

# **FACULTY DEVELOPMENT THROUGH PEER-LEARNING IN THE TELECOM-BCN DESIGN-BUILD PROJECT SUBJECTS**

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## **ABSTRACT**

Standards 9 and 10 clearly state that faculty development is a key aspect in the design and implementation of CDIO oriented curricula. In our institution, the courses for competence learning and assessment programmed by the University Faculty Training Unit cover the insertion of competences in ordinary subjects, but they are not enough to fulfill the needs of design-build project courses and, in addition, faculty members with consolidated positions are often reluctant to follow them. To overcome this drawback, we have designed a peer-learning procedure. New faculty members in the design-build project subjects are required to start teaching in the first year subject (introduction to engineering) and then continue in the second year one (basic engineering project) and then the third one (advanced engineering project). The first time that a lecturer teaches each course, is escorted by a colleague that already did it. In 3 and ½ years (7 semesters), the initial 5 people team has grown to 25 faculty members. Lecturers who were reluctant to enroll in training courses are now making puzzles, using rubrics and evaluating competences, and it is reasonable to think that they will be prone to use these tools in other subjects they teach.

## **KEYWORDS**

Faculty development, peer-learning, skills, design-build projects.

## INTRODUCTION

Faculty development is a key aspect in the design and implementation of CDIO oriented curricula. Standard 9 - Enhancement of Faculty CDIO Skills and also Standard 10 - Enhancement of Faculty Teaching Skills clearly state the need of providing a suitable program to improve the faculty members' competence in personal, interpersonal, and product and system building skills and also in integrated learning methodology.

Initial training programs and hiring procedures which take into account industrial experience are probably the best tools to ensure that new faculty members will be aligned with CDIO methodology [1],[2]. The training of existing staff needs however specific courses or experiences that promote the contact with industry. The training courses are probably more adequate and easy to implement by the university, but faculty members with a consolidated position are often reluctant to follow them.

According to our curricula, all subjects should moderately contribute to the learning process of the generic skills or competences and specifically assess two of them at a given level (basic, medium, advanced). In addition, four specific design-build project subjects have been scattered along the curricula, one per year. We call it the design-build path. The skills are strongly treated in these subjects. The standard courses for competence learning and assessment programmed by the Faculty Training Unit are useful for the first purpose (generic skills imbricated in standard courses) and a number of lecturers have followed several of them, but there is still a relevant amount of faculty members which are averse to be trained. Nevertheless, our main concern is about the faculty development for the design-build project subjects. In this case, we have had to face a paradox when designing the faculty development process. We would like to engage the lecturers with a relevant experience in applied research and technology transfer but they have shown to be the most reluctant to be trained by the university training unit. The apparent reason is that their staff is mainly based on lecturers that have chosen to develop a pedagogical activity instead of a research-based career and by former researchers which, at a given point of their career, decided to change its orientation. With the maximum respect towards this people, who plays a key role in the university, the fact is that our target faculty members to implement the CDIO standards do not recognize their authority and their methods.

To overcome this drawback, we have designed a peer-learning procedure with the double goal of ensuring the correct performance of the design-build path subjects and also permeating the ordinary subjects through the faculty members which are involved in both types of subjects, which would be around the 25% of the staff at the end of the process.

## METHODS

### ***The Design-Build subjects path***

The Telecom-BCN Design-Build subjects' path includes four courses; all of them are located on the second half of each year in the curricula of our five bachelor degrees (4 year-long): Communication Systems Engineering, Audiovisual Systems Engineering, Electronics Engineering, Networks, and Telecom Science and Technology. To allow the progression of the students that fail one or several subjects, almost all courses in our curricula are taught in both autumn and spring semesters. Due to this, the project subjects in the spring semester (the natural cohorts) typically have larger groups and with more skilled students than the autumn semester courses.

The project subjects' main goals are:

- to integrate and enhance the learning outcomes of the previous and simultaneous regular subjects
- to put hooks to engage students in the following subject contents
- to teach and assess several skills, with emphasis in those which are more difficult to insert in regular subjects

The Introduction to Engineering course includes a partially guided project through a complex system, but with low technical difficulty. The second year project has a higher technical difficulty and emphasizes the modular structure of complex ICT systems, although a working team only develops one of the system blocks. In the third year project (Advanced Engineering Project, larger working groups should develop a whole system, including its business plan. The fourth and last year, the individual students join a research department or company to perform their final thesis. The first three steps were successively described in the three last CDIO Conferences [3], [4], [5].

