

# Supporting Shared Responsibility for Integrating Ethics into Science and Technology Education

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**Abstract**—To complement previous research on the top-down inclusion of ethics training within engineering programs, this Innovative Practice Work in Progress paper describes a supplementary strategy acknowledging and supporting ethics training as a shared responsibility. As science and technology have ethical impact, accreditation bodies have in the past decades mandated the inclusion of ethics in STEM education. However, the implementation of ethics education is fraught with obstacles. Through a case study of a Faculty-wide effort to support shared responsibility for ethics training, the pros and cons of an institutionally embedded ethics approach are discussed. It is argued that such an approach can provide a rooted base that can also serve to comply with more formal ethics evaluations, by strengthening a view of ethics as craft, acknowledging subject teachers as ethics ambassadors, reforming the hidden curriculum, and depoliticizing institutional politics.

**Index Terms**—ethics, education

## I. INTRODUCTION

Given that knowledge in engineering and computer sciences, as in other parts of STEM, can be used for a multiplicity of purposes – positive as well as negative – learning outcomes related to ethics are an important part of curricula for education in these subjects. Although such learning outcomes are formally established in program curricula, teachers and pedagogical leaders are still struggling with how to give relevant ethics training in the best way.

Alongside this formal integration of ethics into curricula, research in pedagogy in engineering and computer science have addressed learning outcomes of ethics education for non-ethicists, relevant pedagogical methods, assessment techniques, and related issues. For example, related to learning outcomes, Herkert [1] argued that there is general agreement about the importance of increasing student sensitivity to ethical issues, increasing student knowledge of relevant standards, improving ethical judgement, and increasing ethical will-power (cf. [2]). For obvious reasons, most of the research on ethics in engineering education focuses on how students

can best learn relevant skills and knowledge to recognize and address ethical issues, as reviewed by Hess and Fore [3].

Apart from the individual and course level focus in engineering ethics education research, there is also a focus on the institutional level [4]. In their discussion about the institutional level, Martin et al. review possible ways and related obstacles to integrating ethics at a program level. Walczak et al. observe institutional obstacles to introducing ethics education into curricula, of which the three most commonly encountered are that “1) the curriculum is already full, and there is little room for ethics education, 2) faculty lack adequate training for teaching ethics, and 3) there are too few incentives to incorporate ethics into the curriculum” [5, n.p.]. Another important obstacle is that the hidden curriculum of engineering and computer science education can have a detrimental impact on the effectiveness of ethics education, for example if a majority of teachers on programs view ethics as not really engineering or computer science and this is the dominant discourse outside the engineering ethics classroom [6].

To successfully integrate ethics in engineering education, Martin et al. emphasise the role of accreditation of ethics-related learning outcomes in engineering programs. Drawing on Li and Fu [7], they argue that there is a need for a cohesive and purposeful strategy at an institutional level, paying heed to quality assurance mechanisms, accreditation requirements, and the vision of the institution as well as its ecosystem. Other research focusing on the institutional level concerns how ethics can be implemented in engineering programs, rather than issues concerning course level instruction [8]–[10]. Often this research discusses the usefulness of a stand-alone ethics course or different degrees of integration into engineering programs, and addresses the question of how much ethics instruction is needed to fulfil relevant accreditation criteria (for a critique of this, see [9]). Other papers explicitly describe support activities for teachers, such as the workshops for faculty described by [11]–[13].

In previous research, we can see an emphasis on the planned

inclusion of ethics into engineering programs, thus creating a logical focus on programs and program accreditation. In addition to this research, our paper is intended to highlight supporting activities mostly for faculty that can create an embedded pull for ethics integration into study programs, acknowledging the shared responsibility of integrating ethics. Our approach also highlights the significant demands of crafting a planned, cohesive, and purposeful strategy at an institutional level, and suggests that an embedded support strategy can also play a beneficial role.

An example of such an ethics integration project, functioning alongside the work with integrating ethics on a program level, is our Faculty-wide effort to develop ethical training in science and technology education (henceforth the Ethics Project) accelerating in 2012 and ongoing since then.

