Engineering Students in Needed Communities: an Engineering Education Tool

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Abstract **- This paper describes the experiences of small groups of Engineering students from various areas visiting different needed communities in Brazil. They spent up to 12 days together, within the community, talking to ordinary residents and community leaders, identifying opportunities of transforming specific needs of the community into Engineering projects, which would be offered to be developed later in the year by a single student or by a small group of students. So far, three kinds of communities were visited: a rural community in Central Brazil (in the interior of the State of Tocantins), which included a Brazilian Indian Reservation; a slum (called "Rocinha") in the City of Rio de Janeiro; and a poor neighborhood in the suburban metropolitan area of São Paulo City. These activities are part of a broader Institutional program developed at the Polytechnic School of the University of São Paulo, called "Poli Cidadã", and were carried out jointly with students from the Massachussetts Institute of Technology – MIT (Boston, USA). The results of these efforts were very positive, with great involvement of the students, who had the possibility of exercising, among other things, collaborative work, and their creative Engineering views, representing a useful auxiliary Engineering Education**

Index Terms – field trip, graduation project, group work.

INTRODUCTION

The Polytechnic School of the University of São Paulo ("Poli-USP") is a Public State University Engineering School which has presently over 4000 undergraduate Engineering students, covering 13 different habilitation areas. In 2004, as one of the results of the Strategic Plan extensively discussed within the Institution in the previous year, a new Program was created, called "Programa Poli-Cidadã", intended to enhance the social responsibility and sensitivity of the undergraduate students. The program was initially designed to be a connection between the desire of a significant percentage of the students and instructors in developing themes which have been originated from social demands and the various kinds of Institutions which actually faced such demands in their daily activities.

Therefore, the way of materializing the idea was to organize a website within the School's domain which was fed by the social themes (www.poli.usp.br/policidada). An interested Institution can access the website and record its needs. A detailed electronic registration form is required for that, containing details and purposes of the organization. The information is always filtered by the committee, which allows to go public only the themes and ideas really coming from ethic, non-profit organizations (or departments from any level of government) notably compromised with some social sector. Once the theme becomes available in the site, Polytechnic School students and instructors can access the information provided, and these themes can hence be developed by the student(s) and may also be turned into his or her graduation project. Every year a Seminar is organized by the managing committee of the "Poli-Cidadã" Program, when the concluded projects are briefly presented and certificates are awarded to all involved students and Professors. The organizations are also invited to the event.

After the basic activities of the Program were tested, which included visits to social organizations in order to stimulate their participation in our Program, the range of activities of the initiative was broadened. By establishing collaborations with partners – other universities and private corporations – an intensive work modality was started. In this way of working, a group of 4-5 students with the most adequate profiles was selected from a large group of interested students, and visited, for a period of 7 to 12 days, a poor community, in order to identify opportunities of transforming specific needs of the community into Engineering project. This way, the students worked in groups, and they remained within the community for the whole period of time, when possible. The places to be visited were chosen together with the partners. So far, three different communities were visited:

- A rural community in Central Brazil, in the interior of the State of Tocantins, called Canuanã, which included a Brazilian Indian Reservation (in this paper, special attention to this activity will be given)
- A urban slum, called "Rocinha", in the City of Rio de Janeiro;
- A poor neighborhood in the suburban metropolitan area of São Paulo City, called Jardim Conceição (municipality of Osasco).

SELECTION PROCESS

The Engineering students who took part in the activities here described were selected by a selection process realized in three steps. The Canuanã – Rio de Janeiro raised the greater number of interested students. About 35 to 40 students wanted to join in the voluntary initiative, and demanded the longer selection process. At first, all Poli-USP

students, from all areas, were invited. The ones who showed to be interested, filled in a form available in the Poli-Cidadã website, where, among other details, they should inform their English language skills (at least intermediate level mandatory), year of the Engineering course, and motivation to enroll the initiative. Due to the great number of students, a first selection was carried out by the managing committee, based on all the information provided, but specially based on the topics above, as well as on the existence of any previous experience in social work. After that, the pre-selected students were invited to a workshop, where they were first introduced to the Poli-Cidadã Program, and viewed a talk (video-conference) with the coordinators from the MIT. After that, they were separated in groups of 3 to 5 students and discussed their views and suggestions for the activity they were applying for. An Instructor, member of the Program, took part in the discussion of each group, watching, listening, and posing questions for further discussion within that specific group. After the workshop, the committee decided to invite 8 students to join the MIT students going to Canuanã and Rio. Since there were two consecutive destinations, a final division in two groups was decided in a third step meeting, in agreement with the selected students.

