DESIGNING AN ETHICS COURSE IN A BOLOGNA ENGINEERING MASTER

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Abstract

Our objective is to contribute to the education of the engineer as an organizational responsible element, able to understand and measure the consequences of his/her actions, conscientious of his professional decisions. This simple formulation, however, hides a background of complexity that does not become easy to identify, formulate and solve. Students can develop an ethical consciousness, usually becoming aware of ethics, but this awareness is usually fragmented. And one cannot have ethical thinking only in certain contexts and circumstances. In a world of mobility and dynamic relations, using communications networks and processing time, the engineer is exposed to crescent integration of information, as well as to increasing speeds of communications and translations. Two very strong reasons to develop an ethical mind. Today, more than ever, we do not know what the future career (is that a career? or young engineers just jump around crescent attractive jobs?) of our students will be. So, what we are trying to achieve in this paper is to raise awareness and an ability to reason, taking into account ethics for the students as a whole in their life'. Designing a structured attitude to ethics. More than thinking in the content of a course we are traveling in ways in which the content is a consequence of the course practices. Content is structured in a bottom-up approach, within a constructivist mind-set, never being dogmatic. Content emerges from practice and is not a pillar of the course subject. We use three aligned methodological approaches: Actor Network Theory (to better formulate end problematize our settings), Bologna Framework (to go to the roots of a conceptual learning breakdown), narrative, as a storytelling constructivist way to reason and explore our reflections. Within this qualitative and exploratory frame, our conclusions are mainly pointers to the future, to what can or could be. Our results are passage points, open to extensions and change, and they probably evolve and reform through experience.

Keywords: Ethics, Engineering Education, immutable mobile, obligatory passage point, border object.

1 INTRODUCTION

Is there a unique ethics for all persons and for all situations, in all spaces, from all sides? The question is not even the most relevant, but for the sake of curiosity will that be truth, or not? As usual, good questions are simple but also rise a level of complexity, a level in which answers are not easy, and surely not absolute, nor categorical. In our view with the lenses of Actor-Network Theory (ANT), ethics is an immutable mobile (IM) that travels through contexts and adapts without actually changing, without losing meaning, according to its basic conceptual foundations. An IM is something that can be interpreted in the same way in different contexts, but something that is not completely context-independent. For example, an e-mail, or money can be such a thing. The immutable mobile acts as the vehicle for producing and reproducing a domination order of things, Latour [27]. To understand the analysis we want to perform here, we need to lightly refer some other central concepts used by Actor-Network Theory. We already addressed the immutable mobile, so we now focus on boundary object (BO) and obligatory passage point (OPP), all these concepts are created or outlined in the ANT extended world, for instance BO was adopted from Leigh Star and James Griesemer [1], Gonçalves and Figueiredo [2], and Latour [3].

An unchangeable goal allows the development of negotiated partnerships that evolve according to the agreed-upon calculations (work), constructing meanings on which tacit agreement is reached. IM is something that is interpreted in the same way in different contexts. At a conceptual level, it is exactly what happens with ethics, which crosses contexts while maintaining meaning. The boundary object concept was introduced, as we already said, by Susan Leigh Star and James Griesemer [1].

An assertion of ethics based on the fulfilment of moral precepts does not help us on acting, on the practice of acting ethically. Dictated ethics (top down) does not constitute an operational and practical framework, a reasonable basis for practice. Ethics, like tacit knowledge, is action, it is not (most of the time it shouldn’t be) an application of concepts or codes. Ethics is a form of feeling, a way of understanding, a way of equating each action in its context and its consequences, a habit, Aristotle [4].
Aristotle classifies habits into three categories: (1) theoretical, or the retention of learning understood as “knowing that x is so”; (2) behavioural, through which the agent achieves a rational control of emotion-permeated behaviour (“knowing how to behave”); and (3) technical or learned skills (“knowing how to make or to do”). This scale is a form of situating performance. This form forces us to think of all the consequences of the actions and only then return (backtrack) to the decision about the action to take. It is a reflexive loop process, an action research procedure that represents something inseparable that is positioned at the heart of the ethical process. Ethics thus operate in four stages: identification (seeing), formulation (problematizing) and reflection time (judging) and a time for action (doing or not doing).

Dewey [26] argued that ethical inquiry is the use of reflective intelligence to revise our judgments in light of the consequences of acting on them. We can and must ethically evolve as elements of a society at the individual and collective level, Houdt and Schinkel [5]. This is one of the reasons for our proposal for an ethics curricular unit in an engineering master. We know that other masters would also apply, namely medicine, law, top management.