This case study is intended to illustrate the potential of an integrated approach to developing ethics training in STEM educational programs, supplementing formal institutional work on program level. Thus, it treats ethics integration as a collective multi-level project that seeks to build the involved individuals' experience. It involves long-term interventions and requires an understanding of the university as a complex system [14].

## II. METHODOLOGY

To investigate the outcome of the project, a case study methodology has been used. Given that three of the authors of the paper were part of the Ethics Project from the start, one important source of understanding was to draw on our own memories and recollections in a reflective dialogue between the authors.

This was complemented by interviews. A two-hour session with the faculty members who were heads of education at the time of project initiation was conducted to reconstruct the objectives and rationale for the project from the organisation's point of view and for them to evaluate the approach that was used by the organisation.

Additionally, various sources of written empirical material were used to scaffold the memories and to reconstruct a historical narrative. There was no official documentation of the project, but we have used email conversations and working material regarding the different sub-components of the Ethics Projects.

Finally, semi-structured interviews with former participants of a course to develop the ability to teach ethics were conducted. Questions concerned their view of the course, as well as if, and in that case, how they have used the knowledge and experiences from the course to introduce ethics teaching into their own courses, programs, or subject areas. Up to the submission of this working paper, only two interviews were done so these will not play a major part in the current analysis.

## III. PRELIMINARY RESULTS

In this part, we will provide a narrative of the ethics project built on the empirical material gathered.

### A. Overview of the Ethics Project

In the early 2010s, The Swedish Higher Education Authority conducted a review of all educational programs in engineering and technology, regarding how well they fulfilled the degree objectives in the Higher Education Ordinance. Many engineering programs were deemed to not fulfil the learning outcomes related to ethics. As one of our respondents said, the evaluation was an alarm bell that there were learning outcomes that should be fulfilled. While many engineering and natural science programs managed to fulfil the learning outcomes, perhaps even without knowing of their existence, it was obvious from this evaluation that learning outcomes related to ethics were not reflected by educational activities and assessment of students' knowledge and skills. Therefore, although there had been some discussions about ethics before at the Faculty level, the mentioned evaluation was the impetus for action.

In addition to the established responsibility of program directors for ensuring that ethics is taught within their particular programs, educational leaders at the Faculty initiated the Ethics Project based on the assumption that it was important to acknowledge ethics training as a responsibility of all stakeholders, including subject teachers and students. Although this might sound obvious, there were some who argued that "it is clear that physicists should teach physics and ethicists should teach ethics". This is likely true if the student is intending to become an ethicist but in this case, the goal is to give students the possibility to integrate ethics into their other professional competencies, a process that can be scaffolded by the teacher coupling knowledge in ethics with strong domain knowledge. Furthermore, this emphasises that ethics is part of a STEM professional's expertise, and the teacher could serve as a role model for students. In opposition to the specialist argument captured in the above quote, the Ethics Project was going to involve students, teachers, and educational leaders. It started in 2012, involving a working group comprising a range of teachers; some with significant experience in ethics training, and others with an interest in the subject. At that time, there were some islands of ethics competence within the Faculty. Some programs in biology were already training their students to handle ethical issues. This training was based on hiring ethics expertise from the University's Centre for Research and Bioethics, and the approach was to bring in an ethics expert that, together with the course responsible teacher, would provide an ethics perspective to the subject matter discussed. Another ethics island was a collaboration between faculty members in the departments for engineering sciences and computer science. These departments have a joint history of two decades of teaching ethics within their respective subjects. All faculty members with experience of teaching ethics were invited to the Ethics Project.

An integrated approach was considered as a path forward for the Faculty, consisting of three parts: 1) a lunch lecture series, 2) a course for teachers to develop the ability to teach ethics within the context of their respective subjects, and 3)

development of ethics modules, i.e., lecture and assessment packages, as resources for teachers to incorporate into their courses. Due to space constraints, we will here focus on the course for teachers and its effects.

### *B. Ethics course for teachers*

The course for teachers was targeting faculty members who were interested in integrating ethics into their courses, and was designed collaboratively to give a base in ethical theory, to support teachers in developing ethics modules for their own courses and to build confidence to discuss ethical issues within and in relation to the taught subject. At one of the working group meetings, one respondent remembers that there was a discussion about who should then teach this course. Another discussion item, which mostly took place outside the working group, was where the course was going to be housed organisationally. It was obvious that such a course needed to be funded, in contrast to the organisation of a few ethics seminars. At the same time, the Faculty did not want to create a separate account for funding an ethics course. Rather, the logical attempt seemed to be to incorporate the ethics course into the program of the Faculty's Council for Educational Development (henceforth the Council).