MAKING IT POSSIBLE

The intensive activities of Poli-Cidadã Program, here described, were made possible once collaborative partnerships were established. The partners can contribute with funds, which naturally allow several actions to adequately take place, but, most importantly, can contribute for the viability of all operations, helping with information, resources, and experience. So far, the two partners involved in such intensive activities were the D-Lab, from the Massachussetts Institute of Technology – MIT (Boston, USA), and a Brazilian Foundation, called "Fundação Bradesco", linked to a major Brazilian private bank (Bradesco). The foundation maintains a network of 40 primary and secondary schools throughout Brazil, specially located within poor communities around the country, where good quality education is offered free of charge to the neediest local inhabitants. The intensive activities developed by the Engineering students in Canuanã and in Jardim Conceição were supported by the infra-structure of local Bradesco Foundation schools. MIT's D-Lab keeps regular academic courses every year on prototype construction and poor community cheap Engineering solutions discussion for a number of years now, and a group of 4-5 of their students had already visited Canuanã and Rio de Janeiro in the vacation period of January, 2005.

INSIDE THE COMMUNITIES

The work approach of this modality of intensive activities of the Poli-Cidadã Program within the communities, followed the same pattern. The groups of Engineering students were divided in smaller teams, each one containing Brazilian students and foreign students, and, when possible, local students. The initial step of the work was to get acquainted with the local environment and meet with the organized community leaders, when available. The second step was the identification of problems which could be addressed by the Engineering students, in terms of depth and skills involved, and the search and discussion of possible solutions. The third and last step was the discussion of the ideas and the potential solutions with the community, which could involve the construction and test of prototypes, when it was the case.

Below, a brief discussion of the work in each of the communities is presented:

I. Canuanã

Initially, a collaborative work was established, which took place in the community of Canuanã in January 2005. After that, in January of the next two years, 2006 and 2007, four students from the D-Lab courses were joined by 4 students from Poli-USP and, together, they spent 12 days in the rural locality, where Bradesco Foundation keeps a farm-school. Once there, the Engineering students were joined by a number of 12 to 15 high-school level students from the local Foundation school. All three teams were coordinated by a Instructor from the respective institution. Besides taking part in the more technical activities, the Brazilian Engineering students also worked as language and culture translators, since the local students did not speak English and few of the MIT students had any knowledge of Portuguese, the official Brazilian language.

A few quilometers away from the farm-school, one of many Indian tribes is located. The tribes in that area belong to the "Javaé" tradition. Those native-Brazilians are grouped in tribes throughout a large reservation, which occupies two thirds of Bananal Island, the largest fluvial island in the World, with an area of about twenty thousand km^2. The reservation is mostly supported by the Brazilian government, but the closest tribes also receive occasional help from Bradesco Foundation.

FIGURE 1
NATIVE-BRAZILIAN KIDS IN THE TRIBE'S COMPUTER CENTER.

The students also visited the tribe, particularly interested in their recently inaugurated computer center, where a few desk top machines were installed to allow the members of the community to learn computer skills and the use of the internet (satellite connected), as well as to record and spread their native and millenary culture to the world (dances,

stories, habits, foods, etc.). To our knowledge, this is the first computer site in an Indian community in the Central Brazil, and was made possible by a joint effort of the following institutions: Bradesco Foundation, Intel, and Microsoft. The Foundation gives regular technical support to the center.

In this activity, the daily work in the community followed the procedure: the students were divided in 4 groups, so that each group contained two Engineering students, one from each country, and 3 to 4 local students, and worked in a number of related themes. After the initial planning of the activities, still inside the facilities of the local school, the group started working in the development of a few ideas, discussing the viability of building prototypes or procedures to be tested within the needed local communities. Such work involved, whenever necessary, visits and interviews with the local inhabitants.

