From Moral Reasoning to Ethical Resilience

Engineering Ethics at The Hague University of Applied Sciences/Delft, 2006-2016

Paul van den Berg
The Hague University of Applied Sciences, Faculty of Technology, Innovation & Society, Delft, The Netherlands
ptmvdberg@hhs.nl

Abstract *Integrated E4S education should aim to further develop already available-, but often fragile moral motivations of engineering students into more resilient ethical competences. Ethical competences are relevant for all types of engineers (research and applied) and consist of performative abilities (skills for deciding and acting) on top of moral knowledge and -skills. In particular the ability to react with resilience to morally disturbing social situations, had not yet been part of our 2006 engineering ethics-courses. Finally, a short discussion of the 2016 program at our Industrial Engineering curriculum shows how ethical competences can be stimulated together with other courses and projects: ethics courses are now integrated with rich learning environments of a CDIO-type project and courses in international skills. Foreign universities are invited to participate in this program.*

Keywords *CDIO, Dilemma Analysis, Engineering Ethics, Internationalization, Organizational Change, Resilience.*

I. INTRODUCTION

If Engineering for Society (E4S) is to become integrated in education in the applied engineering sciences, then a range of investments in our curricula will be necessary; both short- and long-term. As partner in the E4S initiative, The Hague University of Applied Sciences (THUAS) has invested in a new Technology for Health program (T4H); positive results of that program are already visible in our faculty Technology, Innovation and Society (TIS) within a brief, two year period. Two examples: a new T4H research group has been established and four conferences have brought together external partners and staff to formulate the relevant research questions. In an even more direct way, our recent T4H Hackathon (Delft, March 16th/17th 2016) has shown how engineering students from different departments can come up, together and within 24 hours, with great solutions for practical problems that had been presented by health care organizations.

Here we take a step back from these energizing events and look at some of the slower, long term changes that may be required for a sustained relation between T4H (or likeminded E4S initiatives) and the engineering curricula to take root. What is needed for this stormy love affair to grow into a stable and fruitful marriage? In particular, we focus on how the curriculum may foster stable development of required moral and ethical skills. Let it be clear: we are very proud of the considerable number of engineering students that is willing to engage in societal issues in the first place! Their moral motivation is strong in the sense that they want to do something positive for society. But we also observe how many of them aim for technical solutions that will solve problems *right here, right now*. That attitude comes with high risks of disappointment; such disappointments in turn may negatively affect attitudes in professional life later on. Our vision of a sustainable E4S education program it that this should further develop available but sometimes fragile moral motivations, into more resilient ethical competences. Our own research on this theme combines new insights from philosophical ethics and change management-studies. In philosophical terms we have conceptualized ethical resilience as a differentiated set of reactive attitudes of respect; we seek to clarify working conditions under which public professionals can legitimately be demanded to act upon such attitudes. Our action-research in change management looks at ways to effectively promote and sustain E4S-orientations within the curricula of the applied sciences. In this paper we focus on the latter task. We reflect on the evolution of engineering ethics education in the last decade at TIS Faculty of THUAS by focusing on one curriculum in particular: that of Industrial Engineering (IE). First we evaluate the ethics course which teaches the analysis of engineering dilemmas and look back at goals we had selected for that course in 2006. In hindsight we conclude that this course stimulates development of *moral* competences only. We then shift to the 2016 curriculum and describe two ways in which we now simultaneously foster the development of *ethical* competences; both competences we believe to be dearly needed by young professionals aiming to 'engineer for society' today.

We conclude that the two educational policies to which many universities (our own included) have already committed themselves in recent years -CDIO and Internationalization- can be implemented pragmatically -with limited extra effort- to also promote effective ethics education, for all students. We specifically invite lecturers and students abroad to participate in our program.

II. THE 2006 ENGINEERING ETHICS COURSE

Excellent study materials in engineering ethics have been available for quite some time in The Netherlands. For all courses at TIS Faculty in 2006, five chapters from Royakkers, van de Poel and Pieters (2004) had been prescribed [1] in combination with *Agora*, an online program for the analysis of engineering dilemmas [2]. Agora was released around that time and had been created by a team of Dutch engineering ethics lecturers (including van den Berg) [3]. After preparatory lessons and exercises, the main assignment in this course is for small groups (of three to five students each) to analyze a

professional dilemma by taking up the role of the engineer standing *in dubio.* This dilemma can be real or fictional but is always complex, involving many stakeholders. Actions chosen by the group are presented before a (staged) audience of stakeholders and have to be justified to them by means of correct application of moral principles. The various roles of aroused stakeholders are gladly taken up by other students in *la grande finale:* a lively stakeholder-debate. Table I outlines the program of this course.

