are dealing with.

3.2.1. Project: Water, a scarce resource

In this project, the target groups were the farming communities in the coastal Pacific areas of Peru, with fertile land and a well-structured social network managing the river waters for irrigation, close to the food markets of the capital but with poor communications and limited access to public services. A community of more than 6,000 farmers from the Chancay-Huarai irrigation district were directly involved in the project.

The goal was to support farmers in improving the quality of life of the community and the local economy. The project involved a number of agents, ranging from the local government (Ministry of Agriculture) to the local farmers association, a local NGO (the Centro Peruano de Estudios Sociales) and the International Development Research Center from Canada, with a contribution from our University in the later stages of the project.

The project involved the introduction of a complete ICT system, including electricity (with water-powered generators) in some areas, a wireless broadband network connecting 14 telecenters, VoIP telephone services and a software application (Yacu) for the management and coordination of irrigation quotas and agricultural production.

The project has been successful in supporting a rural community in adopting an ICT system that helps schools and farmers to be more effective and have a better quality of life. On the other hand, the project has not yet succeeded in exporting this technology to other irrigation districts.

3.2.2. Project: UN Western Sahara refugee camps health care system

The UN Western Sahara refugee camps are situated in the western part of the Algerian desert, near the border between Algeria and Morocco. The men, women and children of Western Sahara have lived here for nearly 20 years, in one of the most inhospitable regions in the world. When they came to these regions, they did not find anything except sand. It is solely thanks to the solid organizational structure and the large feeling of solidarity characteristic to these people that they were able to build a society in this desert.

Nearly all the 20-year-old young adults were born in these camps. At first, the mortality rate was very high, especially in the case of children. But thanks to a strong emphasis on hygiene, the Sahrawi people were able to prevent epidemics and control the high infantile mortality rate. As a result of the policy adopted for dealing with food products destined for children, there are practically no cases of malnourishment anymore. The greatest attention is focused on prevention by the Committee for Health Care, but treatment has also great importance. In the camps, the women are trained to become assistant nurses, helping out in the dispensaries; a number of students are already being trained abroad to become nurses or doctors. The Ministry for Health Care has continued to make progress. A new national hospital just opened. Inside the building, there are operating rooms and possibilities for administering treatments, physically as well as psychologically.

Our work was focused on two projects, developed as part of two Master's theses: (1) An information system for the Central Pharmacy Warehouse, and (2) An information system for the children vaccination program. The first project goal was to optimize the storage system of the Central Pharmacy Warehouse using an information system. The second project goal was to develop a children vaccination information system adapted to the special characteristics of the refugee camps. We developed the software in close collaboration with some pediatricians who have been working as volunteers in the camps for several years. These pediatricians have a deep knowledge of the real problems of the target community, so we act as experts in technology supporting the work of experts in cooperation. In this case, the project was a clear success.

3.2.3. Project: "Casa Guatemala" orphanage and backpackers hotel

Casa Guatemala is a NGO that owns an orphanage, the home and school for over 250 children. Casa Guatemala takes care of orphaned, abandoned or abused children, and even takes care of children that come from families too poor to provide even the basics of children needs. The main site of Casa Guatemala is located in the jungle on the banks of the Rio Dulce, in Guatemala. The orphanage receives no government support and is totally dependent upon the donations from people and groups from around the world. In the orphanage, only accessible by river across a little pier, also live the people who work there: the teachers that are employed at the school and the volunteers from all over the world who give their support.

The orphanage has an area of 40 hectares; this area contains the school, the houses for workers and volunteers, some cultivable land and a farm (which are the main food sources), a little shop to sell some products from the farm and the Backpackers' Hotel. The orphanage is located right on the edge of the Rio Dulce, with rooms and food to suit all budgets. These last two entities contribute to the general budget of Casa Guatemala.

We started our collaboration with Casa Guatemala in 2006. Our efforts have been focused on six main axes: (1) To facilitate access of volunteers/donors/tourists to the orphanage; (2) To improve the service quality and reduce the costs of the Backpackers' Hotel; (3) To improve the agricultural production systems; (4) To improve the water conveyance facilities and water quality; (5) To improve the energy facilities; and (6) To improve the quality of education.