The course was designed based on ideas from the working group meetings, and it was decided that two weeks of full time work would be a good scale. The course development was supported by different members of the Council, who had competence within teacher training and pedagogical development. The course was designed to consist of three parts: 1) to give a base in ethical theory, not necessarily linked to science and technology, 2) to let the participants survey ethical issues in their particular scientific fields, and 3) to support the teachers in developing ethics modules for their own courses, programs, or subjects and building confidence to discuss ethical issues within and in relation to the taught subject.

The first time that the course was given, the interest was high and nine participants signed up. In addition to the responsible teacher, a colleague from the Council was invited, in order to contribute with additional perspectives and learn more about ethics training.

A guiding principle was that the teachers should be able to make – and teach how to make – judgments taking ethics into account, which was a core tenet within the Higher Education Ordinance. The course participants designed educational interventions, and material describing these was uploaded to the shared pool of ethics modules.

The course was given five times until 2021 and will be given also in 2022. The shared knowledge about ethics that had been created within the Council proved beneficial when the previous responsible teacher left the Council but the course continued to be given in essentially the same format.

### *C. Spin-off effects outside the formal project*

As a spin-off to the ethics course for teachers, an ethics network was created in February 2016. The idea was to provide a space for faculty members interested in ethics to

continue sharing experiences and discussing issues. In 2018, the network was rebranded into an ethics seminar series, partly because it often already was conducted in seminar form with a reading or a presentation followed by discussions, and partly in order to open up the network to a broader audience.

Through our interviews and informal discussions with former participants of the ethics course, we have verified that many have continued to run their ethics modules year after year. The course and the ethics seminar have also strengthened personal relations between the participants. Based on the interviews that have been conducted, this has increased knowledge and also awareness of who to turn to for discussions about ethics. The Council has also established itself as a first-in-mind organisation that can help support ethics training, and utilise its contacts with ethics course alumni and other faculty members with knowledge in ethics for further support. As ethics had become an integral part of the Council, it was also included as a regular component of the Faculty-wide course in scholarly teaching in engineering, further accentuating its relevance in engineering education.

The 2019 course instance provided impetus for the development of an ethics stream in one of the Faculty's engineering programs. The program director attended the course and, as an assignment, sketched an ethics stream for the program. They then mobilised the teachers in the program, bought a course book for all students, and initiated an ethics journey throughout the program. This seems to have been inspirational for other program directors, as several similar initiatives have been started since.

Alongside the development of the Ethics Project, most probably related to the existence of it, more program directors have seen the need to integrate ethics into their curricula. As a part of that, some ethics courses, such as an engineering ethics course, have grown from having about 10 students a year to now having around 150 students per year. Ethics courses tailored for other student populations have also been developed and made mandatory for students, for instance one for Master's students in Computer Science subjects.

The connection between ethics teaching and pedagogical development has also been established, where new teachers, not originally part of the Ethics Project but related to people in the project, have engaged in pedagogical development regarding ethics and presented their work at local, national, and international conferences. This could indicate that there is an interest in reflecting about how ethics is included or integrated into courses and curricula and that the interest is spreading beyond those in the Ethics Project.

## IV. DISCUSSION

In this discussion, we will focus on four themes which are derived from our empirical findings as well as our previous knowledge on ethics education, highlighting the pros and cons of an institutionally integrated approach as well as what other educational institutions need to think about before and while embarking on a similar journey.

