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A Project Based Learning Experience Using NGO Projects and A Volunteer Program Abroad*

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This article aims to describe two different project-based learning (PBL) experiences using NGO (Non-Governmental Organization) projects, and complemented with a volunteer program abroad (in Honduras and Kenya). The integration of the projects within the framework of the courses was promoted within a context of a project-based engineering school. The NGOs requested technical support in some projects, which students developed in their classrooms to offer real solutions. Throughout the summer, some student and professor volunteers traveled there to evaluate the situation, implement the projects and collect the data needed to move forth and determine new needs for the next academic year. The awareness brought about, thanks to working with the NGOs in the communities where projects were implemented, increased students' interest and involvement. Working with real projects, enhanced their motivation showing a positive impact on students' learning. This approach has contributed to their development in ethical values and sustainability awareness within a framework of Engineering Education for Sustainable Development. With these projects, students develop key skills as engineers, and as active global citizens, conscious and committed to addressing and solving sustainability problems in the real world.

Keywords: project-based learning; social responsibility; cooperation projects; volunteer programs; engineering education; sustainability

1. Introduction

In 2002, the international Association of Universities signed the Ubuntu Declaration [1], an initiative to make an effort to mobilize the education sector to contribute to sustainable development. Later, the Declaration of Barcelona [2] also supported that engineering education should not restrict their role to teach knowledge and to develop skills but also to prepare future professionals in a globalized world. The 'Shanghai Declaration on Engineering and the Sustainable Future' [3] called upon the engineering community, as well as governments and international organizations, in order to promote engineering for our sustainable future. From this convention, the UNESCO organized a workshop in order to promote Engineering Education for Sustainable Development (here after EESD) in 2006 where some keys are given about the education of future engineers [4]. Moreover, the UNESCO Report [5] shows the role of the engineers as the drivers of innovation, social and economic development.

Besides, the European Higher Education Area (EHEA) described the framework for European universities in this context [6–8]. Students should acquire not only the required technical knowledge but also the skills and competences needed for their future as professionals. University graduates must not only be capable problem solvers at a local, regional or international level, but also develop a realistic and objective vision of the world in which they live in. In particular, a way to introduce this into the curricula is provided by several accrediting agencies such as ABET [9] and Eur-ACE [10]. Both agencies stand that graduates should include in their professional competences the ethical responsibility, the sustainability and the awareness of the impact of their engineering solutions. Alier Forment et al. [11] stand that today's engineers need to be aware of the responsibility they bear, being a driver of sustainability and social commitment (SSC). Engineering students must learn not only in, but also outside, the classroom, and a way to do it is to work in courses in collaboration with NGOs and in Community Problem Solving.

Within this frame, in 2009, a group of faculty members of the Universidad Europea de Madrid (UEM) started to work on Sustainable Development (SD) and volunteering projects. In 2011, they were asked to provide technical support to NGOs or foundations in some projects developed in Ethiopia within an Inter-University Collaboration [12] funded by the Spanish Agency for International Development Cooperation (AECID). This project was conceived to encourage students' participation and to facilitate them with the possibility of carrying out their final degree project in real contexts, working with disadvantaged populations, but it wasn't integrated into the curricula yet.

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In addition, in 2012, the Engineering School of the UEM decided to implement the Project Based Learning (PBL) methodology in all its degrees [13]. PBL is seen as a potential approach in promoting Sustainable Development, with the assumptions that students will learn better when learning relates to real life problems and situations, as far as it allows them to experience it [14–16]. For this reason, we decided to integrate the SD and voluntary projects into our Project Based Engineering School (PBS).

This paper aims to describe the experience of teachers and students involved in two cooperation and socially responsible cooperationprojects. Students appear to be particularly motivated when working on projects where NGOs are involved. In the case described, two NGOs were concerned: the Cerro Verde Foundation (FCV) and the Pablo Horstmann Foundation (PHF). Students and teachers involved, develop the projects in the classrooms using the PBL methodology [17–20] after which, volunteering students and teachers would travel to Cerro Verde in Honduras or Lodwar in Kenya to implement them on site Even so, students, on site volunteers and those that worked solely from the classroom alike, were highly motivated by the belief that their projects would have a positive impact in local communities.

2. Contextualization: Project based engineering school in UEM

As already said, during the 2012/2013 academic year, the Engineering School of the UEM started its 'Project Based Engineering School' (here after PBS) [20, 21]. This PBS consists on the application of the PBL methodology in all its degrees, organizing the students learning around some projects [22, 23]. The students develop, in each academic year, a comprehensive project covering partially the content of several courses. Several teachers are involved in each developed project. This way of learning through projects will follow Kolb's model which requires a learning cycle where the learner: experiences, reflects among its observation, thinks and acts [24].