It should be pointed out that an important outcome of this activity was the positive interaction with the local students. Their very active, highly motivated presence in the daily work was of great importance for the motivation and efficiency of the activities of the whole group of Engineering students. The vast majority of the local students is originary from the region, and mostly have their families living in the settlements nearby, comprised of small rural properties around Bradesco Foundation School's farm. Therefore, they know the local culture, habits, and beliefs of the people of that region, and their input was fundamental for the success of the development of some of the ideas.

FIGURE 2
A TYPICAL HOUSE IN THE CANUANÃ SETTLEMENTS.

At the end of each working day, all groups got together, and each group presented a report of the activities, difficulties, and findings of that day, to all the other students. In the evening, besides some socialization with the local students and instructors, the Engineering students reunited to discuss how the guidelines had been followed. In the end of the whole period, all groups organized a final report and talk, particularly to record the successful experiences.

Some of the projects started in the 2006 visit were continued in 2007, but many new ideas were tested. The practical results of some of the projects worked within the groups have been carried on by the local group of students, and the developments are to be discussed with the students in

São Paulo (Poli-USP), via tele-conference, so that all the work performed in January may find a continuity.

FIGURE 3
EXAMPLE OF A WATER WELL , FROM WHERE THE LOCAL PEOPLE OBTAIN WATER FOR COOKING AND DRINKING

Table 1 presents some representative examples of the problems identified in the Canuanã region, which were addressed by the students while in the region, and showed potential to become a longer duration Engineering student project.

TABLE 1
EXAMPLES OF THEMES WITH POTENTIAL TO BECOME ENGINEERING PROJECTS.

PROBLEM	PROPOSED SOLUTIONS
1. Fruit and meat deterioration	A fast drier of simple construction using the energy of the sun light to dry the food
2. Smoke inside the houses (the typical local stove burns wood)	A simple procedure to build a chimney using discarded oil cans
3. Computer keyboard suited to the indians' language	Software (driver) to adapt the keyboard, reconfiguration of some of the keys on the keyboard
4. Low quality drinking water	Development of a slow sand filter prototype
	Testing water disinfection by exposing it, in plastic bottles, to the UV from sun light
5. Scattered medical records	Development of a computer record database with the medical history of the patients, allowing the identification of patterns and improving the efficiency of the medication

Altogether, fourteen potential projects were singled out during the initial, recognition phase. The five problems indicated in Table 1 are representative examples. Among those, the solutions involving easy procedures and/or handling of materials could be promptly implemented, at least in a prototype level, always counting on the help of the local students. It is never too much to stress again, that this active and intense involvement of the local students

represented one of the key outcomes of the whole intensive project, once they greatly benefited from accompanying the reasoning and execution of the ideas by the Engineering students. On the other hand, those ideas and solutions demanding more time and/or resources to become reality, were not immediately implemented, and remained as themes to be further discussed by the group or to become available to any of our Engineering students, in the form of a new graduation project, in the internet site of "Programa Poli-Cidadã".

Below, the status of the proposed solutions for the five problems pointed out in Table 1, is discussed:

1. The drier was brought in as a previoulsy discussed idea by the MIT team, and it was conceived originally to dry fruits, as a manner of improving their shelf life and a way to obtain a product with commercial value. However, the locals identified the greater need of drying meat, which is already a practice among all settlement residents (currently, meat pieces are hanged on a line, inside home). The concept of the drier was tested and demonstrated with local fruits, and later, as an experience of the local students together with the residents, with great success, as a meat drier.

2. The built a chimney proved very succesful to draw the smoke out the houses. Nevertheless, the residents did not like the idea of adapting wall exits and openings on the roof to accommodate the chimney. Another problem was to find enough discarded oil cans, since most oil products come now in plastic bottles.

3. This was one of the most rewarding ideas to be put into practice. Two modified computer keyboards were put in service by the Engineering students. The development of an adequate driver was part of the work. The indian students quickly learned how to use the keyboards. The experience was very succesful, but a continuous follow up must be performed, in order to keep the young indians estimulated to record, paint, and write about their traditions in their own language.

