Chapter 15
Eyes Wide Shut? Loyalty and Practical Morality in Engineering Education

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Abstract The relationship between technology and society may be conceptualized as a seamless web in a form of coevolution. In modern societies, this coevolution, which includes engineering design and related ethical issues, is largely a kind of social experiment. To prevent unnecessary problems, Martin and Schinzinger suggest that engineers should seek to act ethically. This chapter examines how engineering students develop, or not, ethical concerns and practices in their everyday work. It is based on a case study using mixed methods and focusing on students in mentor companies during their Master's degree program. The educational context is understood as a Mode 2 knowledge production representing a triangular relationship between the student, the university supervisor and the mentor company where power and authority are distributed and shaped over time. Moreover, the student's role is conceptualized as being a legitimate peripheral participant in engineering practices and consequently in the enactment of practical morality. The students work on problem-oriented projects and deal with complex decision-making processes. Having to face the constraints and limits of real-life project development in an organization, they struggle within a web of technical knowledge, loyalty relationships to various actors, norms, and regulations, as well as market demands. These tensions, and their related trade-offs inherent to quick decision-making, leave little space and time to reflect on ethical questions. Nevertheless, one can trace moral concerns in the students' processes during their studies.

Keywords Student mentorships • Mode 2 knowledge • Engineering ethics • Practical morality • Curriculum

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Introduction

The work of engineers has often been described as creating and developing tools and techniques which are then used throughout the real world. In Martin and Schinzinger's (1989) book *Ethics in Engineering*, this process is presented as a form of social experiment: the work of engineers leads to innovation and technological artifacts whose applications and uses have consequences for society and the environment, but these consequences are not as equally well understood. Results can arise which have not been foreseen and which give the entire process an experiment-like feature. Consequently, engineers are asked to identify and reflect upon the moral and ethical consequences of their knowledge production to prevent "bad" use of their results. Martin and Schinzinger identified a number of necessary characteristics for engineers that enable them to act ethically in their everyday practices. However, technology development should not only be seen as taking place within laboratory walls under strict controls before being launched on the market. Authors in the fields of science and technology studies have argued that there is no unequivocal link between technology and development (e.g., Bijker et al. 1987). Besides, technology itself is the product of social and cultural forces. The relationship between technology and society may best be conceptualized as a seamless web in a form of coevolution. In modern societies, this coevolution is largely an open-ended process and thus partly unpredictable. As such, moral and ethical issues cannot only be described as the responsibility of a single individual or group of actors but are also shaped and defined in different contexts by all the actors taking part in the development, production, and uses of technology. Researchers agree on the necessity to reflect on ethics in particular contexts. Lynch and Kline (2000) emphasize that ethics should be studied as part of the socio-technical aspects of engineering taking place in real-life settings and by paying specific attention to "the complexities of engineering practices that shape decisions on a daily basis." Accordingly, we delimit the specific context in which these ethical issues are embedded and become sufficiently challenging for reflection. Here, our context is a Mode 2-based MSc in Engineering program where students work in a mentor company for two days a week. Based on a case study focusing on the students acting in their company, this chapter seeks to understand how and under what circumstances these students show ethical concerns or reflection during the two years of their master studies. Do they close their eyes or do they act? Kubrick's male character (Dr Bill Harford) in the film "Eyes Wide Shut" faces the same choice, yet he is also caught in a complex social game as our students appear to be in their companies.

The chapter draws on community of practice-based learning theory, in particular the notion of legitimate peripheral learning which describes the development of an apprentice when entering a new work community (Lave and Wenger 1991). The social experiment discussion is revisited further with respect to the mentor context in order to describe the position and development of the students.

The chapter is structured as follows: First, we describe the MSc in Engineering study program as embedded in a Mode 2 production of knowledge. Second, this is

developed into an understanding of the student as a legitimate peripheral participant in two different communities, namely, the company community and the academic community, both of which have specific understandings of what engineering is. Third, we describe some characteristics of engineering ethics using the social experiment approach of Martin and Schinzinger as well as a presentation of the notion of moral practices. Fourth, we present the findings of a case study in which we focus on experiences from engineering education. The aim is to challenge the arguments developed in the theory using these practical examples. Finally, we conclude on the circumstances of raising ethical concerns and the possibility of taking a decision to act.