In order to ensure the coherence of the methodology in all project subjects, we ask the lecturers which join the team to perform the whole project subject itinerary, that is, start teaching in the first year subject (introduction to engineering) and then continuing in the second year (basic engineering project) and then the third one (advanced engineering project).

### ***Faculty recruitment and training***

The hiring and promotion system of the Spanish university is not very flexible and hiring some of the most suitable teacher profiles, particularly those coming from the industrial sector is not easy. Furthermore, Spanish University staff is being reduced in the last years by blocking new hires, not replacing retirements and even firing staff with non-permanent positions. Specifically, most part-time lecturers with industrial activity have been fired in the last two years due to the fact that they had weaker contracts. This situation reduces our sources of suitable lecturers for the design-build subjects and we should find them among the existing staff. So we try to engage the lecturers with former experience in the industry or with a relevant activity in projects with the industry and technology transfer. We make yearly calls and choose the new team members among the volunteers with a suitable profile. Of course we also try to convince teachers that we know that already have a suitable profile to join us. That kind of people is usually very active and is involved in several parallel projects. They mostly find the CDIO implementation project also interesting and devote a lot of time in developing the new subjects. There is however a side effect: they have shown to be the most reluctant to be trained by standard means, probably due to the reasons already described in the introduction.

The UPC staff training unit (Education Sciences Institute) is aware about the CDIO implementation which is being carried out at our engineering school, but the design of their courses is oriented towards the whole University and even other universities. They offer standard courses and workshops and also an Initial Training Program. Given that CDIO has been adopted by our School but not by the whole UPC, there are no specific CDIO-oriented courses. A few of us took courses about skills assessment, active learning techniques... and designed a peer-learning procedure to propagate the methods to all team members and tailor them to the CDIO-based design of our curricula.

The process started in 2009 with a group of 5 faculty members (4 of them teaching), which have or have had a strong relationship with the industry and who have been involved in the design of the curricula in the previous two years, being very familiar with the CDIO syllabus and standards.

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There are 4 additional lecturers from the Management and Business Department who teach the economics and business seminars in all courses. There are also a handful of collaborators which teach several single session seminars spread along the courses (patents, information resources, critical thinking, ...)

### ***Faculty development through peer-learning***

The initial team designed and started teaching each one of the three first design-build project subjects (the fourth one is the degree thesis) with a pilot group (60 students in the first year project, ~ 30 students the second and third year). Every following year, each project subject is followed by the whole cohort (~ 250 students in 1st year and ~ 140 in second and 3d year, and there is a gradual entry of new faculty members. Several members of the initial team perform training sessions to teach the new faculty members about the course contents and structure, being these sessions hands-on and less formal than the standard training courses. In addition, the first time a lecturer joins a subject, is fully or partially escorted by a colleague that already has done it.

The first year that a subject is implemented, we are allowed to double the allocation of faculty members to the subjects. The following years, at least during the implementation transient, we can double 2/3 of the staff. That is, for a 3 hours session, two lecturers (an expert and a freshman) teach 2 hours each, sharing at least one of the three hours. This way, the learning methods and practical questions associated with the project development are propagated to new faculty members. Although we initially estimated that most faculty members would prefer staying the minimum time in the first and second year subjects in order to reach the third year project as soon as possible, in practice most of them prefer to consolidate their learning and stay at least a second semester lecturing the same subject, this time alone or teaching a new colleague. These second time practitioners usually propose improvements in the subject structure and materials (slides, rubrics, assessment methods, ...). The Introduction to Engineering course is now coordinated by a lecturer who joined the team in the third iteration and only two members of the initial team participate on it one semester per year.

We have had to cope with the training of full professors with decades of teaching experience that want to join the team but are a bit reluctant to follow all the procedure, mainly the Introduction to Engineering course. We offer them a softer way, which consists in allowing them to follow the first training year as observers. They come to the classes and labs while an experienced lecturer performs and participate in a flexible way in the teaching activities. They usually get more and more involved as the course goes on.