It is in this context where some teachers and students started to work with the CVF on the one side and, on the other, with Pedro Fusté (a journalist involved in international cooperation in Africa) who contacted with PHF to get its support and collaboration. The NGOs requested technical support in some of their projects which students developed in the classrooms in its first stage. Then, the university offers students to become volunteers and travel to Honduras (CVF) or Kenya (PHF) to implement what they had made in class with their peers.

Students develop professional engineering skills thanks to the use of PBL with real NGO projects, educating them in global challenges and values. They see their engineering projects as a win-win for those who serve and for those who receive [25–28].

The experience helps our students to develop sustainability competences as well as multicultural skills and social and human relations skills among others [29, 17]. Using the academic context to approach real-life situations, makes students think about their future profession, developing SSC skills [11].

The two projects addressed respectively by the NGOs to our Telecommunication Engineering students, to be developed under the PBL are:

- 'Analysis and design of a well-PC communication system for detection on non-potable water' for the Cerro Verde Community in Honduras (CVF project).
- 'Deployment of an FM Radio Broadcasting Station' in Lokintaung (Lodwar) for the Turkana Community in Kenya (PHF project.)

Students participating in the projects have to collect technical and legal information and documentation as a first task. Then, they develop the projects, remembering that, as future engineers, these should be technically appropriate, robust, economically viable, taking users into account, and at a sustainable environmental cost.

During March, students are invited to travel voluntarily to Honduras or Kenya to implement what they had been working in their classrooms. In July, the selected volunteers travel there with teachers, in order to evaluate the situation and to implement partially the projects. During this month, they collect the in-situ data needed to complete their project as well as to determine new projects that could be carried out in the area in next academic years. Projects can be implemented by the students over an extended period as they are proposed by the NGO. The process followed can be shown in Fig. 1.

3. Description of the work done

The main concern of the presented experience was to integrate volunteering projects in the PBL curricula.

Both projects follow the same structure (Fig. 1): they are developed in five phases after which the process will start again in the next academic year. Phase 4 is overlapped with phase 3, as we seek for volunteer students during the month of March.

Each phase is explained for both projects in detail in the following sections.

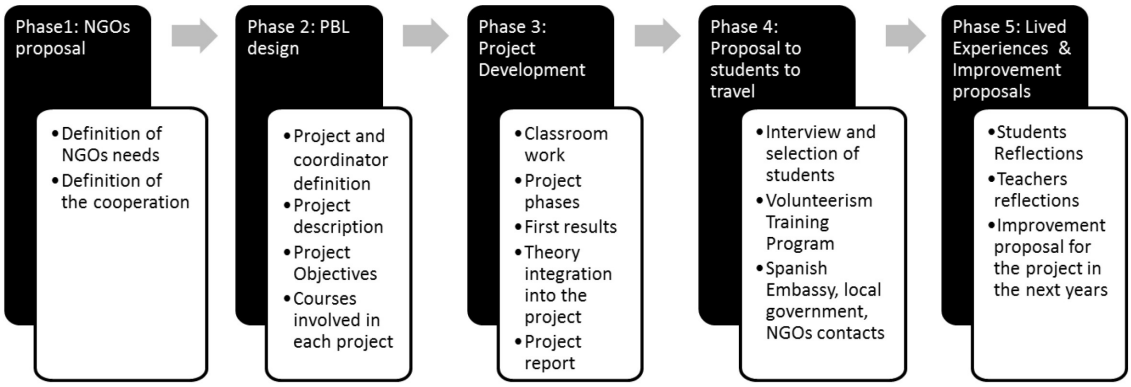

Fig. 1. Phases of the work done.

3.1 First phase: NGO projects proposal

Led and organised by the university, the teachers in charge of the volunteer program met both foundations (FCV and PHF) to study how to integrate their projects in the PBL curricula. Once we decided how to integrate them into courses, a NGO responsible from each foundation came into the classrooms to explain their needs to the students. In this way, students feel the projects closer.

3.1.1 Cerro Verde Foundation (FCV) proposal

In a meeting held on January 2013, FCV[30] requested us technical support in five areas of development: water and sanitation; electricity supply; health and education. From this meeting, some integrating projects between several courses and degrees were thought to be developed in the areas of ICT, civil engineering, architecture and mechanical and electrical engineering.

In the catchment, distribution and regulation of water and development of a sanitation system project, our Telecommunication engineering students were asked for a system to detect when the drinking water becomes contaminated. So, we proposed to FCV a project to detect it in the wells and to communicate these wells with the village in order to automatically send out alert signals in case of contaminated water.

3.1.2 Pablo Horstmann Foundation (PHF) proposal

In January 2014, Pedro Fusté, with PHF [31] asked for technical collaboration to implement a social and community radio from Lokitaung to integrate, inform and share the daily life of this community in Kenya.