TABLE I. ETHICS COURSE 2ECTS, WEEKLY PROGRAM

8 Weeks Course	**Engineering Ethics, BA3 Industrial Engineering**		
	Topics	***Assignments***	***Test***
1	19th, 20th, 21st century ideals of the engineering profession; Moral arguments & fallacies	Spot your own ideals; Spot seven fallacies	For-mative
2	Dilemma Analysis I (Definition/ Stakeholders/ Values/ Options for Action/ Codes of Ethics)	Apply Ethics Code (to simple case)	For-Mative
3	Dilemma Analysis II (moral universalism v. relativism/ universalist principles from Aristotle, Kant and Mill)	Start group-assignment (complex case)	-
4	The Problem of Many Hands: 5 allocations of responsibilities	Re-allocate (ex-post) res-ponsibilities	
5	Individual written exam (MC questions plus simple case-analysis = 50% of final grade)		Sum-mative
6	Finalize group-report (format of report is prescribed and follows steps of analysis)		-
7	Assessments (report, presentation & debate = 50% of final grade)	Stakeholder-debates	Sum-mative
8	Resit of summative tests		

In 2006 this course was given in five engineering curricula at TIS Delft, with a variety of cases on offer. For Industrial Engineering (the only curriculum specializing in management) one extra layer was added to the assignment (as can be seen in table I, week 4): students also have to propose organizational changes 'ex-post' for the cases they studied in order to minimize chances that the same dilemma may occur again. By discussing possible reallocations of responsibilities within organizations, IE students should get a deeper understanding of the so-called 'problem of many hands' that is part and parcel of complex, technology-driven organizations. Whether as responsible managers or as consultants, industrial engineers have a professional responsibility to keep such organizations accountable.

III. EVALUATION OF THE 2006 COURSE

This course was designed to help students develop the following moral competences [1]:

1. Moral sensibility: the ability to recognize ethical issues in engineering;
2. Moral analysis skills: the ability to analyze problems in terms of facts, values, stakeholders and their interests;
3. Moral creativity: the ability to come up with different options for action in a given dilemma;
4. Moral judgment skills: the ability to form judgment, based on theoretical frameworks (ethics codes, moral principles);
5. Moral decision-making skills: the ability to reflect on differences between frameworks and to make a decision based on that reflection;
6. Moral argument skills: the ability to justify one's actions in an audience of stakeholders (engineers and non-engineers).

With modifications, this course is still given today and is obligatory at IE (in other TIS curricula, the course lost obligatory status shortly after introduction of the Major-Minor structure). It has been evaluated positively over the years. Different methods of student-evaluations have been used, but the following points repeatedly showed up; we discuss them in relation to the competences stated as goals above. Students particularly like the creative challenge (competence 3) and the theatrical elements of the course, in particular the stakeholder-debates where competitive elements are added (competence 6). These debates are found highly stimulating, or confrontational, depending on the number of stakeholder-perspectives groups had included in their preparatory analysis. Personal and professional developments reported after the course mostly refer to competences 1, 2, 3 and 6. We consider this no small result! Notably if one takes into consideration that applied sciences students generally, and maybe applied engineering students in particular, tend to be practical problem solvers (by nature and/or as result of most of their professional training). Nothing less than a full *Gestalt switch* is required then for these students to accept firstly that *incommensurability* of candidate-'solutions' is an ineradicable feature of engineering dilemmas; and secondly that the actions they eventually chose in such a dilemma have to be rationally justified nevertheless; through thoughtful argumentation and openness to all stakeholders involved.

For Industrial Engineering students, learning curves on competences 2, 3 and 6 were slightly higher than for other curricula where the course was given. This may be due to the extra assignment added, but differences between curricula as such seem more likely causes. For example, at IE the ethics courses is positioned relatively late, in the 3rd year when most students have gained working experience through internships. Here Aristotle's warning that life experience is a precondition for effective moral education, may prove relevant once again. Also, the IE curriculum generally gives more attention to stakeholder-analysis than other engineering curricula

(currently) do. Repetition may enhance positive learning; notably for competence 2 we perceived this effect at IE.

Regarding competences 4 and 5 student evaluations have been less enthusiastic. When studying 4 (moral judgement skills), many find the prescribed literature on moral principles demanding; understandably so, taking into account that full elucidation of the theories of Aristotle, Kant and Mill would require much more time than is available. Additional online support is offered for these topics (with animations and extra examples) - which is appreciated. Still, few students who completed this course will be able to explain e.g. the difference between the Golden Rule and Kant's first formulation of the categorical imperative. Therefore we adjusted the dilemma-assignment in recent years: regarding competence 4 we now only check whether a good fit is established, and shown convincingly during debates, between the proposed actions and one moral principle. In other words: groups are now allowed to choose the latter more or less intuitively from the large set of principles that has been discussed in class. Finally, competence 5 (the ability of critical meta-reflection on competing theories) was kept out of summative tests for this course all along.

