

Student Motivation and Cross-Curricular Development through e-Learning applied to Cooperation

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Abstract— Technologies and especially information and communication technologies (ICT) are barrier breaking in the current social scenario. Their use is becoming essential for any professional, and their scope of use is becoming particularly widespread in education due to the existence of communication outside the classroom through e-learning tools. Universities, which play an innovative role in education, are using ICT-based approaches to adapt their learning methodology. In this paper, we present a model where students from first-world universities prepare and adapt course contents for use in educational institutions in developing countries. The objectives of this initiative of students' participating in e-learning projects with developing countries are to improve their motivation, develop a set of cross-curricular competencies, and transfer technologies within the scope of university development cooperation.

Motivation; e-learning; development cooperation; cross-curricular competencies

I. INTRODUCTION

Over the past few years new and increasing concerns have emerged in Europe regarding education-related topics that were not taken into account until now [1]. Higher education, as a source of development, culture and science, is responsible for achieving an additional objective: human development. Educational institutions, and especially universities, are the cradle of the citizens who will determine the direction of progress in our global society in the near future.

Educational priorities have changed, and an academic education—and this applies to any field, including new technologies and technical studies—is no longer considered complete if it does not consider student instruction in topics related to human development and social awareness. An overview of the different problems affecting society means that the involvement of higher education students has to go beyond the scope of projects exclusively related to their field of work.

This change should be made simultaneously by all players in the higher education system. However, it is very common for teaching staff to be reluctant to introduce new methods, partly for obvious reasons, such as the increased workload, and partly due to under-motivation to finally achieve definite

educational improvements. On the other hand, students tend to simplify their study methodology to optimize the time they spend on courses. Due to this lack of interest, most participatory methodologies are difficult to implement. This reality is clearly reflected in courses offering the option of assessment either by a final exam or through continuous coursework and group work, where many students opt for the traditional method and reject the educational improvement. Both students and the professors perceive that the workload is heavier, whereas attainment is similar. But, is attainment really the same? Of course, not. So, how can we motivate the two groups? Development cooperation naturally promotes both student motivation and some of the key competencies in higher education. Group work, communication, learning of other languages, awareness through development, and respect for the environment, are but a few of these skills [2]. We propose a methodology using e-learning applied to university development cooperation in Third World educational institutions applying a project-based learning strategy [3], as an effective instrument for motivating professors and students at a First World university, i.e. a highly motivating methodology for students and professors in a developed country. Project-based learning, or rather social project-based learning in this case, should be understood as a model for classroom work and homework that expands student learning with practical and real-world issues. This work with real-world projects is probably the key element of our learning approach that makes it so motivating for professors and students.

Distance education is no longer an experimental method. Educational tradition has, however, stalled the development of this method, which has been regarded as the main source of innovation in education during the past decade. e-Learning is an essential tool for cooperation and can also be used by professors to increase student motivation and training. Western students participating in these projects are involved in the development of society and receive training from the human standpoint. We get an improvement in the quality of available teaching material in developing countries and a wider dissemination of its contents. Additionally, acquired knowledge is consolidated at the same time as it is transferred to third parties. And all this with the added motivation

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provided by the use of their output for both educational and human development.

This proposal has already been successfully tested by the TEDECO (Technology for Development and Cooperation) cooperation group [4] at the Universidad Politécnica de Madrid (UPM) in partnership with the University of Ngozi (UNG) in Burundi. In this context, the cooperation group has exploited its expertise in information and communication technologies to work on a proposal for using ICT tools (adapted e-learning tools) to improve education in developing countries [5].

II. MOTIVATION

Internationalization in higher education, as in scientific research and other educational settings, is bringing together students, professors and researchers from more than one country, some coming from different cultures and social backgrounds [6], at the same university. Partnerships among European member states and their universities or other higher education institutions channelled through the Bologna process is a key component of this process of internationalization [7]. Another priority of higher education focuses on solving problems and responding to the needs and demands of society today, a global society that extends far beyond the European area [8]. Developed countries are now morally indebted to the developing countries; the developing countries' problems should be studied not only by non-governmental organizations but also by research centres and universities from developed countries. All these points are an initial justification for a more global education, aimed at developing not only language skills but also environmental education and intercultural awareness.