### *A. Ethics as craft rather than ethics as blueprint*

In an institutionally integrated approach, our claim is that it is likely that ethics education becomes relevant, because those who deliver the ethics education are teachers of the subjects into which ethics is integrated. In the institutionally integrated approach, ethics is situated in the subject areas, and not bolted on. Ethics is thus not only an espoused value, i.e., a value that one proclaims to follow, but becomes “in-use”; practical and part of the subject matter itself. With this approach, ethics has the potential to not only become blueprint or checklist ethics, in which a range of ethical theories are used to analyse the same problem, but an ethics as craft, in which the specific problem or application is central, and where ethical theories play an instrumental part to understanding the problem or application in a better way, perhaps not only leading to a solution but to a set of new questions that the problem owner needs to consider. A possible downside of the institutionally integrated approach is that ethics can stop being “ethics”, in other words, that what is considered to be ethics within STEM subject domains diverges too much from what is considered to be ethics in philosophy and other subject areas concerned with ethics.

### *B. Ethics ambassadors vs ethics experts*

The institutionally integrated approach that has been described in this paper is built on the voluntary enrollment of a larger range of faculty members to gain knowledge about and care about ethics, and to promote interactions between these faculty members. These ambassadors, if they have positive experiences from taking the ethics course or being part of the ethics seminar, will oftentimes spread the knowledge and care about ethics, and show that even if you are not an ethicist you are allowed and able to integrate ethical aspects into your subjects. A positive aspect of this is that ethics becomes more embedded and more widespread than if all ethics expertise is located in – and procured from – a particular organisational unit. A problem of the approach, compared to a top-down approach in which faculty management requires members to take ethics training, is that it could be perceived as slow. Judging from the number of participants of the ethics course, it is not obvious that the speed of the effort is sufficient, and the ratio of ethics ambassadors is still small. One of our respondents likened it with popcorn: the oil is turning hot and some corn seeds have popped, but the tipping point when all corns pop has not yet been reached. Yet another problem is that the knowledge provided by the ethics ambassadors will not match ethics experts’ knowledge. A robust connection to the discipline might, however, be a more influential asset than deep understanding of ethical theory.

### *C. Reforming the hidden curriculum*

The institutionally integrated approach can counteract a hidden curriculum in which ethics is seen and discussed as irrelevant and vague. If the number of teachers who are knowledgeable and care about ethics increases, and if these teachers are also well versed in their respective STEM subjects, it is

likely that the hidden curriculum will partly be destabilised. However, we have also noticed that in much literature on the hidden curriculum, this phenomenon is seen as reactionary, in a negative sense. This seems to correspond to an idea that ethics education is seen as the imposition of values, almost in an activist sense, rather than the dialogical form of ethics as craft that has been promoted in our institutional integration. Although we do not dispute that there are many forms of undesirable aspects of hidden curricula, we should acknowledge that the hidden curriculum is a culture in which Science is perceived to be defended against irrelevant influences.

With the institutionally integrated approach, ethics is not seen as opposite to the current hidden curriculum and the culture of the subject. Rather, ethics is positioned as being instrumental to becoming an even better craftsman within the subject.

### *D. Apolitical politics*

The institutionally integrated approach has a limited impact on the distribution of resources within the university. Already in the beginning of the Ethics Project, we experienced that much of the discussions did not fully concern ethics but more concerned who was going to provide ethics education and what resources could be made available to whom for the purpose. The creation or development of an organisational structure with dedicated ethics experts would definitely have needed resources that could neither be spared, nor was it entirely clear who would be granted such resources, given that there were more than one island of ethics experts within the Faculty. Undergraduate and graduate education, while well-funded, was seen as a domain of the Departments, and the Faculty did not interfere with any decisions by Departments to create or expand ethics courses for students. However, for the ethics course for teachers, there was a need for funding. The decision to embed the ethics training into the Council, expanding their program rather than adding organizational complexity, simplified the implementation while extending the skill set of the Council. Furthermore, given that the person responsible for ethics was to be institutionally embedded within the Council, there was no funding without commitment to the institutionally integrated approach. Our interpretation is that with an institutionally integrated approach, the issue of money and power was partly neutralised, since the time spent on the ethics working group meetings was pro bono, and that none of the activities were funded by the Faculty, except for sandwiches and drinks for the lunch lectures. A downside of the way that the approach was structured was that the Council was seen mainly as a support function rather than pushing actively for ethics integration. On the other hand, this is indeed a hallmark of an integrated approach – that there is not a single leader of the institutional integration but that it is a collective endeavour. The Council was not trying to establish itself as ethics experts, but rather as a support function for integrating ethics into science and technology education.

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