The Context

Our context is an engineering Master of Engineering degree program offered at Aarhus University, Herning. The setup is a tripartite arrangement combining a study program, a mentor company, and a university. The MSc in Engineering takes place in collaboration between a student, a mentor in a company, and a supervisor from the university, commonly referred to as a mentorship. Traditional university education, including engineering, can be said to be embedded in Mode 1 knowledge production. Mode 1 is a rather closed knowledge system managed by canonical norms and collegial authority (Gibbons et al. 1994). In contrast, Mode 2 knowledge production is found in open environments that are dynamically interactive with outside social interests. Such knowledge production will, according to Gibbons et al., be application-based, transdisciplinary, and heterogeneous involving socially distributed knowledge encompassing reflexivity and accountability and new types of quality control (Gibbons et al. 1994; Musson 2006). It may be argued that contemporary engineering education in general is far from matching those defining characteristics. Our more modest point is that when looking at the role of students enrolled in our MSc in Engineering degree program, the interplay in the tripartite constellation can be viewed as a Mode 2 production of knowledge (Gibbons et al. 1994; Nowotny et al. 2001).

Gibbons et al. suggest a rethinking of the university-company relationship, seeing knowledge increasingly as a coproduction between universities and companies rather than merely a university undertaking. Thus, the space for research has moved into a more nonphysical "in-between" space in their coproduction of knowledge. Nowotny et al. (2001) develop this further by discussing the "agora" as metaphor for new spaces for multiple actors in knowledge production in spatial contexts disjoined from simple boundaries between universities, enterprises, and other institutions. Interestingly, Barley and Kunda (2004) conceptualize the commercial relationships around technical contractors in a somewhat similar vein when they note that knowledge workers effectively enter a bazaar when they sell themselves.

A characteristic feature of the degree program is that, in addition to two days of traditional courses and teaching at the university, the students work in a mentor

company the rest of the week, using the real work setting as basis for their practical and theoretical progression. The core of the MSc study program is innovation. The students must carry out projects that focus on issues, challenges, and opportunities of innovation for their companies. They define the framework and the objectives of their projects in cooperation with the mentor company and in compliance with the curriculum of the study program. Consequently, formulating projects relevant to company issues is primary. Here, the difference between other types of student placement, such as internships or traineeships, is apparent as these usually focus on the learning of everyday operational routines of the company.

We argue that the main similarity between our tripartite mentor organization and the Gibbons et al. (1994) and Nowotny et al. (2001) perspective is the emphasis on the need for multiple players in (attempted) purposeful knowledge coproduction activities in innovation processes and in joint projects. However, it is important to note that a research phase takes place within an educational context where the main collaborator is the student who is provided with a set of academic rules and demands which Mode 2 would usually not include. Musson also discusses this in her study of engineering education in South Africa (Musson 2006). However, as Mode 2 enables us to look at knowledge production as a problem solving process, engaging different actors with different backgrounds to be involved in the process of production, ethical questions are consequently not only dealt with by a specific group of actors, such as engineers, but are more widely distributed and discussed by all the actors taking part in the production of knowledge.

Now that we have defined the context of the social experiment, we can look at how the roles are distributed among actors.

Legitimate Peripheral Participation

In their various writings, Jean Lave and Etienne Wenger, as well as their critics, (Contu and Willmott 2003; Storberg-Walker 2008; Tennant 1997) provide a set of concepts which are useful for understanding our mentorships, since they focus on learning as a longitudinal process. To underline more specifically the role of students in the mentorships, we refer to the concept of "legitimate peripheral participation" (Lave and Wenger 1991). The notion was suggested in order to understand how apprentices learn in the workplace and as part of a community of practice. A community of practice can be defined as a group of practitioners sharing a concern for the work they carry out as well as learning how to improve this as they interact regularly (Wenger 2002). At the very core of the legitimate peripheral participation concept is an understanding of how newcomers are accepted and incorporated in a work context. Equally important is the appreciation of the intimate link between learning, knowledge and practice. It should be noted that Lave and Wenger do not propose craft apprenticeship as an institution to be reinstalled as a schooling instrument. Rather, they propose apprenticeship learning as a way to think of learning processes in educational contexts (Lave 1997).