Below we justify from different points of view —divided into different sections— the reasons that brought us to develop this proposal linking education and development cooperation to improve the performance in both areas through collaborative work.

A. The European Higher Education Area

Changes in our global society have motivated the promotion of profound changes in education through the European Higher Education Area (EHEA) [9]. Cross-curricular competencies and student motivation have become central issues in the new scenario. The development and assessment of cross-curricular competencies not directly related to core technical knowledge is, however, one of the main problems facing professors during the transition period. A global solution requires adapting educational models and methodologies to achieve these new priorities.

One of the most important cross-curricular competencies is independent work, and Internet is playing a crucial role here. Plenty of free and open source material is available through the web, and students must use this information to complete and adapt their own technical material [10]. When students work on a topic they are only developing the core technical competencies of their specialty. But when students add to their material they are developing some of the cross-curricular competencies that are so difficult to improve through traditional education, such as capacity for analysis and synthesis, ability to work independently, team work, etc. [11].

B. Problems of Universities in Developing Countries

Education is the basis of a country's development process. In developing countries, it is very often impossible to wait until all basic needs have been covered to start up higher education programmes. Also, tackling higher education in a society with serious economic problems and no technical institutions to educate professionals in the area is a massive feat. Cooperation takes care of education. Traditionally, though, it has been more concerned about solving basic necessities than about higher education, which appears to be far removed from the possibilities of some developing countries. However, it is well known that higher education is a key field in the development of these countries, where local professionals will drive future changes. This is the main motivation for university cooperation with developing countries requiring assistance to develop their own adapted curricula and course contents. This is a key activity referred to as university development cooperation (UDC).

The traditional role of Western universities in UDC has often been limited to donations (donors of money, professors, and teaching material among other things). Over the last few years, however, a new concept of UDC has arisen, where universities from developed countries have become active participants working with developing universities. First World universities also gain benefits from this cooperation. This paper aims to conduct a methodological study of these benefits.

C. University Development Cooperation

Over recent years Western universities have become aware of their importance in the evolution of an increasingly global society. In this way, the activity of these universities —mainly (and sometimes exclusively) related to higher education and research— has traditionally focused on the needs of Western societies. However, 20% of the world population is clearly not a representation of global society, and therefore it is quite irresponsible for them to focus on solving the problems of just a small part of the world population and leave the problems of 80% of the population living in developing countries completely unattended.

Development cooperation aims to be the response to new concerns for solutions adapted to developing countries, and it has been included in higher education frameworks. There are codes of conduct signed *en masse* by a considerable number of universities —e.g. major Spanish higher education institutions [12, 13]. Universities are considered active agents of cooperation in the fields of education and research, as they are described in master plans designed by regional [14] and national development cooperation agencies [15].

Closely related to the research and innovation groups working on education currently operating at the UPM, there is a new label to identify groups working on development cooperation at the UPM and other universities. They are called **cooperation groups** and have become important technically highly qualified agents with sound expertise in both higher education and research on development.

D. Relevance of Information and Communication Technologies

Information and communication technologies (ICT) are fundamental in the developed countries where “*Information and communication technologies are transforming the way that individuals, institutions and societies learn, work and live. These technologies offer enormous potential benefits for the conduct of teaching, learning, research...*” [16].

Also ICT are fundamental for developing countries where access to information and communications is the key to development in the 21st century. Fig. 1 illustrates the cross-impact of ICT [17]. ICT is playing an important role in education, especially higher education. E-learning is the most common field relating ICT and education. However, traditional e-learning solutions and contents are designed for education in developed countries. Tools must be redesigned and contents must be adapted for application at developing countries’ universities.