IV. Ethical versus moral competences

Our main question here about the 2006 program is whether it may promote E4S-attitudes. To answer this question we shift the analysis from student-evaluations to the competences we had selected as course-goals. Incidentally, our formative testing on competence 5 showed that outcomes on that criterion are a fairly good indicator for a student's chances to successfully complete a research master after receiving his or her bachelor degree in applied engineering. However, that finding also puzzled us in so far as it may suggest that two levels of engineering education -applied and research- (and in The Netherlands: the differences between two types of university) are mirrored in the distinction between competences 4 and 5 above. Because we are not at all convinced that applied engineers tend to possess less skills in moral decision-making than research engineers do. Rather, we now believe that the title of competence 5 was ill-chosen and should be replaced by 'moral reflection skills'. Surely, the ability to reflectively compare diverging moral frameworks is a valuable academic skill. We also agree that insights resulting from the comparison may offer motivational support for a moral decision once taken – all be it an abstract and rather exceptional kind of motivational support. However, this ability to compare is itself still a *cognitive*, not a *performative* skill; the process of decision making (and the subsequent moving to action) has yet to be addressed. In hindsight, we now believe that *all six* competences chosen for our 2006 ethics program focus too strictly on the *cognitive skills* required for moral reflection and moral argumentation. More attention is needed for the range of skills activated when experienced professionals make moral decisions and stick to these–most notably in response to social circumstances when 'the going gets tough'. We label the latter category *ethical competences* in contrast to the six moral competences discussed above. We are well aware that this dual terminology is multi-facetted, even ambiguous; for in academic usage alone, the terms *ethical* and *moral* refer to two different distinctions: theoretical versus practical (as in the Anglo-American understanding of ethics as the study of morality) and contextual-social versus abstract-personal (as in the German-European duo sittlich/ moralisch). Our delineation of performative (ethical) competences and cognitive (moral) competences connects to the German-European distinction.

Finally, we may have missed even more when selecting the 2006 goals for our engineering ethics program (the point requires more detailed analysis but for purposes of this article the following indication may suffice). A third way to apply the distinction between ethical and moral competences is to state that each type refers *to differently structured norms of respect*. Taking up a distinction that was originally introduced by Stephen Darwall [4], ethical competences can be seen as oriented primarily to a subset of norms of respect for persons, to wit: *second-personal* or *reactive respect*. Here one responds to breaches in societal expectations about the respect that is considered due. The response is ethical in so far as it seeks some form of restoration of social expectations breached. In a simplified formula: ethical competences cover the ability to *respond resiliently* to a *disrespect by others*. In contrast, moral competences can be seen as the set of *first-personal* attitudes by which one *gives respect to others*, motivated by cognitive beliefs of one's own (e.g. belief in Mill's no harm-principle or Kant's respect-formula of the categorical imperative). In hindsight, first-personal attitudes of respect have been predominant in our 2006 ethics program. Today we consider the mastering of responsive, second-personal attitudes of respect equally important, if not more important, for society-oriented engineers. However, our experience also learns that training of these complex competences requires more time than is available for a small course of only 2 ECTS credit-points.

V. Ethical competences in the 2016 program

Ethical competences, we have argued, are relevant for both types of engineers (research and applied) and consist of performative abilities (skills for deciding and acting); in particular abilities to react resiliently in morally disturbing social situations. Learning these competences requires not just more time, but also more complex settings than can be offered in the classroom. One reason why learning environments have to be richer for this goal is that students have to experience the need to be receptive to wider social expectations about moral (im)propriety before they will be able to respond ethically to a given real-life dilemma. These wider social expectations are institutionalized (among others) as habits of cultural groups, as organizational behavior, or as formal legal rules; most often complex combinations are involved. Alongside knowledge of moral principles and of distinct interests of stakeholders, an understanding of these wider conventional backgrounds of respect will also be required. In thinking about enriching our learning environments for the 2016 program, we took into account that when students return from an international internship, they tend to be much more receptive to (differences in) such conventional backgrounds.

Luckily, the Bachelor curriculum in Industrial Engineering at THUAS has never been restricted to class-room settings only; it comprises several projects where students do assignments in (or with) real businesses and organizations. Also since recently, international experiences at IE are no

longer reserved for the relatively small number of students which has chosen to do internships abroad. From this current curriculum we briefly describe the final group-project in Organizational Change and the recently created mandatory course in International Skills. The ethics course is now closely connected to both and the three are all positioned in the final semester of the third year. It is during this period that we believe to have created conditions where regular learning of moral *and* ethical competences can simultaneously take place.

