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## THE PROJECT "INTRODUCTION TO COMPLEX SYSTEM" AT THE ENST BRETAGNE – A FRENCH GRADUATE SCHOOL OF TELECOMMUNICATIONS ENGINEERING

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### SUMMARY

*Engineering curricula have to prepare the students to many competences, particularly technical and human competences. In the technical domain, it is not possible to cover the whole knowledge corpus. So, selftraining capacities have to be developed thanks to project based learning and active learning. In our school, each student takes part to two projects per year and the first of it is a large scale project called "introduction to complex systems". Entirely based on active pedagogy, the main objectives of this project are the management of groups, the discovery of a complex telecommunication system and oral presentations. At the end of this project the students should be able to understand better the organization and the contents of the training. They are more sensitive to the questions how learn and how work in a group and with the help of the group. For the teaching team, it is a new and rich experiment. Lecturers are in fact tutors of a group of seven or eight students. Thus, they are not specialists in the field but they give some help in term of management of the group (definition of the role and responsibilities of everyone inside the group).*

**KEY-WORDS :** *large scale project, project-based learning, active learning, telecommunications engineering, concrete form, work in and with a group*

### 1. INTRODUCTION

Engineers are more and more confronted to continuous changes in their careers and professional practice. Engineering curricula have to prepare the students to these new demands in terms of professional, technical and human competences. In the technical domain, it is not possible to cover the whole knowledge corpus, that is why self-training capacities have to be developed. Non technical competences such as communication, oral and written presentations, autonomy, leadership, creativity, team spirit and cooperation are also necessary. For us, projects are a response to this problem, specially large scale project. Therefore, in the new curriculum of our school, every student takes part to two projects every year.

To confirm these points of view, the first project in the schedule, called "introduction to complex systems", is entirely based on active learning ; it has to prepare the students to project based learning. It has three main goals. The first one is to give the basis to work in a group (the management of groups specially the definition of

the role and the responsibilities of everyone inside the group). Then, it allows to explore a complex telecommunication system. Finally, it prepares to oral presentations. Furthermore, during the project, the student learns how to use the project as learning tool. Consequently, at the end of this large scale project, the student should be able to use the project as a way to gain new knowledge and to learn with the help of the group.

This paper presents our approach of using active pedagogy for this large scale project in the first year of the curriculum. Its structure is described below. In section 2, we propose to discuss about the organization on the side of students and also teaching team. Section 3 give the tools for this kind of project. Particularly, we show how it is possible for a student to learn and to understand the most important principles of the complex system in a group with active pedagogy. In section 4, we make an assessment for this first experiment. Finally, we conclude in section 5 with some ideas and perspectives for our next academic year.

## 2. PROJECT ORGANIZATION

The working time scheduled for the project is 108 hours per student parting shot as follow : 6 hours per week during a 14 weeks period and 24 hours after this period (during the week of the final presentation). All evaluation times are enclosed in this working time (multiple-choice questions, oral presentations, intermediate reports).

The student groups are made of by the teaching team so that the students learn to work with persons they have not chosen. Each group is composed by 7 or 8 students. The groups are made according to rules such as : no more than one student having difficulties with the French language (20% of the students are from foreign countries), 0 or 2 (not only 1) girls per group... We also try to put together students who have different competences achieved during their precedent school years.

The teaching team is constituted of :

- designers. It is a group of 6 teachers who write the subjects and present it to the tutors during a meeting before every tutored session.
- tutors (one tutor per group). The tutors are not specialists in the fields studied during the project and belong to all the departments of the school (data processing, microwaves as well as economy or English). For its first experiment, the project was preceded by a training to tutoring in active learning, made by specialists of the University of Louvain (UCL, Belgium).
- experts. Their role is to give technical responses or references at the questions of the students. The responses can be given during meeting with a student per group or individually with internet tools.
- teachers for courses about the search for information or oral presentation.

The project takes place every Wednesday. This day of the week is scheduled as follow. A tutor supervises the group of students for an 1h30 in the morning. This year, there is one tutor per group of seven or eight students. These tutored meetings are used for organizing the groups for preparing the work to be performed by the group and by each student of the group and to share knowledge. The first tutored session is followed by an 1h30 of either personal study, or meeting with experts or a course, depending on the subject of the session. The meetings with experts and the course take place after the need for them appears in the project ; the course are centered on matters useful for the projects : the search for

information (books, internet, ...) or the oral presentation ; they are given in small groups so that there are more interactions between the teacher and the students. Wednesday afternoon is dedicated to personal study (3 hours).

