TEACHING INNOVATION THROUGH COLLABORATIVE PROGRAMS AT EUITI VALENCIA (SPAIN)

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Abstract *¾ Spanish Engineering Schools are evolving by changing their study programs. This has enabled to incorporate new subjects and recognise credits from foreign universities through collaborative programs (Socrates, Erasmus, Alfa, ...) as well as from stays or subjects followed at private or public institutions and industries. The authors show the experiences taken at Escuela Universitaria de Ingeniería Técnica Industrial EUITI of Valencia (Spain) and the improvements brought down as consequence in strengthening the knowledge of the European Community languages and fulfilling the needs of the graduated students in their profession.*

Index Terms ¾ Engineering Education, Collaborative Programs.

NEW ENGINEERING

If we have in mind the definition of an engineer as that professional who is most qualified to meet the challenges within a technologically changing world, it is clear that we must equip him/her with the necessary skills to be able to adapt easily to the work place.

We also believe that the type of engineer who seeks success in our ever more global economy, will be, to paraphrase Umberto Eco, a 'Saint Paul' who was born in Persia, came from a Jewish family, spoke Greek, read the Tora in Hebrew, lived in Jerusalem where he spoke Aramaic, and when they asked for his passport it showed he was Roman.

Very likely future graduates will switch technology and/or change their jobs at least three times in their professional lives. This is the reason why they must be given a sound technological background in the fundamentals, that allows them to continuously update. Therefore we strongly suggest changing that trend of moving to the final years what should be put forward as an introduction to research work and be taught as part of Doctorate programmes.

SPANISH BACKGROUND

Present Spanish Higher Education System dates back to the early eighties when a new law (Ley de Reforma Universitaria, LRU in the sequel) concerning the university structure was approved by the Central Government enabling the development of different syllabuses throughout Spanish universities in order to prepare us to face the 21st Century from a more advanced and flexible framework. This university reform law implied that universities would, on the one hand, share a common core in a given degree nation-wide, and on the other, establish their own priorities according to their environment by being allowed to offer subjects relative to their social demands, and more importantly, to give the student the opportunity to design – up to a certain extent– his or her own curricula, mainly by means of Option- and Elective- subjects to be chosen by him/her in addition to the Core- (fixed by the Ministry of Education) and Compulsory- (fixed by each university) subjects.

The LRU created a framework that made engineering education move into a credit system, with the theoretical contents of many subjects greatly reduced and many new 6-credit subjects added (4 hours/week during 15 weeks, since 1 credit equals 10 contact class hours). This meant reviewing the contents of all the subjects and changing the teaching process if compressing previous teaching programmes was to be avoided, replacing blackboard hours for time spent queuing up at the Xerox machine.

Universities, within their given freedom to restructure their studies, sometimes went too far and created too many small courses which created a proliferation of different subjects taken at the same time by the students. This led the Central Government to introduce in 1998, after some years of testing different curricula designs at the universities, some mild restrictions to the number and length of the term and year subjects which can be taken since both kinds of subjects may coexist within a particular university curricular design. In this respect the minimum size for term subjects is 4.5 credits and 9 credits for annual subjects. On the other hand, in order to allow students to perform their own curricular design, within the foreseen period of time of their respective studies, they should not take more than nine different subjects per year or six subjects at a given moment, both quantities comprising the total number of term and annual subjects each student can take.

Technical teaching and training, through the existing Option- and Elective- subject curriculum, should take into account the types of industry providing employment to the Institution's graduate students. In the School of Valencia we have included a large amount of elective subjects (172) to the so-called POD, i.e. Plan de Ordenación Docente (teaching management plan), as well as optional subjects which encourages an integral education

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and permits the student to acquire the status of 'know how to keep ground' as a step ahead of 'know how to do' and, obviously, of knowledge.

COLLABORATIVE PROGRAMS

On the other hand, it must be taken into account that the economy increasingly moves within the central concept of globalization, thus giving a fundamental role to the knowledge of foreign languages and cultures. International exchange of students, and teaching and administration/services staff should be encouraged. The latter professional group is central to making sure that our incoming international students are properly assisted and, more importantly, properly understood as regards the many daily problems that they come across within the receiving Institution.

