

LEARNING ENGINEERING ETHICS BY DEBATE

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Key words: ethics; engineering education; science, technology and society (STS).

Summary. In this communication, the authors aim to describe their experience in a couple of optional STS courses taught at the school Telecom BCN (ETSETB) of the Universitat Politècnica de Catalunya (UPC). The first one is about the macro-ethics area of technology and society, while the second one focuses on the micro-ethics area of professional responsibility. Both courses are based on the active participation of students in the classroom, mainly through the use of debates, where opposed viewpoints have to be argued. The paper is especially focused to the debates carried out by the students about cases of ethical conflict.

1 INTRODUCTION

As the complexity of the technology and its ability to transform nature and society is continuously increasing, the responsibility of the engineers becomes more and more apparent. This fact is stimulating the existence of many debates, committees of ethics, codes of ethics, etc., which are especially focused to environment and genetic engineering but also to other areas like information technologies. That growing interest in ethics of science and technology and, at the personal level, in the professional responsibility of engineers, is also entering the university classrooms (see e.g. [1]-[2]).

The authors, who are professors of technical disciplines, are currently teaching two optional Science, Technology and Society (STS) courses at the BCN Telecom School (ETSETB) of the Universitat Politècnica de Catalunya (UPC). Those 3-credits courses resulted from splitting a previous 6-credits course that had started in 1994. The first one, *Technology and Society* (T&S), is about the wide macro-ethics area of STS, while the second one, *Technoethics* (TE), focuses more on the micro-ethics area of professional responsibility of the engineer.

Both are optional courses which belong to the curriculum of the Telecommunication Engineering degree (similar to the Electrical Engineering curricula from other countries), but up to 5 students from other engineering curricula can also enroll on it. They are one semester long (14 real weeks), offered in alternate semesters, and with 2 hours per week of class attendance. The classroom is a meeting room with a large table so that all the students and teachers can sit around it. There is also a screen for projection of movies and slides. An additional room is available to allow splitting the group in two subgroups when it is needed.

The courses, which accept up to 20 students, are based on the active participation of students in the classroom, mainly through the use of debates, where opposed viewpoints have to be argued. Movies and documentary films are also used to foster discussion, and, in the TE course, a case-study methodology is largely used. Every year the courses are evaluated by both the participant students and teachers as a positive learning/teaching experience, and particularly the practice of argumentation and dialog is considered very important for the learning process.

In this communication, the authors want to describe their experience with both courses, and especially the debates carried out by the students about cases of ethical conflict.

2 AIMS, CONTENT, METHODOLOGY AND PROGRAMME OF THE COURSES

Both courses share the aim of helping students to reflect about the social and environmental aspects of technology by using a highly-participative methodology. In this way, the students improve their knowledge of the relation between technology and society, and become more aware of their mutual interactions, something that is rarely done in the other courses, nearly all technical, that are offered to them. In the TE course, a main goal is also that students become more aware of the involvement of ethics in the daily engineering practice. In addition, the students of both courses have the chance to practice and further develop their capacity of argumentation and discussion, and also their communicative skills. In fact, these kind of non-technical courses make the use of debate possible and useful. In consequence, the students find in our two courses a learning scenario which is quite new and challenging for them.

2.1 The *Technology and Society* course

The T&S course aims to the inter-dependence between technology and its social (and natural) environment. The first part of the course deals with science, technology and society in a general sense. Then, in the second part, the interest is shift to the particular case of information and communication technologies. As a strong activity point in the course, the students have to do an essay, in teams of two, that is presented in both written and oral forms.

The course starts with a presentation and a debate based on a documentary film (*Visions of Heaven and Hell*, in the last year), to show diverse opinions regarding the value of information technologies. After that motivational class, the idea of progress and its relation with the technical development are discussed. A questionnaire is made available to students in the UPC virtual campus before the class in order that they start to think in advance about the topic they will debate during the class. The answers given by the students are also useful to start the debate class. In that class, the teacher or teachers act as moderators and they usually ask the students to play in the debate the role of defending one of two opposite positions, and also to change to the opposite position at a given time. The methodology for debating will be explained with more detail in section 4.

The second main theme in the course is about science and technique: historical development, scientific knowledge, and technoscience. There is also a questionnaire for the

students, a lecture that is based on the answers to that questionnaire and uses a participative methodology, and a posterior two-hour debate session, which is fostered by previously watching together a film (*Fat man and little boy*, in the last year).