The most relevant issue the project faced was the difficulty that 90% of Turkana locals had in accessing television, radio and computer content. The use of a radio as a participatory community design allow overcoming the lack of information, content of training, education, culture, health information, etc. Moreover, the radio can be a tool where people, who have no other means of communication, could receive information and messages turning into an instrument of social transformation that generates collective community identity.

To achieve this goal the solution proposed was the deployment of a broadcasting FM radio stationaided by the university's institutional support.

3.2 Second phase: Projects design with PBL

The aim of this phase is to define the project to be developed by the students (structure and general guidelines). In order to assure a proper coordination between the teachers involved in each project, the general form defined for all the integrating projects in the PBS [32] is used. This completed form for both projects can be found in Table 1.

As there are students not enrolled in all the courses of each project, this form is very important to help teachers involved in each project to coordinate themselves. Before the beginning of the course, teachers have a meeting to fill the form, to divide the general objective into the specific ones to be achieved in each subject and to designate a coordinator for the overall project.

Projects are developed by teams of 3–5 students. In order to guarantee the project development, team members are chosen by the teacher who coordinates the project. This teacher always assigns to each team at least one student who is enrolled in all the courses involved.

3.3 Third phase: Projects development

Students get the project form (Table 1) where the overall objective of the project as well as the specific objectives of each course can be found. Then each team should develop the project giving their own solution to the problem as explained by the NGO. In the first session, the project is explained, on the one hand by a NGOs collaborator and, on the other, by

Table 1. Projects Forms

Project Name	**Analysis and design of a well-PC communication system for detection on non-potable water**	**Deployment of an FM Radio Broadcasting Station**
Bachelor Degree	Telecommunications Systems Engineering	Telecommunications Systems Engineering
Year-course of study	Second year of study	Third year of study
Project description and general objectives	Objectives of this project are: to analyze, design and implement a prototype integrating a sensor, an Arduino processor, a Wi-Fi antenna and a PC. This prototype must be capable of detecting non-potable water, sending info through a wireless connection and generating an alarm signal on a specific PC app	Project objective is to implement a social and community radio from Lokitaung to integrate, inform and share the daily life of the Turkana community. The project has to be developed in two stages or phases: 1. Equipment definition and setup in the real emplacement as well as the radio transmission parameters characterization. 2. Study and design of radio links to increase coverage to Lodwar
Courses (6 ECTS) involved in the Project	• "Transmission and Reception" • "Digital Electronics and Microprocessors" • "Multimedia Programming" • "Analog and Digital Communications"	• "Radio Communications" • "Telecommunications systems engineering projects and deontology"
Schedule of the project	The project starts on the 3rd week after the classes have begun Students will work on it for 1.5 ECTS in each course	The project starts on the 3rd week after the classes have begun. Students will work on it for 1.5 ECTS in each course
Assessment Procedures and tools	Given in an appendix	Given in an appendix

the teachers. This first session helps to motivate students in developing a good project (to address a real problem motivates attention and focus in the students). During the project students must develop the technical and generic competences related to the courses involved.

As a first task, they have to collect the technical and legal information, and the documentation needed. At the end, students must write a technical report for their teachers and make a video explaining the project developed. Both projects videos can be found in the university web page [33].

It is during this phase when students are invited to be involved in the volunteer program and travel to Honduras or Kenya to implement the projects developed (Phase 4).

3.3.1 Cerro Verde PBL development

The ultimate goal of the 'Analysis and design of a well-PC communication system for detection on non-potable water' project is the complete design of the electronics (sensors), IT (information management and definition of the user interface) and telecommunications (planning and performance radio) on a geographic environment in a developing area (in this case Cerro Verde, in the region of Choluteca in Honduras). The project is carried out to emulate the establishment and the optimization of a telecommunication system oriented to get the use of ITC anywhere.

More specifically, the entire system will allow communicating the Cerro Verde wells with the NGO office in order to automatically issue alerts, in the case of non-potable water, by using an integrated system. This system is designed including sensors in wells, microprocessor for managing signals, RF transmission system and multimedia application in the NGO office for the interpretation and management of information provided about the wells.

Another objective is the realization of simple prototypes that emulate, at a smaller scale, the system referred. In particular, the installation and system configuration consists of sensor-arduino-cable-PC for further assembly and then the test runs the previous system but with plate 'Wi-Fi' on 'arduino' and communication with the computer.

Once the project is well defined, the specific objectives and tasks to be performed in each course (see Table 2) are determined following the structure shown in Fig. 2.

3.3.2 Lokitaung radio PBL development

The goal of this project is to implement a social and community radio in Lokitaung (in the region of Turkana in Kenya). So, the 'Deployment of an FM Radio Broadcasting Station' project was done in order to integrate, inform and share the daily life of the Lokitaung community with the specific objectives and tasks that must be achieved in each course shown in Table 3.

As a result, the students defined the radio community system that should be implemented in Lokitaung (Fig. 3).