Ethics should be an obligatory point of passage for situated action (social, organizational, environmental, ecological, cosmic, sustainability...). Applying to all actor’s present (identified) in the network, it is particularly important for engineers. In a mematic way, if something goes wrong all network behaves wrongly. But let's look at the case of engineers. The proliferation of communication channels as well as technological advances in communication and processing speeds makes the ethical challenge increasingly demanding, Stahl et al, [6]. But within the framework of ordinary citizens there will be different demands on ethical responsibility. The one that does, the one that creates, tops of hierarchical chains, are examples of actors with bigger networks (greater responsibilities?) and who, as such, should try to achieve ethical excellence, or we should demand that from them. Maybe some mechanisms and processes need to be created so that society is able to demand this responsibility.

The engineer is someone who creates technology, someone who creates and develops technological artefacts, reason why it is considered to be an actor to whom greater ethical responsibility must be demanded.

It is in this broad context that this research arises and the purpose of this article is to explore the importance of ethics for engineers and to reason how to design (Poel) [7] an ethics curricular unit for a master's degree in engineering.

Our research question would be something like – we intend to speculate on a possible design, Bucciarelli [8] for an Ethic Master Course in an engineering degree, using an approach to facilitate both alignment and conciliation in the engineering education broad area, Elly Govers [9]. We begin by experimenting some ideas, exploring the conciliation of wills and addressing some ANT concepts in an articulated manner. After, using a Bolonha framework to design new curricular units we interweave the two frameworks and explore actions to be taken. Then we extend our ideas trying to explore a modus operandi. Finally, we extend again our modus operandi into an action proposal. This action proposal is very simple and intends to be mainly illustrative.

2 THE BOLOGNA APPROACH AND ANT, DESIGN AND METHODS

Rather than adopting problem solving as a model for theorizing learning processes in engineering practices and education, researchers on engineering education should view theory construction as sense making, Astley [10]. In our approach, valid for students, teachers, professional practitioners, and technologist we would translate theory construction into conciliation, as we need to integrate what and why, that is problem formulation, and problematization in ANT terms (Callon) [11]. These two processes reshape each other, in the sense they construct alternative realities that trigger innovation, they ‘socialize’, Nonaka and Takeuchi [12] between themselves and create knowledge. These alternative realities constructed by this “socialization of things” can be addressed as ongoing extensions and detours in pathways of evolution. We use the term socialization, coined by Nonaka, in an ANT way, that is, we are interested in the play of hybrid actors, not only human. Hybrid can be material, immaterial, laws, rules, policies, ...

The combination of innovation and learning in a context of engineering, formulating problems, constructing requirements, defining specifications, designing (Bucciarelli) [8] and doing things should explore conciliation and use reflective practices (Schon) [13]. Socialization is a key step in the knowledge creation process.

In fact, we may say that technology and society are two interwoven systems that reshape each other, Bijker, Hugues, and Pinch [14]. If we look at this interplay, we are able to understand things in a different
way. The attempt to conciliate these two realities is mediated by our knowledge, our filters, by the way we look at things (paradigms), the way we translate our “realities”, and finally the way we define our situation, or context for our action (situate action).

We need to design an approach to provide alignment of technology and society but for that effect we should not rely on an usual social network. Our approach favours the construction of actor-networks (networks of things) that interact constantly. Akrich and Latour [15].

Learning is a necessary actor in this system. But as John Locke said [16], “No man’s knowledge can go beyond his experience”, which means that we need to address knowledge as action, and not as a repository of concepts. Locke also alerts to the fact that you learn by doing, by reflecting on what you do, the way you do it, how and why, the errors you commit. Learning is an integrative process, that travels in networks, is driven by purposes, and allows sensible action. This “virtuous cycle of knowledge” imposes that practice brings people and things together, instigates this ‘abstract socialization’ and facilitates the construction of new knowledge that in turn improves the ability of doing things better, Le Moigne [17].

The actors enrolled in our network are teachers, students, developers, researchers, users, learning systems, companies, organizations, regulations, laws, tools, administrative policies, and policy makers to reference only a possibility and give an idea of the heterogeneity addressed.

ANT supports relations with material (relating things) and semiotic (working with concepts) without distinguishing between them. There are no either/or situations, all things are integrated and conciliated.