In their initial conceptualization of legitimate peripheral learning, Lave and Wenger (1991) define apprenticeship as a process of becoming a member of a community of practice. By observing and sharing through peripheral activities, the newcomer becomes familiar with the tasks, vocabulary, cultures, habits, and organizing principles of a specific community (Lave 1997, p. 33). Through this engagement in a common structure pattern of learning experiences without being taught, examined or reduced to mechanical copiers of everyday tasks, they would become skilled and respected master craftsmen (Lave and Wenger 1991, p. 30). Lave and Wenger subsequently underlined the ambiguity, dissent, and dynamics of the learning and its context. Lave (1997) thus proposes to think of apprenticeship as "an improvised, opportunity and dilemma based learning process" (Lave 1997, p. 34) and Wenger (1998, p. 79) underlines how differences in interpretation occur and are negotiated in the construction of joint enterprise.

Both Lave and Wenger address the relationship which the peripheral learner might have to the community alone and together with other members. Wenger (1998) describes the negotiating of joint enterprise as "not just a stated goal, but creates among participants relations of mutual accountability that become an integral part of the practice" (Wenger 1998, p. 78). The peripheral learner is interwoven with an ongoing creation of negotiated preferences inbuilt in the joint enterprises and also, through the mutual accountability in the community, is expected to be loyal to its other members. Even if Lave and Wenger do not directly address issues of loyalty and ethics, the latter can be derived directly from their analysis of learning processes. It can be assumed that within the position of the learner and the community characteristics, loyalty and moral issues are embedded in the workplace learning.

When referring to the critics of the concept of legitimate peripheral learning, the issues related to loyalty become more complex, since the valorization of work process, the labor contract and the employment relations are seen to construe the position of the peripheral learner in their community (Contu and Willmott 2003).

The notion of a peripheral learner was extended by Star (1991) who notes that multiple marginalities might be the "curse" of the learner, being a member of multiple communities (here the company and the university) placing the learner in a high tension zone in-between accepted communities, negotiating rival allegiances: "at once heterogeneous, split apart, multiple and through living in multiple worlds without delegation we have experience of a self unified only through action, work and the patchwork of collective biography" (Star 1991, p. 26).

Here, however, the students are supposed to contribute to innovation in the company; thus, entering an even more liminal zone (Czarniawska and Mazza 2003) as the stability of existing work practices is to be broken down. The community of practice approach and the notion of legitimate peripheral participation therefore bring insights as well as having several limitations. First, the engineering students are not involved in a stable engineering culture or community of practice (Kunda 1992; Koch 2004). Rather, they operate on the edge of several communities. Second, the concepts of community of practice and legitimate peripheral participations have been rightly criticized for delivering a too rosy and peaceful image of enterprise collaboration and under-illuminating issues of power and control (Tennant 1997;

Contu and Willmott 2003). Tennant claims that situated learning theory, in its proponent's eagerness to depart from formal education, forgets the power issues linked to the learning situation regarding knowledge ownership and control. Contu and Willmott (2003) point out that years of research in politicizing processes of practice risk being lost in Wenger and his followers' harmonious notions, such as "joint enterprise," mutual engagement and shared repertoire (Wenger 1998). In this educational context, power and control, institution and conflict are ubiquitous.

Engineering Ethics

Martin and Schinzinger (1989, p. 26) define engineering ethics as the study of moral issues and decisions confronting not only individuals involved in engineering but also the various organizations dealing with their related practices. But their definition includes many more actors in society such as consumers, managers, scientists, lawyers and government officials who are also confronted with questions about moral conduct, character, policies, and relationships of people and corporations involved in technological activity. Further, they conceptualize social experiment as

> the framework for discussing various aspects of responsible engineering practice: imaginative foreseeing of possible side effects, careful monitoring of projects and respecting the rights of clients and the public to make informed decisions about the products which affect them.
>
> (Martin and Schinzinger 1989, p. 18)

However, Martin and Schinzinger (1989) acknowledge a number of pitfalls which are challenging and therefore condition the work performed by engineers. They recognize that there are many challenges to acting as responsible actors in their daily work:

> They include: the pressure caused by time schedules and organizational rules restricting free speech; the narrow division of labor which tends to cause moral tunnel vision; a preoccupation with legalities; and the human tendency to divorce oneself from one's actions by placing all responsibility on an authority such as one employer.
>
> (Martin and Schinzinger 1989, p. 103)

Therefore, the possibility to reflect on and identify ethical questions is not straightforward when engineers deal with everyday practices. Either they do not recognize the moral challenges embedded in their decisions or they see their own role as neutral and pass the task on to managers or politicians to engage with the moral debate and make decisions (Van de Poel 2001; Munch 2005). We call the latter mechanism "referral." Van de Poel and Van Gorp (2006) have pointed out that designing engineers when facing many external constraints deal with few ethical issues, arguing that especially in the case of "low-level normal design," relevant decisions are already embedded in technical norms and codes.