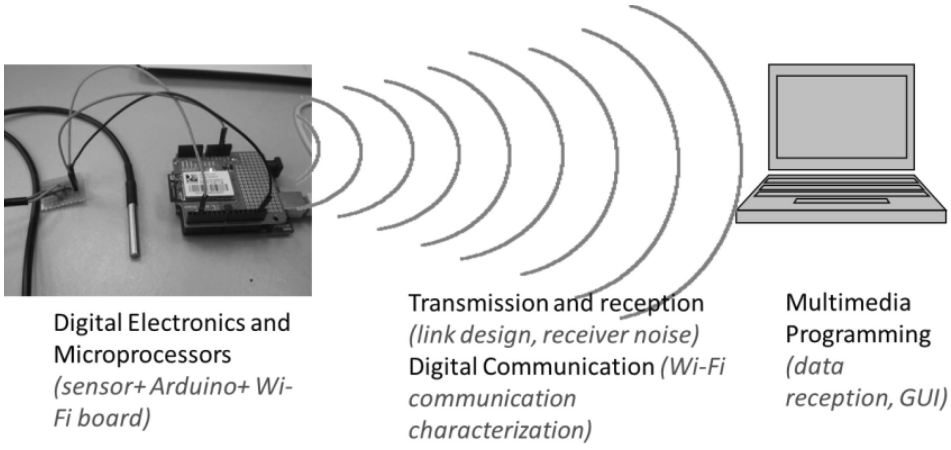

Fig. 2. Organization of the Cerro Verde PBL in the courses.

Table 2. Objectives and tasks for the Cerro Verde project in each course

Course	Specific Objectives and tasks
Transmission and Reception	• Search for specifications and analysis of performance of the required radiofrequency communication equipment: antennas, transmitters and receivers. • Radiofrequency link calculations • Noise calculations at the receiver
Digital Electronics and Microprocessors	• Implementation of the prototype: sensor, Arduino and Wi-Fi module • Prototype configuration and testing • Alarm signal transmission and management at the microprocessor end
Multimedia Programming	• App with a simple user interface for alarm management • Processing the information from different wells • General well status follow up • Real time active detection and information on alarms
Analog and Digital Communications	• Coverage, BER, quality and spectrum distribution calculations • Overall project conclusions, integration and project documentation wrap up • Project technical report • Overall project demonstration

Table 3. Objectives and tasks for the Turkana Radio project in each course

Course	Specific Objectives and tasks
Radio communications	• Analysis of a FM station equipment and interconnection (high and low frequency) • Characterization and calculation of radio links • RF simulation • Network deployment in two phases: – Phase 1: low cost station for village coverage – Phase 2: design, analysis and deployment of radio links to provide regional coverage to Lodwar
Telecommunications systems engineering projects and deontology	• Technical data gathering • Preparation of a complete real-life Telecommunication • Project document, including: budget, timing, user manuals, infrastructure and logistics

3.4 Phase 4: Travelling and volunteerism project

During the development of the projects in the classrooms, teachers offer their students to become a volunteer and travel to where their project was going to be implemented. Students are reminded that those selected are not going to travel alone but with students from other areas of knowledge, teachers and NGOs representatives.

Students must be aware that the stay in these communities involves a number of difficulties that students are not used to (for example the lack of water and light, high temperatures, presence of insects or very limited public transport). These situations determine very significantly the methodology followed and, of course, generate an exercise of reflection on the existence of other realities very

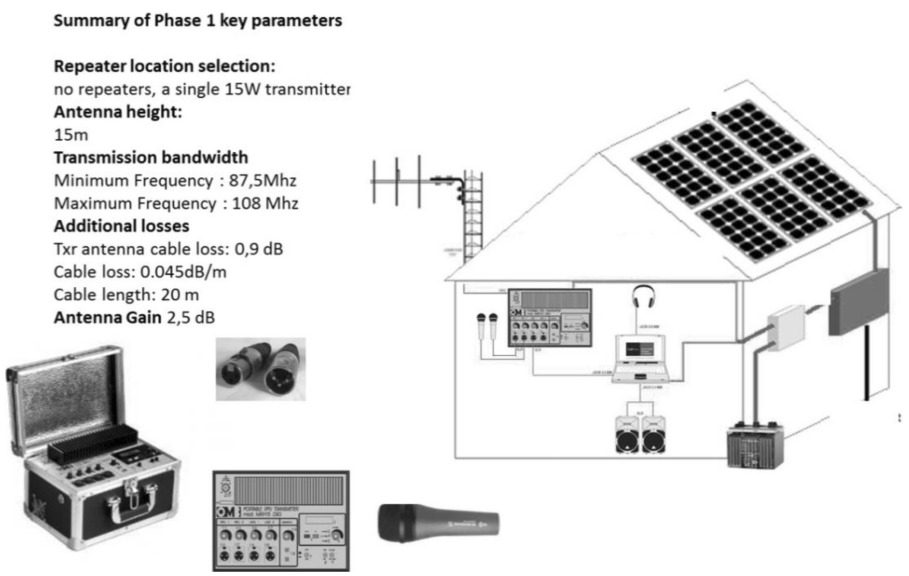

Fig. 3. Radio Community System to be implanted in Lokitaung.

different from their own one and, therefore, about the world in which they live. Working from social commitment, with the most disadvantaged, from what we do in a university, which is to provide our knowledge, brings us to a broader and responsible vision of our role as professionals in the case of teachers, and as future professionals in the case of students, and, of course, as global citizens.