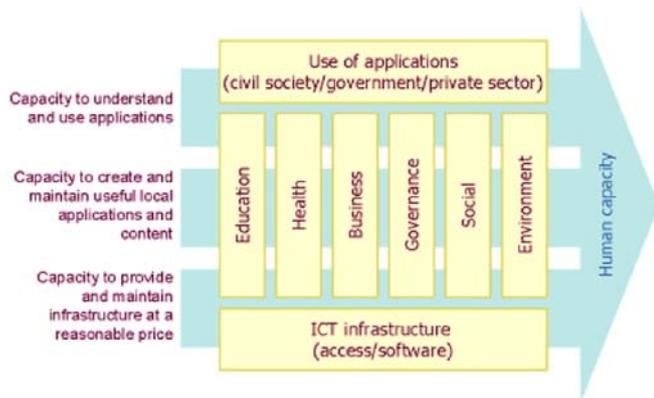


Figure 1. ICT cross-impact [17].

III. E-LEARNING APPLIED TO COOPERATION

Traditionally e-learning in the higher education model, i.e. at university, has been employed to: (1) increase university visibility, (2) extend the educational offer, and (3) as learning “virtualization” [18]. As shown in the last section, however, e-learning is especially interesting within ICT in developing countries, since it can overcome some of the physical and economic obstacles to education. Some of these obstacles that can be overcome by e-learning are the shortage of teachers or the lack of adequate training (especially in technical topics) of the available faculty. Hence technologies that enable distance learning are highly valuable in such environments, and e-learning could be the tool for transferring teaching activities to developing countries.

There are currently several projects using e-learning in developing countries as a support tool for education. Some of these projects are part of a broad educational program, divided into three noteworthy programs:

- The Latin American *Programa de Actualización de Maestros en Educación*¹ (AME) [19], a program

¹ Primary school teacher refresher course.

specifically focusing on basic education teachers in Latin America using television and distance learning.

- The African Virtual University (AVU) [20].
- The Virtual University of Pakistan (VU), Pakistan’s first university based completely on modern information and communication technologies [21].

Although our approach focuses directly on a university in a developing country, these projects are also good candidates for receiving the information that the method proposed here can provide. However, none of these projects has carried out a joint study of benefits for participants at First World universities: motivation, cross-curricular development, etc., encouraging and training students to prepare the necessary topics.

Within the TEDECO cooperation group [4], we published a novel approach (methodology, architecture and implementation) addressing this challenge. This approach included a new term, that is, c&d-learning [5], i.e. learning for cooperation and development. The c&d-learning model is based on the use of the Moodle² platform [22], adapted to the needs and infrastructures of developing countries. Not only does the c&d-learning model lead to an adaptation of the educational platform used, but it also proposes the requirements that must be taken into account when preparing the educational content of each course. In this paper we also propose an educational approach focusing on the fact that student participation in a c&d-learning project aims to achieve three objectives: (1) student motivation, (2) cross-curricular development, and (3) technology transfer.

In the remainder of this section we detail our approach. We justify this approach in Section 4, presenting a case study and its results, the experience of c&d-learning developed by UPM students with the UNG. In Section 5, we present the conclusions drawn from the implementation of the proposed method.

A. Scope

There has been much debate and many classifications of what is and what is not e-learning, but this is not the objective of this paper. It is important, though, to clarify some properties and uses of e-learning that must be taken into account when implementing this proposal. For example, depending on the communication and interaction between teacher and students, e-learning can be used as a synchronous or asynchronous (occasionally alternative terms, such as on-line or off-line education, respectively, could be used) teaching aid. Note importantly that e-learning extends the properties of the communication channel between teacher and students, thus providing new educational situations that did not occur in the traditional method. This is the case of an asynchronous communication where a message communicated by the teacher may not be immediately received by students.

In our case, c&d-learning should be classified as an asynchronous- and distance-learning model. First, the model

² Moodle is a course management system (CMS) commonly used in e-learning, also known as a learning management system (LMS) or a virtual learning environment (VLE) [20].

involves distance learning because courses developed as part of this approach are not applied *in situ* since there is a shortage of instructors. Second, the model is asynchronous because cooperation with developing countries does not require a constant or continuous communication. This last characteristic is the main constraint that the c&d-learning must overcome, since it requires the adaptation of course contents and e-learning platforms (designed for First World academic models) [5]. Some causes preventing a continuous communication can be: time difference among countries (which applies, for example, in partnerships between countries from Europe and Latin America, quite a common cooperation partnership), problems with Internet connections, different work schedules, or even cultural differences.