Kunda's (1992) analysis of engineering cultures underlines the multiple tensions and dynamics that can be found in engineering work, also when involving

external collaborators (Barley and Kunda 2004). Munch's (2005) study of the practical morality of engineers is carried out in a similar engineering context. She shows that moral and ethical issues are occurring as part and parcel of the production of knowledge. Engineers mitigate their expert responsibilities and the ethical issues derive directly from these processes of knowledge production. New knowledge and learning thus lead to new ethical and moral issues.

The engineer's practical morality draws on a pragmatic ethic of benefit where "the good" and the "decent" lie with the impact of actions, typically whether projects are a success and the client is satisfied (Munch 2005, p. 106). Munch finds that the complexity and dynamics in the organization of engineering work and tasks push toward an ethics of benefit leading to the disregard of ethics of virtue or duty. She argues that if ethics of benefit is not made explicit and managed somehow in a collective process, there is a risk that the push for ethics of benefit leads to an emotional and subjective ethics and a further individualization of the responsibility of decisions (Munch 2005, p. 138).

In order to help the engineers to be able to act ethically, Martin and Schinzinger (1989) identify a number of necessary individual characteristics. They refer to the concept of responsible agency which involves the following features:

1. Conscientious commitment to live by moral values
2. Disposition to maintain a comprehensive perspective on the context and possible consequences of one's actions
3. Autonomous, personal involvement in one's activities
4. An acceptance of accountability for the results of one's conduct.

(Martin and Schinzinger 1989, p. 103)

As Van de Poel and Verbeek (2006) suggest, in order to be meaningful, ethical questions should only be treated within the specific context in which they appear and be studied in relation to this context. The following case study focuses on how ethical questions are identified and dealt with in various situations where students confront their academic knowledge with the practical reality of enterprises. The purpose is to describe the context in which the dilemmas occur in daily life and how they are managed by the engineering students.

Methods

The empirical material is drawn from ongoing research on the mentor carried out at Aarhus University, Herning, within the MSc in Engineering study program over the last 3 years (Buser et al. 2011; Buser and Jensen 2010). In the present chapter, the study is presented as a case study which focuses on students' ethical development. It uses a mixed methods approach combining qualitative and quantitative studies. The qualitative research encompasses the two authors' participant observation for the last 3 years. This includes teaching, negotiating contracts with the mentor companies, supervising more than 40 students for a minimum of two semesters,

and examining their projects in the presence of external examiners. In addition, 17 qualitative interviews with students, company mentors, and supervisors were carried out during the winter 2010–2011. This was complemented by a quantitative survey made in the spring of 2011 with engineering students active in the second and fourth semesters. The response rate was 68% for a population of 60 students (Buser et al. 2011). The fact that the authors of this chapter are part of the academic team active on the MSc program provides an in-depth insight into what takes place during the mentor program. However, the authors must be careful to keep the necessary critical distance in terms of their involvement and commitment. The trustworthiness of the results is achieved through triangulation by the comparison of information collected through different channels (Bryman and Bell 2011).

Students in Enterprises

The following discussion builds on Martin and Schinzinger's four features: the first is to be aware of moral values and be able to recognize ethical dilemmas; the second consists of being able to have a comprehensive perspective on what happens in a given situation and the consequences of actual decisions; the third focuses on the possibility of acting autonomously within the process, being able to verbalize doubts or disagreements; and the fourth aims at being able to act according to moral choices and take responsibility for one's conduct.

But before presenting the case study, it is important to stress that in the questionnaire noted above, only seven out of 41 respondents (17%) spontaneously acknowledged that they face ethical or moral dilemmas in their mentor company and this only "to a minor degree." The interviews, supervision, teaching and observation, however, show another picture, though the issues we present here may not be recognized as moral or ethical by the students.