From the interested students, a selection process is made in order to select those really involved in volunteerism. This selection process consisted in a personal interview with the NGO responsible and the teachers involved, apart from a report from their tutor and a motivation letter written by them. Selected students have a training program about volunteerism and international cooperation. This program provides them some orientation about the country, emphasized on specific context on cultures, and gave them some health and safety issues needed in addition to the specific training.

Teachers and students travel there throughout the summer in order to implement part of the projects developed in the classrooms and to evaluate other tasks that can be accomplished in the future. Therefore, they have to collect all the data required by each project to move forth during the next academic year. Coexistence with the villagers in order to better adapt each project to the real context will be the first setback they'll have to face. Then a study of the specific area conditions where they will develop the project is needed.

In the Cerro Verde projects, the given help by UNITEC (Universidad Tecnológica Centroamericana, in Honduras) with the data was very important at this stage. In that case, as there were four different projects (just one of them is explained here), ten students and two teachers travelled there. The technical objective of this travel is to implement the projects developed in the classrooms with the PBL and to collect as much data as possible in order to be able to finish or improve the projects in the next academic year. In particular, our students have to install the sensors in the wells and measure the range of the signal to the station with the prototypes they have made in their classroom. As it usually happens, the range of the measurements fulfilled in situ was smaller than the one they calculated at the university, but is useful to improve the projects in the next academic year, or even to suggest new projects.

For the Turkana radio project, three students with a teacher travelled to Kenya. The technical objective of this team was to install and commission the station site designed in the classroom. This part owns an additional complexity as it is an area without energy or material resources. Besides other goals for the trip are to design a basic template of radio programs for the community and to train technicians and announcers.

Arranging and transporting the technical equipment from Madrid to Lokitaung and finally installing it on site was another of the projects successfully overcome challenges. The installation and transmission kick-off had to tackle unforeseen technical challenges, but the team was proficient enough to see them through. Another fundamental goal was to teach some native people to use the radio equipment, coaching that was also carried out by the students successfully.

In both cases, students and teachers are guested in the village. Thanks to this lived experience, students' learning can be improved with other activities

developed in collaboration with other agents of the local communities (Cerro Verde and Lokitaung), following in part what it is called Service-Learning (SL). SL is a proposal which emerges from the volunteer service to the community and from skills acquisition, combining them in a single articulated project [34, 28]. Meeting up and spending time with the local population allowed a deeper understanding of their cultural reality and thus the creation of tailored projects that could meet their needs in a more accurate way. Students use their engineering knowledge and interact with the local community to observe their needs and reflect on social issues.

3.5 Phase 5: Reflection about the experience and improvement proposals

During their stay abroad, students must write a technical report with the all the data collected and explaining all the work developed as well as a personal diary with their personal experience. These personal diaries were anonymous, so they felt free of writing their own feelings. A copy of the technical reports and the personal diaries was given to the teachers at the end of their stay.

With all of this data, students, teachers and the FCV and PHF (in collaboration with Pedro Fusté) agree the most appropriate future projects for the needs of the population of Cerro Verde or Lokitaung (to be carried out by means of final project degrees, PBLs and/or SL).

The data collection involved a visit to all the houses in the community and to talk to a large number of villagers in order to gather their needs. On this tour, they recorded some interviews and filled cards to complete some information corresponding to water consumption, hygiene, number of people living in the house, number of rooms, house conditions, and type of housing and representative photos. Besides, these visits offered the opportunity to meet the concerns of the population, their fears and their problems and create a framework of trust and closeness between students, teachers and villagers. It is important to consider the culture shock that implies this volunteering and the emotional implications for all, villagers and university students and teachers. It is important to stress that teachers and students have stayed in the villagers homes allowing closeness to the reality of the village. Also, the volunteers developed different workshops to empower local people during their daily activities there.

All the collected data is used as a starting point in the next academic year. After the experience, tested the projects designed in situ, some areas of improvement are detected in the design of the PBL for the next academic year, such as:

- To improve coordination among teachers of courses.
- To better integrate the volunteer program into the classroom project from the beginning of the academic year.
- To work on improving the coverage area of the CVF project.
- To improve prototypes from the perceived needs.
- To use new devices which integrate subsystems for easy mounting in situ.
- To get the needed licenses for the radio emission as well as the installation or more FM repeaters to increase the coverage to Lodwar (in the PHF project)
- To improve the procurement processes of equipment, transport procedures with air lines, permits and customs in airports in the next trip.