With all this in mind, EUITI is involved in several tasks seeking Teaching Innovation for which it has favoured several programs which may be summarized in:

- Methodology innovation programmes and efficient use of multimedia technology used as a training tool.
- Involvement in international collaborative and exchange programmes.
- Relationship with industry.

Focussing on Collaborative Programs let us mention that EUITI participates in several programs since 1987: ERASMUS, SOCRATES, LINGUA, LEONARDO and TEMPUS. In addition, new international projects have emerged with the US and South America, for example ALFA. The ERASMUS Programme was created to prevent education from being left aside in Europe and to turn the European Common Market into a reality involving also university education. This programme meant economic support for universities, their students and staff, with the aim of promoting student mobility and co-operation in the field of higher education in another EU member state. Our students were given the opportunity to get to know other cultures and a better understanding of the implications of becoming the European Union. The European Student Exchange Programme, SOCRATES, is the successor of the ERASMUS programme. The LINGUA programme aims to help Europeans overcome language barriers, to improve quantity and quality of the teaching and learning of foreign languages, to achieve the better qualification of the future workforce, making competitiveness possible within the internal market. TEMPUS is an acronym corresponding to Trans-European Mobility Programme for University Studies, which was adopted by the Council of Ministers of the EC, May 7, 1990. It formed part of the global programme of community aid for the economic restructuring of the Central and Eastern European countries. Finally, EUITI also has participated in ALFA projects between the EU and Latin American universities, for instance *Luis Vives II* focused towards the improvement and innovation in industrial engineering education with the participation of 7 EU institutions and 7 Latin-American universities and *San Alberto* focused towards linking Environmental Euro-engineering with Latin American societies

We have a yearly average of 110 outgoing students following on average a nine-month study stay, spread over the European Union countries (UK, Ireland, Germany, Finland…) and an incipient student mobility to Latin America (Uruguay, Chile, Argentina, Mexico and soon Cuba); we maintain relationships with several institutions in the USA and Canada. The number of teaching staff is around twenty and the administration and technical staff moving this year will be 8 (including Laboratory Technicians and International Relations staff).

Although these facts and figures, together with the nearly 100 students received through European programmes, can be considered very positive, we still believe that the numbers fall far short of what future teaching should look like, one in which undergraduate students should benefit from a minimum stay of six months abroad, or, ideally, one full year at a foreign university giving the possibility of obtaining a jointly awarded degree.

TRAINING AND TEACHING IN ENGINEERING

EUITI favours a model of training and teaching which, as a result of taking into account the student abilities, is able to develop a series of attitudes within the pedagogical process encouraging them to develop a strong interest in their own training, as students should understand that they have the main responsibility for their own teaching and learning process. On the other hand teachers have to select the necessary contents to achieve the appropriate goals.

It must be emphasized that traditional teaching was in favour of giving a large amount of information, and in this process many teachers from their blackboards were mere givers of pages and pages of information which was copied, learnt by heart and answered back in exams by students.

Moreover, it must as well be remembered that, apart from changing the roles of the teacher, who must become a motivating and counselling figure, and the student, we also should achieve a more global training that enables the future graduate students to shift from an interest in 'knowing' to a concern to 'know how to do' (with the subsequent active learning) and then to 'know how to stand'. All this can only be achieved if a substantial amount of 'chalk face' hours are devoted to student active work.

Excuses can always be found for not changing curricula or teaching methodologies. Usually they can be classified into four groups which correspond to the lack of more technical and administrative staff, teaching staff, resources and space. And quite commonly a combination of these. In order to face all these drawbacks, our suggestion is to put forward proposals so as to obtain what is required, and to take off and act even if all the needs may not be fully met.

The future must encourage a type of teaching which is increasingly more and more technified, with computer support in most of the subjects and teaching labs guiding the students' learning work. The newspaper *Expansión & Empleo* dated 2-3 September 2000 already reported that the Net improves student performance by 20%. Along this line, on the 13th of August 2000, the newspaper *El País* stated that the fields of computing and telecommunications account for a fourth of the newly created jobs in Spain.

We have been encouraging the use of new and core technologies in teaching for over ten years now, because if students work with the same computer support and with a similar equipment for several subject matters, their performance and mastery of the resources increases accordingly.