The same pattern is followed in the third and fourth main themes of the T&S course. The first one is about technology and society. Here, the emphasis is put on the technological change, the values of our society, and the political management of the technology. A film is also watched (*The China syndrome*, in the last year) to foster the posterior debate.

Finally, the fourth theme is about information and communication technologies. In it, the various aspects of the information society are considered: technical, economical, cultural, law and ethics. In the last year, the debate has been focused to the privacy issue (the film used was *Minority report*).

The essay is carried out in teams of two students. The written document has to follow the typical layout of a paper from a technical conference: title, abstract, introduction, etc; with a 4-pages 2-column format. The oral presentation uses to be carried out in a workshop style and a poster format, provided that the number of students is large enough; otherwise it is done as a 15 minute-long slide-based presentation. In the last edition, the subjects chosen by the students were: transgenic food, climate change, nanotechnologies, technologies for the 3rd World, and T&S after 9-11.

2.2 The Technoethics course

The TE course aims to the ethical aspects of the engineer profession and, in particular, to the social responsibility associated to it. The main specific concepts used in the course are just a few: profession, values, moral dilemmas, and codes of ethics. However, these basic concepts are not common background at the beginning of the course. In fact, in a poll carried out during the first class, the students have showed us that some of those concepts are less familiar to them than it was expected by us. Concretely, the term "code of ethics" is largely unknown; a moral dilemma is considered more a conflict between the own conscience and a duty imposed by something external to oneself, than a conflict of values; and the ethos associated to a profession seems to be almost missing in their awareness.

As a strong activity point in the course, the students have to prepare and lead, in teams of two, a debate of their classmates around a case of ethical conflict in the professional practice. Those debates, which take place during the second part of the course, will be particularly considered in the next section.

The first part of the course consists of an introductory 4-weeks-long period followed by 2 more weeks of classes that are in common with the T&S course, which will be presented in section 2.3. During the initial 4 weeks a first contact is made, using an interactive class format, with the basic notions mentioned above (profession, values, ethical conflicts and codes of ethics), and with the practice of argumentation, just to set a common ground where to build the debates that take place in the second part. That is initially motivated with the study and debate of a case extracted from real-life of a recent graduated engineer from our school, and the film *Incident at Morales* [3].

The real-life case shows how the realization of a technical project evolves when

unpredicted situations and human factors arise, and how the ethical values of the engineer are involved in professional situations which are quite ordinary. In addition, it includes an ethical conflict between quality of service given to the users and privacy protection. Working in teams of 2 or 3, the students discuss in class the various aspects of that case; then, the conclusions and arguments are brought to the whole group. The teacher acts as stimulator and moderator of the debate, and also introduces in it, when appropriate, concepts or short texts from books and codes of ethics (especially the IEEE's one [4]), which may help to set up the aimed common ontology and terminology.

Incident at Morales is a film, around 40 minutes long, that has been specifically designed by the *National Institute for Engineering Ethics* [2] to teach engineering ethics. It was produced in English, but it comes with subtitles in several languages, and other material that can be used to guide its use in the classroom is also distributed from the webpage [3]. In our course we spend two 2-hour sessions to watch it and to debate.

2.3 Common to both courses

As it has been explained above, the teachers use a similar methodology for both courses. Also, in their evaluation of the students, three same aspects were taken into account by the teachers in both courses: essay or case preparation&debate (60%), active participation in class (20%) and class attendance (20%). Peer evaluations are made by the students at the end of each presentation/debate and they are used by the teachers in the evaluation of either the essay or the case preparation&debate. Additionally, in the last class, the teachers request from each student a self-evaluation (about the strong and weak points of either the essay or the case preparation&debate) that is also taken into account in the final evaluation.

Additionally, during the last class, a poll about the course is anonymously answered by the students in both courses. It will be reported and commented in section 4.

Apart from that, there is a small portion of classes (two 2-hour sessions) of each of the two courses that is shared with the other course, in order that students who only attend one course (most of them) are also aware of the main issues involved in the other course. Concretely, in the last edition of the T&S course, the film *Incident at Morales* was used for two debate sessions, aiming to raise the student awareness of the involvement of ethics in the ordinary engineering practice. And in the last edition of the TE course, both the documentary *Visions of Heaven and Hell* and a couple of dissemination videos about emerging information technologies (related to the ambient intelligence notion, and produced by the EU project CHIL [5]) were used to broaden the perspective of the students, by bringing to the class the subject of ethics in technology development.