B. Role Description

Before detailing the planning strategy for our approach, this section gives a description of the different roles involved in the proposed methodology. Before we start to describe roles, let us clarify one point: from now on, when we use the term “local” in reference to professors, students or even resources, it should be considered as an indication of locality at the final destination of this educational proposal, i.e. at **universities in developing countries**. On the other hand, if used **without** the term “local”, we will be referring to staff, professors, students or resources of **universities in developed countries**.

a) **Professor** (at a First World university) is responsible for starting this initiative (at a developed country’s university), managing its evolution and performing the final evaluation. He or she supervises the process to assure the quality of the result. Furthermore, he or she could also be the beneficiary of the creation of repositories for learning resources [23].

b) **Students** (at a First World university) are the drive behind this approach, working together with the *Professor* to develop course contents at the same time as they assimilate the key concepts. Although they may not have all the training required to run a course, this approach is applicable thanks to supervision by the *Professor* and the lower academic level at developing countries’ universities. In any case, first-year courses that are continued in following years (e.g. Programming I, Programming II) are the best candidates for running this proposal.

c) **Local Professor** (at a Third World university): Sometimes called *facilitator*³, he or she is responsible for managing course contents at the target university, i.e. at a local university. He or she may need to perform some or all of the following tasks: present the contents *in situ*, answer questions or extend content, forward queries about user-level technical issues related to the e-learning platform to the *Professor* as necessary.

d) **Local Students** (at a Third World university) are the students located at the university in a developing country, i.e. the final beneficiaries of this approach.

³ In the absence of local professors at the local university (i.e. in a developing country), a temporary entity, the facilitator, could possibly assume the role of teacher.

Henceforth the terms professor and student (whether or not they are preceded by the term “local”) will be shown in uppercase and italics when referring to a specific role of this proposal, fulfilling the functions described above.

The roles defined above within a full c&d-learning scenario are shown in Fig. 2. All roles are linked by a common e-learning platform. The dotted lines represent all the paths for content transfer (e.g. content preparation, supervision, evaluation, query resolution, etc.). An asynchronous channel determines communication between *Students* and the *Local Professor* from universities in developed and developing countries, respectively. Although interaction processes are flexible, delegating responsibilities to *Students* regarding course content transfer encourages a valuable communication with the *Local Professor*. In any case, it is essential for the *Professor* and the *Local Professor* to supervise topics, methodologies, assessments and content developed by *Students*, and communication.

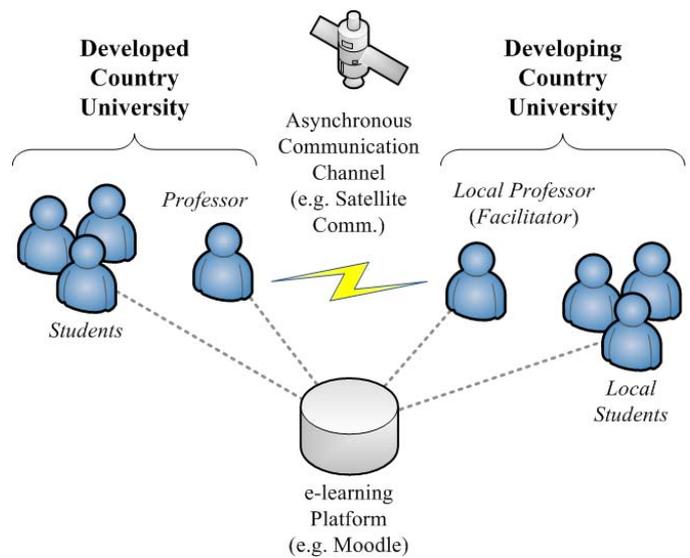


Figure 2. The c&d-learning scenario, including participant roles (*Professor*, *Student*, *Local Professor* or facilitator, and *Local Student*), communication channels and an e-learning platform.