At the beginning of each session, the students discuss in the group to choose a leader, a scribe for the blackboard and a secretary. We arrange for each student in the group to take each of the three roles at least once. The leader organizes the session. He allocates to each member of the group a speaking time to explain what he has made during his personal study. He backs up the dispatches of the session prepared by the group during the previous session. At the end of the session, he assigns the work to each student in the group for the next session with a "who do what" paper. The scribe takes place close to the blackboard (there is one blackboard by group and two groups by room). He writes on it all important information to progress in the project. The secretary makes the report of the session.

On the teaching team side, at the end of each session, a meeting with designers and tutors allowed to gather the impressions of the tutors, the progress of the students in order to prepare the next session.

## 3. PROJECT TOOLS

The subject of the project is the same for each group, but leads to different solutions. This year, we had 18 solutions for 18 groups. From a technical point of view, the aim of the project is not to apply specific techniques but to discover the role of the main devices in a complex telecommunication system and to grasp the complexity of engineering problems, hence of the matters that are taught in our engineering school.

To be more specific, a global mission is given to the students by a virtual company (an actual lecturer plays the role of the director of this company), under the form of a need for a new service linked to the GSM system of mobile phone. The students have to study the feasibility and the profitability of this new service.

Intermediate missions, focused on specific subjects are also proposed, in order to force the student to learn specific themes like antennae for mobile communications or pictures transmission. During a tutored session, each student accounts to the others what he has learnt during personal study. They have to produce reports at each

intermediate mission and, at the middle of the project, a pre-report followed by an oral presentation.

We also use the fact that we have 2 groups in the same room : during one session, the groups present to each other their solutions. This allows the students to become conscious that one problem has not necessarily only one solution.

During the project, all students work with the BSCW system, a partnership workspace. With BSCW, the students can share documents. They are informed of all relevant events in the shared-workspace. This kind of tools is very relevant for this kind of project because each student can work individually, write a report about his research on BSCW to make it available to all. The sharing of the knowledge is then eased within the group.

The evaluation is performed at the end of the six-month period ; it consists of a report (weight : 3) – in which the technical aspects and the French language are evaluated-, an oral presentation (weight : 4) and in multiple-choice questions exam (weight : 3). Note that a grid is being created in order to follow the transversal learning (such as the written and the oral presentations) in order to facilitate the self-training of the students.

#### 4. ASSESSMENT

For the teaching team, it was a new and rich experience. For the tutors team, the mission will be to trigger self-analysis among members of the group (definition of the role and responsibilities of everyone inside the group, adaptability and autonomy of students). A tutor helps students identifying the learning process (what was learnt, how it was learnt, and how it can be applied again to another context). He does not make a course. In the project, the role of a tutor is to demonstrate to students that they should be able to perform projects through self-training. It is not inevitably easy because tutors are also and before all teachers. A really positive point is the many interesting contacts and swaps between tutors. Effectively, tutors belong to all the departments of the school (data processing, microwave, electronics, networks, economy, English, ...). Therefore, it was very beneficial to work together, especially in a project where one of the main objectives is the discovery of a complex telecommunication system.

On the students side, it is difficult for us to validate this first experiment but with regards to the sensations obtained this year, we are clearly optimistic on the future results. Furthermore, many of them have taken advantage of the project in a few theoretical courses results.

#### 5. CONCLUSION

A 14 weeks period in a large scale project context is proposed to the incoming students in our school. The pedagogy is based on an active learning environment. In this first project, the product to be created is not the primary goal. On the other hand, the method to focus to a solution is important. It allows to prepare students to group working and inter-disciplinary context. It involves trained-tutors to follow and to help students within their groups and experts to give responses to the theoretical queries of the students.

For the next year, we envisage to be more accurate in the text of the global mission and in the text of each intermediate missions. Each session will be defined in term of pedagogical objectives (what was learnt and what was done during the session). The expert meetings shall be more measurable to improve the learning. The bond with the courses in the technical and economical domains (informatics, electronic, data communication, economy, networks) will be improved.

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