3 DEBATES LED BY THE STUDENTS IN THE *TECHNOETHICS* COURSE

In the second edition of the TE course, that took place the last semester (autumn 2007), 20 students initially enrolled in the TE course, all coming from the Telecommunication Engineering curriculum. Three were foreigner students participating in exchange programmes; one of them dropped from the list after realizing the language difficulties for

debating. Actually, Catalan is the most used language in class, but Spanish is also employed by a few students; in most cases, everybody can understand both languages, but in that last edition there was a South-american student who could hardly understand Catalan at the beginning, a fact that did not obstruct his progressive involvement in the course and his lively participation in the debates.

3.1 Study of the case and preparation of the debate

The second part of the course consists of debates about cases that had been prepared by the students themselves. The whole class group is split at the beginning of the course in small teams of two students (or three, if necessary), and each team prepares a case according to some specific guidelines given by the teachers. The students are requested to either look for or invent a case of ethical conflict in professional practice involving several actors, preferably related to engineering tasks. The topics chosen by the students in the last semester were diverse:

- Relation between mobile telephony aerials and real cancer cases in a primary school. Case that appeared in Spanish newspapers.
- Internet censorship in the People's Republic of China. The Google's case.
- Security of a control software for use in public health related facilities.
- Secure transmissions of confidential user data.
- Safety of a building structure and confidentiality of the technical report.
- Cultural and social conflict in cooperation activities for a less-developed country.
- Obligations of a student with a company beyond its internship contract.
- Liability related to a mortal accident caused by a TV antenna tower collapse.
- Bribery related to confidential information and illegal sale of material.

Three of them were real cases, either taken from the mass-media or from the own experience. Often, the fiction cases closely followed real-life situations (like occurs in the above mentioned film *Incident at Morales*). After agreeing with the supervisor (teacher) the topic of the case, the student team is asked to analyze the case according to the following guidelines: First of all, describe the case, the involved actors and their positions and attitudes. Next, determine the norms or laws that apply or could be applied to that case; look for the underlying values (especially those related to science and technology); find the possible moral dilemmas; confront the case with relevant articles from codes of ethics of engineering societies; and analyze the consequences of each position or decision. In open cases, the student team is asked to look for a decision creatively and argumentatively; on the other hand, if the decision is already given, the team has to look for arguments. Finally, the team is asked to think about and answer, if appropriate, three questions from the ones proposed in [6] as action evaluation tests: 1) what would professional colleagues say?, 2) what if everyone behaved in this way?, and 3) how would this choice look in a newspaper?

Before starting the period of case debates, each team had to deliver to the teachers an essay about the case with a succinct and clear description of it, the analysis done, and the

preparation of the debate session, explaining in detail its format, i.e. presentation of the case, dynamics of the discussion, roles to be played by the students, decisions to be taken, etc. Once a week, two teams presented their own case, simultaneously, in separate rooms, to the rest of the class, which had been split in two groups. The members of each team chaired the debate, acting as both stimulators and moderators.

3.2 Methodologies used in the debates

When the number of students is too large, like in the last edition of the TE course (19 students), to allow that everybody can have several participation turns during the debate, the class is split in two groups, and a teacher is assigned to each group. Attendance rate was very high, so a sufficient number of students participated in all the debates.

A common practice of the chairing teams concerning the dynamics of the debate was to split the group (half of the class audience) and assign to each sub-group (usually 2 or 3 people) the role of one of the (usually 3 or 4) actors or postures involved in the case. Students playing each role gather and take a few minutes to prepare the argumentation before the debate starts.

Another common practice consisted in presenting the case by parts, so that the information was gradually introduced and the changes in the opinion of the participants on the basis of the available information could be perceived. In a large number of debates, the IEEE code of ethics and other codes were brought to the debate by the chair team in order to be consulted by the participants.

In order to avoid the lack of student participation, the chair team usually decided to ask all students for individual reflections and opinions, and succeeded in it. One of the chair teams limited the response time to 30 seconds to guarantee a concrete, concise and impulsive answer. In these individual reflections, the participants were usually asked for a personal opinion, whereas, when using the role playing method, usually the roles were assigned arbitrarily by the chair team.