At the beginning of the next academic year the volunteers will show their experience to their classmates. A round table with all the participants in the volunteerism travel is organized. Participants discuss and debate about their experience to motivate future students to participate on it and to make them aware of the SD.

4. Results: Competences and learnings

With these projects, we wanted to facilitate teachers and students not only the experience of working on real world projects but to facilitate them with a volunteer international experience as a way to develop competences linked to EESD. These projects and living experiences leave students with a deeper impression than learning merely in their classrooms because they find meaning in context.

In the courses, the needed knowledge and skills related to their specific discipline are predefined in the curricula and the projects are designed making sure that those technical and general competences and skills are covered. For instance, the following specific competences of the subjects of the CVF Project are just the activities that have been carried out by the students:

- Ability to analyse and design combinational circuits and using microprocessors.
- Ability to analyse and to specify main parameters in a communication system.
- Ability to design and to implement software for a client-server system.
- Ability to implement applications for a multimedia web browser.

What's more, the realization of the projects (PBLs) in the classroom involves the development of some key skills such as autonomous learning, teamwork, responsibility, creativity, communication skills or

Table 4. Survey questions and responses about the students' perceptions with the projects (1 to 5 Likert Scale)

Topic	Question	Mean
Motivation in Subjects	I've been more motivated in subjects involved in the project than in the subjects which are not involved in	4.4
Motivation in Degree	Participating in this project has motivated me to continue with the degree	3.9
Closeness to Profession	I believe that the work I have done in the project will be very similar to what I will do in my future	3.5
Deeper Learning	Developing the project has provided me the knowledge and understanding of the technical content of the subject involved in it	4.3
Sustainability	Implementing the project has allowed me to think about the economic, social and/or environmental implications, which are associated with the achievement of my future profession	4.7

ability to adapt to new situations, which are assessed by means of a rubric [35]. It should be pointed out that the learning objectives established for all these courses were fully met, producing really good works.

Results of this experience are related to the work developed in the classrooms and to the lived experience abroad.

4.1 In classroom results

To collect the results from the project developed in the classrooms following the PBL methodology three tools to gather the data were used:

- Data sheets to analyze the final marks of the students in different academic years.
- The institutional surveys of satisfaction with the teaching of the subjects involved.
- A survey to collect students' perceptions about the project.

In Figure 4, the results from the previous academic year where no PBL methodology was used are compared with the ones from the experience shown in this paper.

This Figure shows the academic results of our students in the courses implied in the CFV project using the PBL with NGO projects and the ones before using the PBL. Students' satisfaction with their teachers is also shown.

We can notice that the results improve in general. There is less students' dropout in general (except in one course) and the students' marks are better (as it can be seen in the failed marks percentages and in the average marks). In the institutional surveys of satisfaction with the teaching, teachers got an increase in their results (in a 1 to 5 Likert- scale, being 1 = Strongly Disagree and 5 = strongly Agree).

To collect the student's perceptions with the projects an anonymous survey was carried out. The scale use to collect information was a Likert-scale from 1 to 5 (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree). An 87% of all the students enrolled answered the survey (28 students answered the survey for the CVF project, being 60% enrolled in all the courses involved; and 27 the PHF one, being 80% enrolled in all the courses). The detailed questions and the mean of the responses can be found in Table 4.

As we can see they think that working on this kind of projects motivates them more and make their learning deeper, not only in technical competences but also in sustainability. The worst results are found when comparing the project with their future (3.5) probably because they do not believe they will work in this kind of projects (volunteerism and cooperation). It seems that, as Terpenny et al. stand [36], if students are engaged in their projects, they produce better results and learn more.

4.2 Lived experience results

A real Higher Education needs to believe that the students and teachers can make the world a better place through this kind of experiences. To make this happen we need to continue inspiring changes every day through education. Some of these findings can be found in J. Peris et al. [37], in Fernández-Sánchez et al. [38] or in Moskal et al. [39] who stand that these kind of activities develop in engineering students a different understanding of the engineering beyond conventional learning objectives.

In order to collect the impact of our students' lived experience, they were asked to write reflective diaries as they provide rich information [28]. Volunteer students were asked to write their personal diaries with an acronym if they wanted. The diaries content was qualitatively analyzed in order to extract the students' perceptions [40]. Some coding and interpretative analysis technique was used to do it, with the help of the NVivo10 software.