From an actor-network perspective, every innovation involves a reconfiguration of the actor-network of actors through the enrolment of new actors and the discard of others. Innovation means translations crafted in the interacting of social and natural processes (things), playing with displacements of content and context, in ways that change practices and create the new. In this sense innovation is a complex process of co-evolution/co-production. Just as new ideas and concepts have to be inscribed into materials, practices, or products to make them durable and mobile, new technologies have to be translated into artefacts in order to gain sustainability, and new practices inscribed in behaviour and processes to establish standards.

3 METHODOLOGY

We discuss in this section two assertion: the generic the methodology used in conducting our research, our inquiry, and then the concrete methodology for the creation of a Bologna curricular unit.

We use a narrative strategy in an interpretive approach constituted by a storytelling methodology, Bakar et al [18]. With this narrative strategy, we have the great advantage of never fragmenting the whole into parts, quite the contrary, we are able to give the parts a whole. We make sense of what is going on with the parts, people, things, systems, and contexts. This narrative strategy allows a systemic approach, a contingent understanding and harmony of the whole. In addition, engineering is an activity in which data is often perceived without (enough) context and as such, using forms of contextualization, situating action, can represent an advantage, if not a necessity. The narrative can also be a method of mediation, which both in the exercise of the investigation and in the exercise of the practice can be extremely opportune, considering the options that have to be taken, Moon, [19]. These are some of the reasons why we consider this methodological/strategic approach appropriate for this investigation.

Situations such as developing competences per se and, for example, learning to acquire competences, are two completely different facets of learning. Following the methodology proposed by Bologna, the process of designing a new curricular unit should not follow the traditional approach (cantered on the teacher/teaching). Rather, it must follow an inverse process that starts from what is intended to be obtained, the learning outcomes, Taylor [20], and associated competencies. It is a process in "reverse engineering" that starts from the objectives to be achieved in relation to the academic level of the student, or the class. This process is cyclical and evolutionary as Brundiers and Wiek [21] states, and should basically consist of the following steps (Program Design Based on Learning Outcomes) that articulate in a scaled manner, in a behavioural approach to education.

Following this approach, we should define the following list of main concerns.

- Aims (General Purposes)
- General Competences to be developed
- Subject Specific Competences
- Define overall learning outcomes
- Decide how they can be assessed
- Monitor results obtained by students
- Iterate above steps to improve

The methodology to create a new curricular unit establishes that one must start from the general objectives (aims), one must identify, according to the level of the course (in this case second cycle, master’s degree), the description of which competences should be learning outcomes, the criteria and assessment methods that should be defined in conjunction with the teaching strategies (form) and then define the content with a description of the subjects of the program.

At the beginning of this process the objectives depend on the descriptors of the level at which the curricular unit is inserted. Like any process, this creation process must also be evolutionary, in the sense of seeking constant improvement, with cyclical iterations that somehow resort to the double loop concept, Argyris and Schön [23]. In fact, once the curricular module is conceived, the objectives, learning outcomes, evaluation criteria and teaching strategies, themselves already purified, (that means objectives, strategies and values) ... allows you a moment of relax and calm without change, see Figure 1, extracted from Moon [19], beginning another cycle is always possible and inertia shouldn’t be pervasive, Goldratt [22].

Regarding the levels of understanding on the part of the student, we can consider several acting levels: procedural; conditional; functional or declarative, which is the most common - from the principle that what the student says represents his knowledge. In our case, with ethics, we aim to reach goals beyond the declarative level and absolutely reach the level of functioning/action, but this also depends on the level at which we operate and as such on the descriptors of these same level. The appropriate competency building model in our case is an open content, in which the student is supposed to have a critical attitude towards what is proposed to him, and must develop a contextual reflection on the application of the knowledge that he is building. The students must also seek to get results and projects of his own or his own community, in collaborative practices. Here the importance of group work, group projects, exploring the component of team organization with internal communication (within the team) and external, with the remaining students of the course attending classes. This also raises the awareness of the level of performance through shared practices and discussed shared assessments. As far as knowledge and understanding are concerned, they must be supported by texts linked to research, at the frontier of knowledge in the respective area, in the case of ethics, borders can extend through personal, professional, organizational, and corporate topics.

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![Figure 1 Basic model for granting a curricular unit design, Moon [19].](image-url)
What would be an OPP in our network? Something that forces the actors to converge on a certain behaviour, a certain practice. It could be a formal ethical interpretation/practice that obliges all actors in
the network. You need to pass through these points in order to calculate, that means to be displaced in
the network. And an immutable mobile (IM)? Information passes along the networks using IMs, actors
whose form and function remains stable across different contexts and places. In its specific circulations
influences others. And a boundary object (BO)? What would that be? Something that travels in
the network and everybody recognizes but sometimes with different meanings, understanding how the
various actors involved can cooperate, despite having different and oftentimes conflicting interests.