### ***Involved teaching methods***

The main goal of asking the faculty members to teach gradually in the three design-build project subjects is to ensure the coherence of the methodology along the path, but also to display them the student's skills maturation process. When the initial team started with the first students cohort, we had a tendency to expect too much of the students in each activities from the Introduction to Engineering course. Probably due to the Pigmalion Effect, the performance of that cohort has been outstanding, but that level collapsed most of the students of the second (and four times larger) cohort and we learnt to iterate the same concepts and to scale their level of demand along the path.

The project management topics are inherent to the project courses and should be standardized in order to be used in all project subjects. The project documentation method we use has been

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adapted from LIPS model [6]. In the third year project the PMBOK [7] model is also introduced. Although most involved lecturers are used to manage projects, there is a variety of management and documentation methods and there was a need for standardization.

Additionally to the project based learning issues, there is also a variety of active learning methods and tools that are introduced into the seminars of the project courses. Most of the involved faculty members hadn't received any formal training on these methods but they learn them by doing in a peer-learning basis:

- Puzzles are used to introduce the project topic background in the second year project in the first 3 weeks.
- Clickers are occasionally used during complex systems presentations in the Introduction to Engineering course
- Presentations prepared by the students are used in the Introduction to Engineering course and in the Advanced Engineering Project. Students perform pre and post questionnaires through the Moodle-based LMS.
- Co-assessment is used in Advanced Engineering Project
- Rubric-based assessment is pervasively used in the project tollgates

All lecturers are also involved in regular subjects. Although the use of active learning methods is intensive in the project subjects, they would permeate to other courses which are shared by colleagues not involved in the project path. We hope this would spread the knowledge of active learning methods and reduce the reluctance towards its use.

## RESULTS

The initial 5 people team has grown to 25 faculty members in 3 and 1/2 years (7 semesters) and will continue growing up to the estimated 45-50 people which is needed to run the design-build project subjects path in steady state. The progression is shown in the following table:

Table 1. Faculty members involved in the project subjects

semester	Introd to Eng	Basic Eng Proj	Adv Eng Proj
2009-2010 spring	4	-	-
2010-2011 autumn	2	-	-
2010-2011 spring	12	5	-
2011-2012 autumn	5	5	-
2011-2012 spring	10	10	4
2012-2013 autumn	6	8	-
2012-2013 spring	12	10	9

The natural cohorts take the project subjects on the spring semester. Because of this autumn semesters have less students and need less teachers. Several lecturers teach in more than one project subject simultaneously

## CONCLUSIONS

Initial training programs and hiring procedures which take into account industrial experience are probably the best tools to ensure that new faculty members will be aligned with CDIO

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methodology. At Telecom-BCN, however, we have faced the implementation of the new CDIO-based curricula with senior lecturers. Standard or tailored training courses should be enough to update the skills of the faculty members and adapt them to the active learning and project-based methods. Faculty members with a consolidated position are often reluctant to follow training courses, mainly if a close colleague teaches them. On the other hand, the University staff training unit courses are really useful but not completely CDIO aligned. To solve this tradeoff, we designed and implemented a learning-by-doing / peer-learning method which allowed growing from 5 to 25 trained faculty members in 3 and 1/2 years. Some concluding remarks and facts about the implementation are the following:

- No one has left the team up to now. There are critical opinions in the coordination meetings but, up to now, they have been fair and constructive.
- The main source of volunteers who apply for joining the project subjects team are colleagues of existing team members which have been told about the experience
- Although the profile of our target lecturers is more active and busy than the average, they devote lots of hours to the development of the new courses.
- Although we initially thought that most lecturers would prefer to follow the project subjects path quickly in order to reach the Advanced Engineering Project as soon as possible, most of them are staying in the first and second level for 2, 3 and 4 times in order to improve the courses and feel secure.
- Faculty members who were reluctant to enroll in training courses are now using puzzles and rubrics and other active learning tools and evaluating competences, and is reasonable to think that they will be prone to use these tools in other subjects they teach.
- The close cooperation between faculty members from different departments is creating synergies and enhancing the feeling of School.
- The cost of this method in hours according to our implementation is in the range 1.5 to 2 times the course time (two teachers instead of one). That is 40 to 65 person-hours for a 6 ECTS course. This is probably more than the training time using standard training courses but is being a solution to collectively learn to teach using projects.
- Of course, the real validation of this method would come from the assessment of the graduated engineers' skills by their employers. We need however a few more years to reach this point, given that our first cohort will be issued this year and most of them will enroll in a Master program.

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