From this analysis, we have found that the experience has led to goals related to the aca-

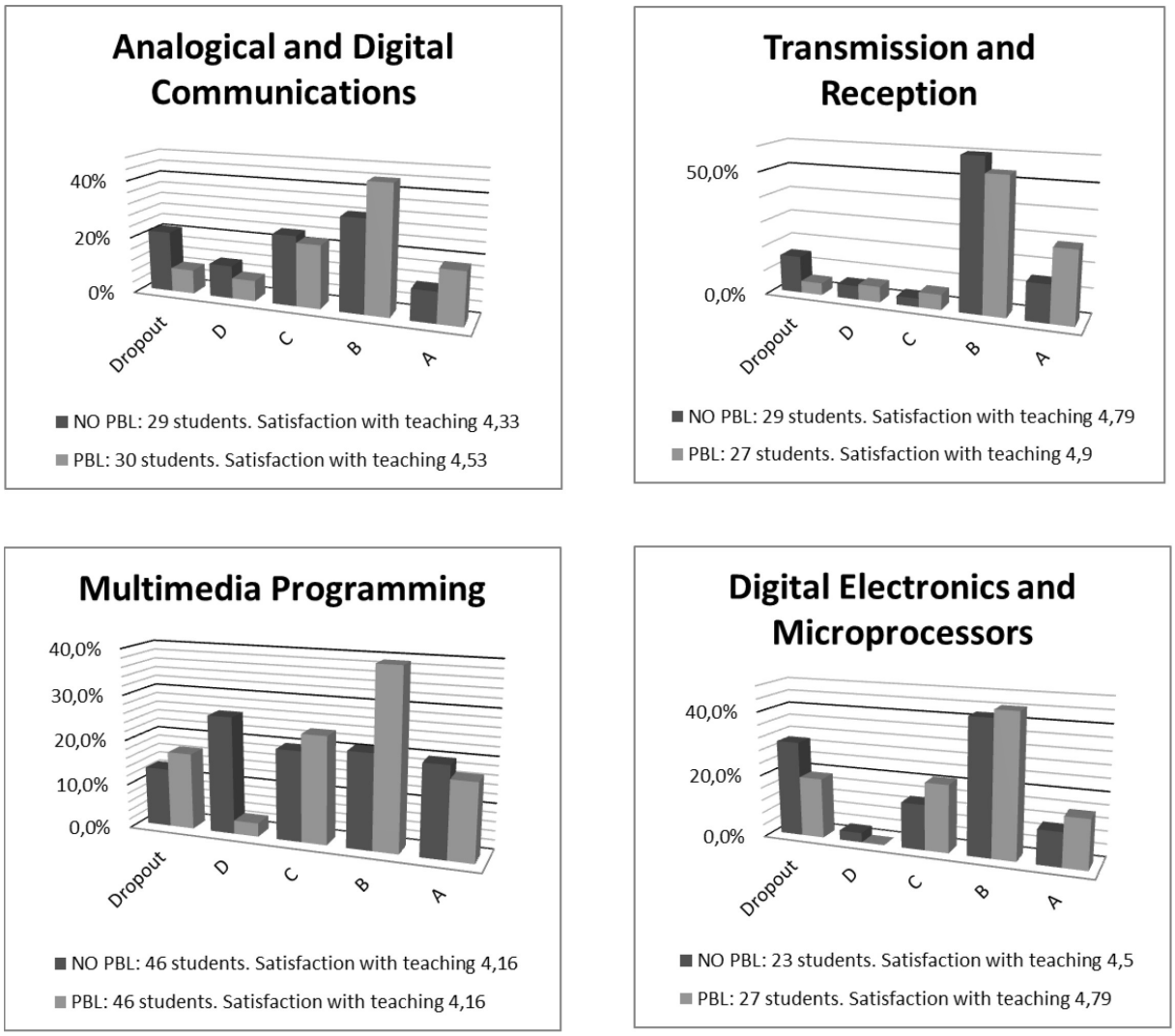

Fig. 4. Comparison of students' marks and satisfaction with the teachers "with" and "without" PBL in the Cerro Verde Project.

demic/professional education and to education values such as:

- Critical thinking: Critical contextualization of knowledge by establishing relationships with global social, economic and environmental problems, local, and/or global.
- Confidence: not afraid bringing their knowledge to problem solving, developing skills to apply technical competences into practice.
- Sustainability and responsibility: sustainable use of resources and the prevention of negative impacts on the natural and social environment.
- Relationships and decision making in sustainability: participation in community processes that promote sustainability.
- Awareness of ethical values: application of ethical principles related to the values of sustainability in personal and professional behavior.
- Global mindset: Willingness to promote diversity, openness and respect for other cultures, working effectively with people of different cultures, styles and skills, making optimal use of their views and ideas for meeting goals.
- Global Social Network: take in action collective skills to create positive global change in society.

The diaries were deemed a valuable tool to help volunteer better understand and interiorize their experience. They allowed volunteers to self-assess their participation and made them more inquisitive and introspective about their volunteer action.