A SUGGESTION

The document 'MEJORA DE LA FORMACIÓN UNIVERSITARIA: sugerencia desde la Empresa' (University Training Improvement: suggestion from the Enterprise World) is a consequence of the work of a team including Enterprise and University people. Its origin can be found in the worry felt by enterprises that expressed the need to find a greater suitability in the abilities of recent graduates to adapt to the labour market. This idea found an adequate ground within the sectorial working group of University members of the Quality Management Club network.

It is especially important because it means the first serious attempt to protest against the existing situation of inertia and conservative attitude which has long been characteristic of the Spanish University system, and therefore it could well be compulsorily distributed among all members of the University teaching staff.

Its suggestion is straight forward: the enterprise world considers of prime importance for the training of University students a series of abilities and certain knowledge corresponding to overall requirements within the labour market, regardless of what the students' field or major is. Abilities are as important as University curricular contents. To give but a general overview, the required qualifications are: leadership and motivation, teamwork, project management, buying and selling processes, self-learning, personal development, quality, communication, information search and retrieval, oral and written expression.

To properly meet these requirements implies a deep change in University teaching objectives. To be more concrete, two key demands are perceived:

- To give predominance to learning in the learning-teaching balance.
- To train in qualifications/abilities.

All this implies a decrease in the expositive content of teaching while keeping up with the integrity of teaching and the level of knowledge corresponding to Higher Education, and taking into consideration a context of general reduction of teaching hours within the new University curricula, and a greater balance between theory and practice required by a more comprehensive and efficient technical training.

Therefore our suggestion to solve this important problem is well rooted within a greater use of technological resources for teaching and informative purposes which allows the above mentioned change in the role of teachers to become more motivating and stimulating. In order to achieve this goal, the use of computer classrooms, audiovisual and multimedia resources provides powerful tools which are relatively affordable and easy to implement. accordingly.

EUITI EXPERIENCES

The policy in favour of a greater technification has taken us to a need to train not only students (with subjects related to computing and multimedia) but also the teaching staff, with the development of courses for teachers that introduce us to the proper use of teaching technologies, which is consolidating the emergence of several research groups within the field of pedagogy.

Teaching in laboratory classrooms allows a full integration between theory and practice. It is necessary for these classrooms to be multidisciplinar, which is positive for a greater connection among disciplines and subjects and enhances the overall vision on the students' part. It also allows a sharing of resources which can reduce costs significantly.

From our experience some recommendations for teaching for instance in the first year of Electronic Engineering are the following:

- A computer classroom: it will be the location for subjects that only require computer facilities: Mathematics, Computer Fundamentals, Technical Drawing, Languages…
- A computer classroom: it will be the location for subjects that only require computer facilities: Mathematics, Computer Fundamentals, Technical Drawing, Languages…
- A specialised laboratory classroom for subjects requiring not only computers but also other equipment, such as Physics Fundamentals
- External laboratories: some subjects requiring complex facilities and installations, such as Chemistry…

For the second year of Electronics, two classrooms hosting 33/40 workstations with computer facilities and basic equipment, namely oscilloscope, generator, power supply, multimeter and logic analizer are required.

For the third year we have experienced an improvement with the use of smaller labs, since more specialised equipment is required.

In order to achieve a more active participation of the students in their training from the start we teach a series of prerequisite courses, together with the development of experiences such as counselling students and tutor teachers.

We strongly encourage the students to carry out project work related to two or more subjects and which could be presented to and evaluated by different subject teachers. And in the second year the development of prototypes is a fundamental part of several subjects.

Different subjects make wide use of Inter- and Intranet bulletin boards to work which enables an innovative relation between students and teachers.

We have started the teaching of various subjects in English, as well as other subjects taught in companies and institutes of the Technological Park, which provides students with a wider (and probably more professional) perspective.

To develop other abilities among the student population, we are considering the possibility of teaching part of the curriculum as smaller seminars with fewer students, which allows a closer attention paid to students by teachers, as well as a more active learning. These seminar rooms consist of 10 / 14 computer workstations when required.

Another type of subject uses multimedia formats in its methodology, as well as the presentation of essays and works by students, thus encouraging the acquisition of abilities required by most of the job offers: teamwork, speaking to an audience, computer literacy and languages.

All these lines of action, together with over 100 Industrial Placements with an average duration of 6 months and a very large amount of Final Year Projects done in companies, provide EUITI students with an adequate adaptation to the industrial world, achieving a high percentage (over 95%) of employability of our graduates within six months upon graduation.

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