C. Work Planning

The ultimate aim for participants in this initiative is to feed an e-learning platform with adapted course contents. This model delegates course scheduling and execution using the provided material, as well as supervision of course development, to the *Local Professor*. With the proposed delegation of responsibilities, we try to minimize interactions between *Local Students* and the external (non-local) *Professor*. This should bolster the figure of the *Local Professor*. In fact, after a training period teaching one or more courses, the *Local Professor* should be able to reproduce this ability, and dependence on the First World *Professor* should gradually decrease. The proposed educational method can be set up in three phases:

1) *Student recruitment*: the *Professor* in charge of *Student* recruitment should take into account a number of issues to launch this initiative.

a) *Motivation*: Development cooperation is a motivation in itself. As shown in the results section, the *Students* involved are volunteers. Since technology transfer is carried out where it is most necessary, development cooperation should be emphasized within the recruitment process.

b) *Repetition*: One of the main advantages of the proposed method is that the call —message used to engage *Students*— can be repeated periodically during each course. We recommend that the call be repeated and monitored during the development of the proposed approach to encourage student motivation throughout.

Note importantly that *Student* recruitment is a critical element for the success of the proposed approach, but educational methods should not be developed only to deal with the most appealing issues for students. In fact, the *Professor* in charge of these initiatives should use this proposal to complement their course planning to develop further cross-curricular competencies.

2) *Initialization and Development*: Once a group of *Students* has enrolled in this initiative, the required adaptation of the e-learning concept must be clarified. At First World universities, e-learning may facilitate two well-known models [18]: (1) uploading resources to supplement on-campus education, or (2) tele- or on-line education. Both models have a requirement that is only satisfied in developed countries: student Internet access from home or work. The situation in developing countries is the opposite: students usually only have on-campus access to ICT-based education. Bearing this in mind, content adaptation for *Students* must cover two important issues:

a) *Resources self-sufficiency*: If possible, the content developed by *Students* should provide methods to cover the complete educational process of each course. Otherwise, further resources must be available for off-line use, i.e. taking into account the limitations of the communication infrastructure in developing countries.

b) *Self-assessment*: Inclusion of self-assessment mechanisms to help *Local Students* to find out what they have learned.

c) *Completeness*: *Local Students* probably will not have access to additional content with which to increase their knowledge and training, and the information necessary to complete or understand an explanation.

Comparing the workload of traditional e-learning professors to the c&d-learning *Professor*, whereas working as an e-learning professor is a full-time engagement, the *Professor* in the proposed approach should transfer almost all responsibilities to *Local Professors*. In fact, their participation focuses mainly on the early phases of generating the course content and the final phases of evaluation. In the meantime, occasional and asynchronous interaction is required to answer advanced questions. This is potentially another argument in

favour of motivation, since c&d-learning can be combined with the daily workload of the *Professor* and *Students* involved.

3) *Evaluation*: Although the main objective of e-learning technologies is to facilitate the move from “blackboard to on-line” education, they can also be used for [18]: (1) self-assessment and organization of the educational methodology, (2) content quality control and analysis, and (3) didactic refresher activities. In developed countries’ universities, student assessment must cover more than just specific knowledge acquired in the respective course. Besides the cross-curricular competencies mentioned in section II [11], the Organization for Economic Cooperation and Development (OECD) suggests three main groups of cross-curricular competencies in higher education [2]. With a project-based learning model [3] as proposed here, the following competencies can be developed and hence evaluated.

a) *Use tools interactively* (e.g. language, technology). ICT skills are developed through e-learning usage, not only at the user level, but, in this case, at the editor level as well. Regarding languages, when *Students* cooperate with a different country, they must use a foreign language to prepare the course content and communicate with the local university staff.

b) *Interact in heterogeneous groups*: Compared to First World university environments, personnel working at universities in a developing country are one of the most heterogeneous groups that *Students* are likely to work with in their academic and professional life. Contact with a really different culture is a valuable experience for *Students*, and how they cope with these differences is also an issue to be evaluated.

c) *Work independently*: In this environment, *Students* become leaders and are responsible for the development of a particular course. Although supervised by a *Professor*, they must make important decisions that may have a significant impact on things such as content extension, assessment implementation or available resources. Key decisions, such as methodological approaches or assessment procedures, are outlined by the supervisor.