It is our duty to identify possible referents for these three actors. Make them circulate in the network
and design narratives teachers can explore with their students. Doing that we are in the core of a course
that is not about content, but about form and behaviour.

4 CONCLUSIONS IN OPEN NARRATIVE

Ethics is something that lays in practice, in society, in real experimentation, in every possible translation.
An introductory discipline to ethical practice must, as far as possible, be situated in this perspective.
That is, the curricular unit cannot be developed around the content, but, above all, around the objectives
and consequently of the form. The concepts, mechanisms and models applicable in the practice of
ethics can be known (content), but it is fundamental to conceive ways to organize and structure them
as a framework for practice (form). The ethical building is traditionally organized vertically. For the
engineer, however, it is fundamental to see it in a different way, in a horizontal way, the way in which
the processes are inserted.

Starting with the objectives, general purpose that justifies the creation of this curricular unit, we have
already said the main one. Traditionally, schools were formative in their scope of activity, later it was
understood that they should be formative only in the initial cycles of learning and that, in a master's
degree, they would cease to be formative. It was assumed that the master's students were already
"educated" so the essential thing was to learn concepts and tools, on a basis not necessarily framed by
a social purpose, not even a value purpose, not even a purpose of needs. Obviously, this view had
negative implications for behavioural adjustment, social education, and student socialization strategies.

Thus, we understand that this curricular unit, like any other at the level of a master's degree, should be
concerned with the concepts, the framework of reflection, the models, but also with the practices,
behaviours and the consequences of these practices, which means interacting with contexts.

Regarding the competences that the course unit should provide, or facilitate, we would say that it should
focus on the heart of the learning idea itself. We mean that if ethical awareness is a result of learning in
this curricular unit, then students, through trial and critical thinking, will be able to educate their ability to
acquire skills, roughly and in a generic and transversal way. In a more specific context we refer to the
ability to know how to listen (knowing how to listen to what colleagues or other stakeholders have to
say), the ability to know how to ask about essential aspects and issues, how to feel the specific nature
of the context. Also, the experience of the debate is fundamental, it exercises not only the rhetorical
strategy but also motivates the students to the subject under discussion, exercising the mental agility
and compelling to hear and to answer different points of view, fighting to define positions, Brookfield and
Preskill [24].

The so-called learning outcomes are above all a specific definition of what we have said so far, they are
the result of a clear and rigorous definition of scope. We would say that in this case it is a question of
solving complex problems (with interrelated social and technological interactions) in such a way that the
systemic variables are all included and the decision can reach a level that is complete (system, in its
operational, social and environmental) Davis [25].

In the case of a curricular unit in which group environments (teams) are to be explored around issues
that reflect ethical dilemmas, the evaluation must have individual and group components and the group
relationships must have a significant weight.

Assessment and monitoring of student activities is difficult, as they should be applied over constant
monitoring, and that is unfeasible.

The structure of work should favour cyclic reflection, progressive and continuous refinement, that is,
after a refinement cycle, lessons learned must be incorporated and, with critical distancing, a new cycle
should be executed.
With this approach, we can systematize the exercise of several factors, Brookfield and Preskill [24] that must be taken into account in our reflection-ethical action: cognitive factors, social factors and physical factors.

Cognitive factors, such as determining and communicating learning objectives, planning strategies, asking consciously and in an innovative way (that is, seeking to advance through the new unknown rather than confirming the known), define the direction of the circle of reflection.

Social and emotional factors, such as demonstration of relevance, encouragement of active participation, signalling the importance of quality participation, evaluation of the action and discussion of positioning and framing it.

Physical factors, such as the definition of the setting, the correct situation of the problem, working directly in the working conditions, defining the rules of operation.

Specifically, the teacher has to define and work in the space of action (situated action), room conditions, devices that will be used in audio-visual terms, definition of group rules (valid for groups that are formed and for building the groups), and community rules (valid for all groups and all students in the curricular unit). Part of the rules are directed toward defining an objective, discussing the goal, and assuming, as a result, a consensual goal. The students help to define the objective of the curricular unit in the semester. The curricular unit can thus have different contents in different semesters. That is, the curricular unit dynamically changes according to (and because of) the students, keeping the rules, the objective, and the learning outcomes immutable.

REFERENCES