Being Aware of Moral Values and Dilemmas

Moral concerns appear even before students begin their study. First of all, this is seen in their choice of company, since many students are attracted by sustainable production or solutions, giving their preferences to companies with a green profile or being active in alternative energy, such as wave energy or wind turbines.

Then, secondly, as students are required to find their mentor company themselves, the negotiation process to be accepted as mentee can be difficult to balance: on one side, the desire to look competent and professional and, on the other, the difficulty to assess one's own skills:

> I hope I'm good enough and can be helpful to my company and deliver what they expect me to. I wouldn't like them to be disappointed and feel I had misled them in terms of what I can.
>
> (M. male student, 24 years old)

Once the study has begun, the first weeks are marked particularly by uncertainty, since the students must manage two new working communities, that is, the enterprise and the university. This may lead to an identity problem:

> I don't know what to do when I visit a competing company. Do I present myself as a student and get as much information as possible, or should I announce myself as employee of the mentor company knowing that it will limit my access to interesting information?
>
> (K. male student, 24 years old)

This conflict of interest is shared by many students who discuss it every first semester during a study course on the MSc program. The course also addresses more general ethical issues related to scientific research and ethical behavior within a company, and these are discussed by students who easily express their opinions. However, they clearly state that they do not feel they have a role to play in the decision phase in real life:

> Who am I to decide what should be done in a situation of controversy? I'm just a student and there are so many issues I don't understand or even don't have enough knowledge of in these discussions. I don't have the competences and it is too complex.
>
> (B. female student, 24 years old)

Within the company, students may feel insecure about expressing their own views when facing experienced practitioners. This integration phase can be time-consuming; our questionnaire shows that an average of 2–4 weeks is needed to understand the company specifics, but it takes up to 4 months for one third of the students to feel comfortable in their new environment. Companies, especially those that mentor more than one student, recognize that this adaptation phase is necessary. During these first months, the students very often start identifying themselves strongly with the company of which they are part: "We, at XX, do this and that…. We are the leader on the market…. We have a social concern…. We are interested in reducing pollution." Most students begin by repeating the company and mentor position without reflecting on its actual content. But for some, the gap between company rhetoric and its actions reveals inconsistency or disparity and, as a result, students start questioning their context; for example, does the company in fact aim at reducing carbon dioxide emissions or is it just a marketing argument (M. male student, 25 years old)? This leads us to the second feature.

Comprehensive Understanding of the Contextual Situation

A phrase every supervisor hears after a few weeks from each student in a mentor company is

> I can't define my problem statement now. I need more time to find out what they (the company) are doing. There are so many things I don't understand yet.
>
> (B. female student 24 years old)

This quote shows insecurity, but it also reveals the will of the students to be able to really understand their surroundings. It is not uncommon that a student who becomes more knowledgeable over time rephrases the problem statement or even identifies other relevant aspects of the organization before working on the former process under focus. A revealing sign is that the student realizes that companies do not always share a unified position: conflicts and disagreements indeed coexist within the same space. Taking sides most often signifies accepting the mentor view of the problem (which most students appear to do), but some students have succeeded in giving voice to competing positions and thus expressing moral concerns.

This tension between what the companies/the mentors expect and what students find out may be managed in different ways, but it usually constitutes a crisis for the students who find themselves torn between mentor expectations and their own understanding.

An example can be found in the various collaborations between Denmark and China where several large companies have been involved. The companies are caught between the necessity to develop collaboration with Chinese engineers and the fear of being betrayed by them. For example, a company has started an innovation process between the two countries, but the Danish part delivers 10-year-old documentation and specifications to their Chinese collaborators to avoid being circumvented. This kind of decision prevents projects being fully developed. Students often express their disillusion in a university context but can choose to accept company decisions:

> I'm supposed to deliver a knowledge management tool for this collaboration, but I know it won't work as the problems are somewhere else. I would rather work on another subject, but my mentors want me to work on this one.
>
> (P. male student, 24 years old)

And then, they may end up reproducing the mentor point of view without taking into account their own reflection:

> The Chinese culture as based on Confucianism is not aiming at the innovation process, since employees don't dare to contradict their superiors.
>
> (Conclusion of a student project, X. Chinese male student, 25 years old)

This can lead to difficulty regarding their academic assessment as obviously the conclusion of the project does not address the issues described.