4. A prototype of the slow sand filter was built, with cheap materials, and tested. It worked very well, but it was too difficult to convince the locals that the practice was worthwhile. The project did not advance. The same happened with the sunlight water disinfection method. The performed tests showed that the method was efficient in eliminating the infecting cells present in the water, but such idea was not able to be efficiently conveyed to the residents. Some tentative new approaches should be tried.

5. The basis for a computer medical record database was released. The development was performed during the stay in Canuanã and later, by one of the Brazilian Engineering students. The project stopped, and now is available to another volunteer student to complete the task, removing the bugs, and completing the links and special features.

II. Rio de Janeiro

Rio is the center of a very large, urban, metropolitan area. In this case, the joint group of Poli-MIT students visited two local communities, very much in need of most urban services, like water distribution, sewer, garbage collection, called Rocinha (a famous slum), and the poor community of Bangú. This time the students worked in two groups, always trying to balance the number of Brazilians and foreigners, and talked directly to local community leaders and organizations. The daily work procedure also included the general meeting at the end of the day and the generation of final reports and presentations at the final of the whole period.

III. Jardim Conceição

This is a neighborhood in the outskirts of the Metropolitan area of the city of São Paulo, in the Osasco Municipality, where Bradesco Foundation keeps one of its schools. It is a poor region, but which has recently received some improvement, like asphalt and public lighting in the main streets. However, the occupation of the areas was carried out in a completely random manner, with small, packed houses. Most houses are built with masonry, but their distribution, internal lay-outs, electrical and water connections and distributions are fully out of the standards.

FIGURE 4
JARDIM CONCEIÇÃO: NEIGHBORHOOD VIEW

In this case, the Poli-MIT students also worked in groups, in a similar manner to the one adopted in Rio de Janeiro, interacting with the local leadership with the difference that, again, a number of students from the Bradesco school joined and helped the work of the groups.

FIGURE 5
JARDIM CONCEIÇÃO: A SQUARE RENOVATION, WHERE THE STUDENTS WORKED TOGETHER WITH VOLUNTARY LOCAL PEOPLE.

ACADEMIC RESULTS

The whole effort of putting together a series of activities such as the ones described here pays off. Selecting students, taking care of logistic details (ground and air transportation, contact with Institutions, paperwork, etc.), receiving and looking after foreign students, setting major targets to be achieved by the students with the partners, either academic or not. All those actions require a large number of hours to be addressed, so that a group of people is required to correctly perform them. However, the results of all this effort were very positive, with great involvement of the students, who had the possibility of exercising, among other things, the application of the fundamental Engineering principles, and their creative and critical Engineering views, besides developing collaborative work, and enhancing their respect for the human being. Overall, it represented a useful auxiliary Engineering Education tool.

The non-Brazilian students also valued a great deal the contact with communities with such different ways of living from their own. Particularly in the case of Canuanã community, the simple and honest, resigned, even candid, manners of the local people represented a great life lesson for everybody from the outside, including the big city inhabitants Brazilian Engineering students. Therefore, besides stimulating the creativity and basic concepts of the Engineering students, this experience certainly affected the way the same future Engineers, but most of all citizens, see life, its possibilities and potentialities.

In terms of the collaborative model, the general idea is to consolidate this model of partnership Brazilian University – Foreign University – Brazilian Foundation, which worked very well in the activities here described, involving Polytechnic School, MIT, and Bradesco Foundation, with its following extension to other localities of the country, where local Brazilian universities should be involved. More details of this model of partnership will be described in another paper in this meeting.

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REFERENCES

[1]. Toffoli, S.M.; Kemer, T.; Silva, R.R.; Peig, D.B.; Michelino, F.A.S.; Coelho, B.B.C. "Experiência de inserção social em comunidades carentes: Etapa Canuanã". Internal Report. Polytechnic School, University of São Paulo, Jan. 2006.

[2]. Lianza, S.; Addor, F. "Tecnologia e Desenvolvimento Social e Solidário". UFRGS Editora, Porto Alegre, 2005.