As before, groups of students follow the 2 ECTS ethics course in order to learn how to analyze a professional dilemma. But now these same groups also identify a complex dilemma in an existing organization; this dilemma they confront head-on as part of their larger project in Care Related Organizational Change (CROC). Ten organizations which provide or facilitate (health)care have participated in the 2016 CROC-project; among these were several hospitals, care organizations for the mentally ill, housing projects for the elderly and a number of commercial manufacturers (of wheel chairs, exoskeletons and other orthopedic devices). The task for each group of students was to address a problem identified by that particular organization; then to collect data to analyze possible causes (often after redefining the problem initially stated) and redesign relevant processes; and finally, to help implement the proposed changes.

The 2CTS course in international skills was most recently added as an extra layer around the CROC project; during this course, groups perform an international comparison on a selection of the questions they had formulated as central to their project. Assignments of the international skills-course evolve around thoroughly prepared Skype-interviews: first with a student abroad and then with an expert working for a comparable care-organizations within that country. Goals of this course are of two kinds: on the one hand the learning of international communication-, networking- and research-skills; on the other hand, participants (students as well as participating organizations) are stimulated to broaden their cultural views on the dilemma posed and on possible solutions. To mention one example: one CROC project-group was asked to explore possibilities to switch techniques for the commercial production of braces and other tailor-made orthopedic devices to 3D-printing. We have seen how many groups in similar cases in the past have fallen for the intuitive appeals to apply the latest or hottest technologies. Not this group: they quickly argued, supported by results from their international research, that organizational conditions are currently not in place for an effective implementing of 3D-printing in this particular company. Their final report came up with practical measures by which the company can reduce production costs and production time, while maintaining their present production techniques. Table II outlines the International Skills course.

TABLE II. INTERNATIONAL SKILLS COURSE 2 ECTS, WEEKLY PROGRAM

8 weeks course	**International Skills (BA3 Industrial Engineering)**		
	Topics	***Assignments***	***Test***
1	Globalized Business: how to get international contacts	Do Skype I (student abroad)	(linked to previous tasks and courses)
2	Hofstede Typology I: Analysis of national cultures	Hand in research-Q; Reflect on Skype I	Formative
3	Hofstede-Typology II: Analysis of synthetic cultures	Hand in interview-setup	Formative
4	Globalized Reseach: how to do cross-country-comparisons	Do Skype II (expert abroad)	
5	Individual written exam	Reflect on Skype II and Typologies	Summa-tive 50%
6	Finalize intern. groupreport (data & Skype reflections)	Optional: do Skype III (2nd expert)	-
7	Group-assessment, combined with final feedback on advances in wider project	Present report	Summa-tive 50%
8	Resit of exams	Adjusted report	Summa-tive

VI. CONCLUSION

The 2016 semester just described finished shortly before finishing this article, when evaluations were not yet complete. However, most of the organizations participating in the 2016 CROC project have already commented that our students delivered highly practical results from which clients as well as patients will reap the positive benefits in the short term. In the context of this article, the long-term results of the semester are of equal importance: participating students have developed ethical resilience during the months in which they struggled with concrete dilemmas in Dutch health care organizations. Students have learnt this semester that quick and easy technological fixes seldom exist in this complex, highly bureaucratic world. However, that fact has been no reason to them to become disappointed about the professional commitments with which they entered their projects. And from their activities during the International Skills course, students have learnt that comparable problems do exist worldwide, so that much is to be gained by networking when looking for creative solutions. Finally, the Skype conversations appear to be a highly effective way to combat the so-called tunnel visions on intuitive moral judgements, which we have often seen emerging in groups during engineering ethics-courses in the past. The next step in this promising development of our IE program will be to fine-tune formats for the summative testing on the ethical skills described above.

We conclude that the two educational policies to which THUAS has already committed itself in recent years –to wit: CDIO [5] and Internationalization- can be implemented jointly, and in practical ways which do stimulate the development of sustainable E4S orientations in the engineering

professions. As TIS faculty of THUAS we invite technical universities worldwide to co-develop international assignments in order to further advance ethical competences. Notably in relation to our Technology for Health program, opportunities to cooperate already in this year are available, for IE as well as for other engineering curricula. For even the simplest international Skype assignment in which students discuss difficulties they experience in their own projects, will strengthen students' resilience in confronting hardship – and will expand their informal knowledge networks at the same time. Please email us if you consider adding an international assignment to your project or course, or wish to explore other possibilities to cooperate.

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