The experience acted as a first approach to troubleshooting in their future as professionals. Students understood underlying relations between contents and applications. They found ways around problems in an area in which additional difficulties appear as a result from the living conditions where they were developed. The final result is that the contents of the courses are no longer isolated elements but they have a direct correlation with reality. Moreover, as the team is interdisciplin-

ary, you can establish the relationship of learning objectives with other areas of knowledge.

"*I think that really all the students need the chance to take part in some volunteer work. There are so many differences between what I learnt in the classroom and what I have seen here! We made designs in Spain and now, in real-life I have to consider the conditions of the village and make adjustments of our work. We had made a perfect planning! And. . . we have had to re-adjust everything. So, what I have learnt is. . .. So much! Not only I had to relate all the subjects but I had to lead with people.*" [Student A]

"*Being here made me aware that carrying out a real project, and... proving it... well, I think that I've learnt a lot more!*" [Student B]

"*Living during these days in Lokitaung has helped me, let's say with my responsibility*" [Student C]

On the other hand, this distance between what it is learnt in the classroom and what they found in the field became a trouble sometimes.

"*I think there is some things that should be improved . . . For instance, to inform better about the projects we were going to develop here [. . .] if someone has explain me better what I would have had here I would have invest more time in other parts of the project.*" [Student A]

"*. . . we have seen the projects as a whole. With the PBL in class I thought I knew all the variables. But, here, it is not a theory, but. . . actually it is people you speak with or people that.. you are acting or analyzing something you see.*" [Student D]

For instance, in the CVF project they saw the relationship between the distribution of drinking water and creating some kind of sanitation to avoid diseases. Living with health students, they discovered how some diseases occur as a result of the consumption of untreated water or water contaminated by fecal matter due to the lack treatment of wastewater.

"*I learn a lot being with health students. They know so many things I don't!, . . . I didn't know the importance of teaching people about sanitation*" [Student D]

Another purpose of the projects is to help to improve the living conditions of the villages. In this way the student is an active subject, committed to the development of social commitment and empathy, and the ability to guide reflective processes.

"*I wanted to understand the feeling of the villagers. [. . .] I encountered so many things that were out of my expectations! I didn't want to leave*" [Student A]

"*I am very proud of seeing that I am able to make real and worthy things. . .*" [Student C]

A problem that was detected is the complexity of living together in such a different environment than usual one. They had to live without light, water scarcity and away from the family circle and friends, unable to use the 'What's App' or the internet.

"*I am missing my friends. I miss my family. I wish I could send them a what's app.*" [Student D]

Local organizations have received with admiration and gratitude that students and teachers from a Spanish university moving to their village to live with its citizens and to participate in projects there and this has motivated students there even more.

"*They told me thanks so many times. . .even local authorities came to visit us to say thanks for being there.*" [Student C]

5. Conclusions

This paper aims to show two experiences of carrying out projects suggested by NGOs following the PBL methodology. Results show that these integrated experiences move beyond learning.

An improvement in the students' academic results and in their self-perceptions survey has been observed as well as an overall positive tendency in their satisfaction with the teaching. In the diary written by the students, it is revealed the extent to which the competences are developed and their degree of satisfaction with the learning process.

Some conclusions about students working with this type of NGO's real projects can be drawn:

- They become aware of sustainability and of the difficulties working under poor conditions of labor.
- They take an active role in solving the projects which in turn bestows meaning to their academic curriculum, developing a predisposition to value the contribution of others (engineers or not) in solving their problems.
- They feel useful and able to make things of value, which in turn prepares them for the near future and their chosen field and profession.
- There is a clear contribution of each of the participants in developing the projects through a cooperative, responsible and ethical work. Their participation involves intense personal experiences in a hostile environment in relation to everyday life of students and teachers.
- The multidisciplinary nature of the project generates an overview of the actions that each student accomplishes in their area of expertise, fostering a global contextualization of the work performed and the idea of convergence of each performance as well as the transfer of knowledge.

For the FCV and the PHF, participation of the University in these projects means to open a field of action in specific volunteering programs that complement our Project Based Engineering School. It gives a support that facilitates data collection and a

detailed analysis of the previous situation of the village and the changes they have been operating.

These academic activities related to development cooperation involve a major advance in current approaches to Education for Development and Sustainability within the European Higher Education Area (EHEA). PBL as a teaching and learning method integrated with SD projects can successfully facilitate participative students' learning, critical thinking, creativity, and cultural awareness, which are core values of sustainability. However, these initiatives require institutional support for their development and implementation in all areas of knowledge and, thus, to involve more students in the volunteerism travel abroad part.

This project's success has spurred institutional support in our favor opening possibilities for multiple future initiatives of a similar nature where our current knowhow and proficiency of our volunteers can make way for more ambitious and better researched initiatives that we are very willing to undertake.

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