Another example of the importance of contextual understanding is when students realize that the mission they have been given may have drastic consequences on the company:

> What if they fire people after my analysis? I don't want that to happen. I don't want to be the boss' spy. I would feel awful.
>
> (L. female student, 36 years old)

Nevertheless, during the second semester, the majority of the students are able to distance themselves from their mentor and express their own understanding. This is described in the next paragraph.

Autonomous Involvement

If the student is able to identify contradictions or misalignments within their surroundings, the student is in a critical moral position: either to act or to ignore and accept if they are to engage in challenging the community they have just entered:

> I think my mentor is part of the problem. The way he manages, or rather doesn't manage, creates big problems for all the employees, but I can't write this, can I?
>
> (M. female student, 24 years old)

In expressing doubts and engaging in a discussion with the mentor, the student underlines a disagreement and therefore risks damaging their relationship with the community. For many, the mentor company represents possible employment at the end of their studies. It is easier for the student to follow their own considerations if there is not a job at stake:

> I have chosen not to work on the problem given by my mentor. I thought it was a fake and instead, I work on the company organization and dysfunctions. I learn more by doing so, but no one is going to read it in my company. It will end up in a drawer, but I don't care. I have found a new company for my MSc.
>
> (M. female student, 25 years old)

But experience shows that the students who confront their mentor not only gain self-confidence but also receive recognition from their mentors. Competing understandings can in turn be developed to a new common view and, thus, integrate the student even more in the community. In situations of doubt or crisis, the academic supervisor can also play a role, either as a source of objective reflection, as a negotiator, or as a support to the student.

Acceptance of Accountability

Acceptance of accountability is the consequence of the moral choices made by students when facing ethical problems. Here, this decision is often reduced to simply accepting or not accepting being part of the given project:

> I had a conflict with my mentor on the quality of what we produce and this was really unpleasant. I'm not going to repeat this. I will know better in my new company.
>
> (E. male student, 25 years old)

The "keeping silent" strategy does not always mean bending in front of the mentor, but it may lead to the student changing company and searching for a new mentor where they will feel more comfortable. But being outspoken in the company can also be beneficial not only to the students but to the company, helping it to focus on specific problems:

> For a long time, my mentor thought I was wasting my time on an irrelevant subject (manager's role in innovation transition phase), but now part of my recommendations are going to be implemented to strengthen the transition. It's cool.
>
> (A. male student, 24 years old)

In conclusion, some of the students are ready to take responsibility for what they think is wrong or bad and to assume the consequences of their choices, although we have to recognize that being able to act ethically is not a given competence here, but rather is achieved over a (sometimes) long process.

Discussion

As confirmed by the literature (Van de Poel and Van Gorp 2006; Munch 2005), the identification of explicit ethical questions is not straightforward for students in their everyday practices. They fail to identify or recognize that the doubts and questions they encounter are ethically related. They tend to see ethical questions as connected to more general discussions and choices, for example, in technological controversies. When confronted with these more outright moral challenges, students tend to let other actors make the decision. Their mentee situation reinforces the perception that they are not supposed to take part in debating these issues. As peripheral learners, they do not see themselves as experienced enough to give a qualified answer or to be heard as a competent actor. This is confirmed by the companies' representatives who do not expect the students to interfere in the decisions they have made.

Using the concept of peripheral learner, the case showed that nevertheless there is an option during the student project to develop a personal reflection mirroring moral issues. In the beginning, initial understanding enables the student to commence collecting actors' interpretations and knowledge, and this process sheds new light on the initial understanding of the problem. Gradually, a new understanding of the problem emerges, and new players and their knowledge become relevant. However, when a student is able to develop new knowledge and reflect on ethical questions, it does not mean that these are translated into actions. The challenge is then to choose between two attitudes: either shutting one's eyes (to keep silent and accept the dominant understanding) or to express doubts and engage in a discussion with the mentor. In doing the latter, the student underlines a disagreement and therefore risks damaging the relationship with the community, since the company must be in a position to listen to the student's comments. The non-referring strategy may also lead to the student finding a new mentor company. In this situation, the student needs to feel confident enough to express or defend their position. This process signifies that the student is "solid" enough to progressively detach themselves from the personal mentor's view. To act ethically, the student will have to resourcefully and intentionally manage issues of power, authority, and loyalty, parallel to that described by Contu and Willmott (2003). Even if classical mentorship requires full loyalty of the mentee, the student can and should act as a responsible agent.