A less common but successful practice – according to the students’ posterior comments – was to “force” the students to defend a position contrary to the one they had been defending so far. In one of the debates, for example, the students had to pass a ball to one of their partners, and once they got the ball, they had to defend the position opposite to the previous one, so that they did not know which posture they were going to defend until the last minute. This was a useful practice, since it obliged the students to analyze the case from different points of view. Actually, we think that students learn the most if they have to defend the position that is farthest away from their own opinion.

One of the teams initially requested from each participant an analysis of the ethical values related to the case, and those chair students led the debate on the basis of the values found by the participants. Another team divided the whole group in three small groups; one of the groups took the role of a judge, and the remaining two had to confront different postures. At the end, the judge had to return a verdict.

During the debates, the teachers usually act as spectators of the debate. If they think it is appropriate, they give to the students a criticism of the development of the debate, both in

terms of content and dynamics. Indeed, this could also be done by a student team. However, we have realized students do not like very much that only a few of them play the role and the rest are passive attendants. At the end of each debate, every participant student answers a questionnaire in order to evaluate the task of the members of the chair team in terms of both case preparation and performance in the debate.

3.3 Manifesto

In the last TE class, and as a conclusion of the course, the whole class group discussed a proposal of manifesto drafted by one team (the one with three members). This was made in both editions of the TE course. The draft proposal had been written as a very long list of duties, mostly extracted from articles of codes of ethics. After discussion and voting, many articles were removed, other were merged, and other were rewritten to include all the modifications agreed by the big group; at last, only 9 or 10 articles were kept. We have observed in these two years, that the approved manifesto is strongly dependent on the sources used for drafting it and on the specificities of the preparation team. For example, in the first year a point about genre discrimination was included in the approved manifesto, and this was correlated with the fact that the drafting team was composed of the only three females attending the course. Once approved, the manifesto is uploaded to the course webpage. An English translation of the first manifesto can be found in [7].

4 CONCLUSIONS

As it may have been made clear in this communication, the teachers do not think there are *good* and *bad* answers to questions, and they do not give *their* answers to the questions that arise during the classes. Actually, we do believe that, regarding ethics, students learn the most from contrasting opinions with their own classmates.

Most of the students enrolled in the courses show from the very beginning a noticeable degree of involvement and participation. Unfortunately, the number of students that take advantage of these courses is quite low, less than 10%. Actually, these courses can not be easily extended to all the students since the debate-based methodology requires small groups, and because optionality allows to have motivated students; nevertheless, many of them confess at the end of the semester that both the schedule constraints and the possibility of having 3 credits without doing final exam were strong reasons to enroll in the course.

During the last class, an anonymous poll is carried out. Summarizing the answers, we can say that the participant students evaluate the learning experience very satisfactorily. Actually, our curriculum has very few courses that lie in the intersection between technical and social or human disciplines. They confess they had been "positively surprised", because initially they did not expect a so high degree of student participation and interaction. The practice of argumentation and dialog is considered a very important exercise for their learning process. And, they are happy because the course –they say– "has been so enjoyable". In the TE course, they also value very much the fact of leading the debates.

Additionally, in every poll they make some suggestions for improvement. For instance, they always say that even less time should be spent by teachers with "theory", that only a few classes should be spent with unavoidable theoretical background, and those classes should be even more practically oriented. When we ask them if they would recommend the courses to their study mates, they mostly state a clear "yes". However, they show some reluctance to make the courses obligatory for all the students, since they are afraid the low degree of involvement of the students with low interest would make difficult to reach the current level of achievement with the other more motivated students.

We would like to see the time when the faculty members of our technical curricula think that it is worth to devote a meaningful portion of the learning time of our students to the social and human aspects of their formation as engineers, and they realize that courses or activities from that area have the additional advantage of allowing the use of alternative learning methods (e.g. debates) which are very effective for acquiring the required (and praised) communication competences. Actually, the "sociohumanization" of the technical studies does not need to be enclosed within specific courses. Conversely, the authors think that it would be even more effective that the technical courses themselves include learning activities that, being related to the content of the course, are similar to, or have the same goals that, the ones described in this paper.

5 ACKNOWLEDGMENTS

The authors want to acknowledge and thank the contribution of all the enrolled students to make the teaching experience so fruitful and satisfactory. And we also want to thank Sonia González, who kindly allowed us to use her real-life case of engineering practice.

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