In the past years we have done 16 different projects related to these six axes. We have improved physical access to technology through successive donations of computer equipment, provided by the Reuse Workshop at our university. This technology is needed at the orphanage to promote the digital literacy of children. It also helps to improve the internal management processes. However, given that teachers in Casa Guatemala did not have adequate training to operate such equipment and teach the children, we have conducted various training courses, aimed primarily at teachers of the school. Our volunteers are also involved in solving technical problems during their stay. We have also designed a program for managing the hotel using free software tools, and a FOSS CRM (Customer Relationship Management) is being designed to allow the administration of the orphanage to manage the large volumes of information they need.

4. Volunteers and institutional support

Without volunteers, almost nothing can be done. Academic staff is required to integrate these ideas into their subjects and to advise on projects. Students are required to implement these projects. Administration staff is required to help maintain the system. Moreover, institutional support is required: the University and the School should facilitate and motivate these initiatives.

A growing movement in solidarity exists in our University, receiving strong support from the institutional framework. An internal institution, named the Center of Cooperation to Development, coordinates this movement. This center has as its aim the centralization of all solidarity initiatives of the University, as well as offering legal, logistic and financial support to these initiatives. Another institution in our University, named the Institute for Sustainability, encourages the reduction, reuse and recycling of several materials, in particular electronic equipment. This center is responsible for gathering together all the computers we are going to repair and fix in the Reuse

Workshop. Furthermore, the Barcelona School of Informatics provides storage space for the computers as well as lab facilities. Finally, there is the support of the UPC-Barcelona Tech Education Sciences Institute, our reference institute for teacher training and education, which supports these initiatives with the RIMA-VISCA group (Research and Innovation in Learning Methodologies – Values, Equality, Sustainability, Cooperation and Accessibility).

However, the most important resource is people. The Barcelona School of Informatics gives support to an internal non-governmental organization named Technology for Everyone -TxT is the acronym in our language- (Farreras, Franquesa, & López, 2009). This organization consists of students and academic and administration staff, and participates in several solidarity projects around the world. Some volunteers manage the organization of the Reuse Workshop, so students involved in the lab can devote all their efforts to repairing and fixing computers, as well as installing adapted software. It is thanks to the volunteers and support from institutions that the Reuse Workshop works successfully.

5. Conclusions

Using ICT4D projects and Service Learning allows students to acquire very important but difficult to learn skills, while helping developing communities. Also, it enriches students' learning experience while encouraging lifelong civic engagement and strengthening communities for the common good. Unfortunately, it is a highly demanding methodology that requires volunteers and an extensive infrastructure at the University to support it.

Acknowledgements

References

Coyle, E.J., Jamieson, L.H., & Oakes, W.C. (2005). EPICS: Engineering Projects in Community Service, *International Journal of Engineering Education*, 21(1), 139–150.

Duffy, J., Tsang, E., & Lord, S. (2000). Service-Learning in Engineering: What, Why and How?. In proceedings of the *ASEE 2000 Annual Conference*, St. Louis, Missouri.

Farreras, M., Franquesa, D., & López, D (2009). TXT as a vehicle for Service Learning. In proceedings of the *9th Workshop in Active Learning for Engineering Education*. Barcelona, Spain.

Franquesa, D., Cruz J. Ll., Álvarez, C., Sánchez, F., Fernández, A., & López, D. (2010). The Social and Environmental Impact of Engineering Solutions: from the Lab to the Real World. *International Journal of Engineering Education*. 26(5), 1144-1155.

Jacoby, B. (1996). *Service-learning in Higher Education: Concepts and practice*, San Francisco: Jossey-Bass Publishers.

Shuman, L.J., Besterfield-Sacre, M., & McGourty, J. (2005). The ABET Professional Skills – Can They Be Taught? Can They Be Assessed? *Journal of Engineering Education*, 94(1), 41-55.

Tsang, E.(ed.) (2000). *Projects that matter: Concepts and models for service learning in engineering*. Washington DC: American Association for Higher Education.