A dominant group of students choose not to refer to those issues, whereas a smaller group is able to develop and articulate an explicit position. Non-referral occurs, for example, when manufacturing companies seek new production technologies. When discussing the consequences of technology, we observed that our students delegate responsibility to the company or the users and do not feel legitimated to criticize the products or technology as such. But this does not mean that students

do not have moral conflicts during their mentorship. Most of the time, the nature of these conflicts is linked to the differences of perception between the student and their mentor or colleagues.

Regarding the characteristics of ethical behavior identified by Martin and Schinzinger, we can identify a kind of progression from understanding to action, from being able to identify moral issues to taking a position, to acting accordingly, and, finally, to being responsible for the consequences of one's own actions. But this development very much takes place in interaction with the social processes in the company. The practical moral issues are numerous, but they recurrently refer to human relations and being a member of a community. The student has to decide between keeping their doubts to themselves and playing the game as defined by the mentor or to confronting the mentor with a competing understanding. They may also view their condition as individual and isolated when dealing with ethics as emotional and subjective questions leading to a further individualization of the responsibility of decisions as described by Munch (2005). The development of a practical morality cannot, however, be reduced to individual choices, but is highly integrated in the production of knowledge in the engineering community. This observation is in tension with the non-referring ethical issues that the student experiences. The "silencing as a community" phenomenon implies the shaping of docile employees. Support given by the university supervisor is often important in order to confirm in the student the coherence of their analysis. The role devoted to the university is then to help the student to carry out his/her analysis by relying on a systematic production of knowledge.

The dilemma goes hand in hand with identity problems as described above. Should the student perceive himself or herself as a student or an employee from the mentor company? This double identity forces them to reflect on their role and position. The double identity also tends to serve comfortably in non-referral coping. The student informs the supervisor about all the taboos of the enterprise and the enterprise mentor of all the taboos of the university. As a supervisor (and mentor), one might find oneself in a role as a confessional partner, yet voicing frustrations in another context indirectly leading to apparent stabilization of non-referring and consent.

Students in enterprises work with problem-oriented projects and deal with complex decision-making processes. Facing the constraints and limits of real-life project development in an organization, they need to operate within a network of organizational and technological knowledge, loyalty to various actors, norms, and regulations, quick decision-making and market demands. These tensions leave little space and time for reflection on ethical questions (Evans et al. 2004; Koch 2004). Another important area of possibly explicit ethical consideration is the formulation of the study program by the university teachers and administrators. There are many tensions between commercial and societal concerns, between management and employees, between normative model and contextualizing theory, etc. All of these could lead to ethical concerns related to the pertinence of the student's education facing the realities of the work practices they see. But we witness relatively few articulations of such ethical elements. In fact, most students tend to prefer practical tools over theory which we here interpret as indirect consent to the strong business orientation within their education.

Conclusion

Studying engineering in a Mode 2 context is closely intertwined with construction of loyalty toward the community within the enterprise which leads to negotiation of preferences and ethics. It also leads to individualization as the student's position involves boundaries between other communities with ambiguous references and the tendency of not attempting to manage an ethical issue if one arises. Students develop competence in relation to conscious commitment to live by moral values. They develop a disposition to contribute to a comprehensive perspective on the context and possible consequences of their actions, an autonomous, personal involvement in their activities and an acceptance of accountability for the results of their conduct. The development of these aspects of a practical morality cannot be reduced to individual choices, but is completely integrated in the production of knowledge in the engineering community.

In order to attain the freedom to adopt responsible agency as defined by Martin and Schinzinger, our students need to resolve loyalty issues in the communities, company and university of which they are part. This can only be achieved if the student is aware of the fact that their doubts and worries are not only confidence issues but rather a challenge inherent to their position and development as a member of the two communities. This is legitimate peripheral learning. Our role as teacher is to contribute to the gradual, partial, and ambiguous description of these processes with the students and to give our students the tools to mature and be able to act as responsible engineers: thus, to enable them to act with their eyes wide open.

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