Finally, technology transfer can also be evaluated through the final beneficiaries of this initiative, *Local Students* and *Professors*. Traditional mechanisms, such as surveys, academic attainment comparison or course content quality, are suitable methods for such an evaluation and are provided by the actual e-learning platform for use.

IV. CASE STUDY AND RESULTS

In this section we present the case of study and its results. This case of study was carried out as a result of cooperation between Spain’s Universidad Politécnica de Madrid (UPM) and Burundi’s University of Ngozi (UNG). In mid-November 2005, the UPM received a request for cooperation involving teaching staff from UPM teaching computer science courses at the UNG. They replied to the original request by sending two professors from the UPM’s School of Computing. These instructors gave their first classes during the months of April

and May 2006. This initial cooperation was followed up by the design of an action plan to promote the self-sufficiency of the UNG based on ICT training and development.

After its initial contact with the UNG, the UPM's university development cooperation group, TEDECO, focused on designing a comprehensive action plan for UNG. It is here where the work of TEDECO really began. This project is divided into three phases, which have been carried out over the past two years. In chronological order, the planned tasks were: (1) the modernization of the computer equipment, (2) the installation of a shared Internet connection, and (3) the adaptation of a platform for planning educational material.

Currently TEDECO is working on the third and final phase described above, where we have started to simultaneously prepare the educational material necessary for the remote provision of courses at the UNG. We have also started to implement the educational methodology proposed here. To do this, we have used the previously developed c&d-learning model and delegated the preparation of the contents of the original materials delivered using e-learning since the 2006/07 academic year.

After the application of the proposed approach, the results can be viewed from two different perspectives. Firstly, we present UPM participation data: number of *Professors*, *Students* and other staff involved in this initiative. Secondly, we also discuss the impact of material provided by *Students* and *Professors* at the local university (UNG). From the analysis of these data we can: (1) evaluate the development of *Students* cross-curricular competencies —although *Professor* supervision is the main source of evaluation, local course outcomes should be also considered—; and (2) motivation feedback through technology transfer evaluation.

A. Participation

Table I and Fig. 3 summarize the participation data of *Professors*, *Students* and other participants⁴ involved in e-learning approaches implemented by the TEDECO cooperation group.

TABLE I. PROFESSORS, STUDENTS AND OTHER STAFF INVOLVED IN THE PROJECT.

Actors	Year			
	2006	2007	2008	2009 ^a
<i>Professors</i>	2	4	4	5
<i>Students</i>	2	12	14	17
Others	1	3	0	4
Total	5	19	18	22
Project-based learning ^b	1 (50.0%)	3 (25.0%)	8 (57.1%)	10 (58.8%)

a. On-going year. Data may be incomplete.

b. *Students* involved in project-based learning.

⁴ They are mainly former students.

The last row in Table I shows the number and percentage of *Students* over the total number of staff involved in project-based learning (listed in the second row).

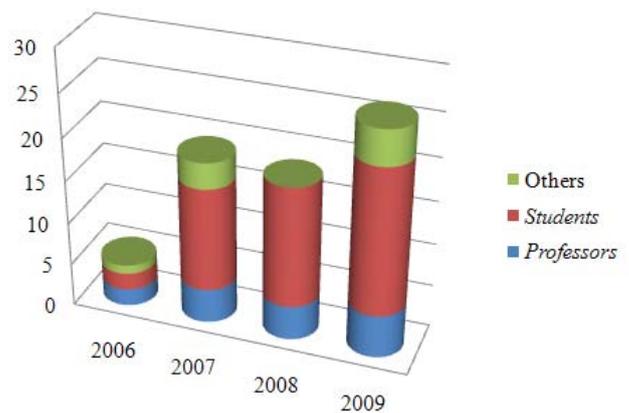


Figure 3. Number of *Professors*, *Students* and other staff involved in e-learning projects within TEDECO since 2006.

As shown in Fig. 3, the final number of participants has increased slowly but fairly constantly since the project kicked off and was consolidated. As the application of the approach has not been extrapolated to other institutions yet, further participation increments are not feasible.

B. Impact at the local university

Table II shows the evolution of the number of *Local Students* of computer science at the UNG. The number of *Local Students* is broken down by course and year. For the first two years, the UNG organized the computer science degree as a three-year course, which was expanded by a further fourth year from 2007 onwards. Row 5 shows the total number of *Local Students*, and rows 6 and 7 list the number of *Local Students* that have graduated in computer science vs. the number of *Local Students* that dropped out of the degree course. The last row in the table shows the evolution of the number of on-line subjects available at UNG [24]: Operating Systems, Programming Methodology, HTML and Web Development, Communications Networks, “*Java et bases de données*” (only French version available), and Linux Network Administration⁵.

TABLE II. LOCAL STUDENT EVOLUTION IN COMPUTER SCIENCE AT UNIVERSITY OF NGOZI.

Number of Local Students	Year			
	2005/06	2006/07	2007/08	2008/09 ^b
First year	35	55	58	62
Second year	17	19	24	18
Third year	12	14	18	19
Fourth year ^a			40	29

⁵ Corresponding authors: F. Escudero Tello, A. Jiménez Castellanos, M. Cortés Cornax, F. J. Jiménez Martínez, M. A. González Gisbert, and D. López.

Number of Local Students	Year			
	2005/06	2006/07	2007/08	2008/09 ^b
Total	64	88	140	128
CS Graduates	12	14	40	?
CS Dropouts	11	10	12	?
On-line Subjects		0	3	6

a. For the first two years, 2005/06 and 2006/07, the computer science degree did not include a fourth year.

b. Course units taught during 2008/09 are missing (illustrated by a question mark) because some data are not available or incomplete.

After UPM-UNG cooperation was consolidated, there was a notable increase in the efficiency rate and a drop in the dropout rate. Beyond a positive evaluation of the *Professors* involved in this initiative, these results suggest that the objectives of this approach (cross-curricular competency development, motivation and technology transfer) have been achieved.

V. CONCLUSIONS

In this paper we have presented a new method for applying a blended learning model (b-learning) to cooperation and development (c&d-learning). This proposal is based on the experiences of the TEDECO cooperation group at the UPM's School of Computing (Madrid, Spain) in partnership with the UNG School of Computer Science (Ngozi, Burundi). Following a study of e-learning differences applied to a university in a developing country and the implementation of a new methodology, we have conducted an analysis of benefits for participants, *Students*.

In traditional education, students receive the technical material required to acquire some specific competencies from their professors. Generally, students are not involved in the process of preparing, improving or updating course contents. However, we have proven that they are able to deal with such issues after taking the respective course. Independent work, interpersonal skills and teamwork, or foreign language communication are just some examples of the cross-curricular competencies developed by *Students* involved in this initiative. Also, this proposal is also interesting for improving the development of some of the least valued competencies in an engineering or information technologies degree —especially competencies related to ethical or social skills—, such as environmental awareness or ethical commitment to others [25].

In addition, development cooperation has proven to act like a catalyst of motivation, since *Students* got involved in the case study despite limited academic recognition: final-year projects or free choice credits in few cases. If this approach were also incorporated into new academic programmes through cross-curricular competency development, participation would be dramatically improved. However, this is also the main limitation of this approach, the double-edged sword of the participants' status as volunteers. Motivation is enhanced but effectiveness cannot be completely assured in these situations. Results suggest that this problem would be solved if this approach were adopted officially, where *Students*, coordinated

by the *Professor* of the respective subject, would work with a *Local Professor* at the target university. They would coordinate and adapt the contents of the subject to the requirements of a developing country. This would increase *Student* motivation in the subject, cross-curricular competency development and, finally, technology transfer from the First World to developing countries.

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