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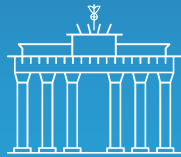
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# Blended Learning in Engineering Education:

challenging, enlightening –
and lasting?

# Imprint

# ETHICS EDUCATION FOR ENGINEERS, CREATING OPEN EDUCATIONAL MATERIALS

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## ABSTRACT

We propose a workshop on creating Open Educational Materials for teaching ethics to engineering students, based on a project encouraging the reuse, creation and open publication of Case-Based Exercises within a community of ethics and philosophy of technology scholars in the Netherlands.

## 1 INTRODUCTION

As ethics education has become an integral part of the engineering curriculum, universities of technology in the Netherlands have increased their load of ethics classes to students coming from all engineering disciplines (on BSc, MSc, and PhD levels). An important instrument in this form of teaching is the Case-Based Exercise (CBE), in which the students tackle ethical questions by studying a specific application of technology (the case) by using various theoretical frameworks. Often these exercises are situated in a context of Design for Values or Responsible Innovation.

Usually, CBEs are created by the teachers themselves and shared only incidentally and locally (within departments) with other teachers. To increase sharing and reuse of CBEs within Dutch universities and beyond, we initiated a project whose aim is to create an initial collection and the online infrastructure for the open publication of CBEs[1] , which can then be opened to contributions of national and international partners and the wider circle of scholars teaching ethics to engineering students worldwide.

It takes a considerable editorial effort to modify the description of a CBE that a teacher can use in her own teaching to the point where it can be used by another teacher, since a lot of tacit knowledge needs to be made explicit. To help teachers bridge this gap, we have developed a toolkit, consisting of a template specifying all relevant aspects for documenting a CBE, a set of learning outcomes, descriptions of educational activities (that can be used as inspiration), and glossary of ethical terms.

## 2 SETUP OF THE WORKSHOP

The workshop is targeted at anyone interested in teaching ethics to engineering students through CBEs.

### 2.1 Aim

The workshops aims to introduce the participants to the toolkit method of building up CBEs, by having them apply it to create a CBE of their own during the workshop. This hands-on training will allow teachers to learn how to design a CBE as an open educational resource and, ultimately, to stimulate the open sharing of educational materials among universities.

### 2.2 Format
Where possible, we will provide the toolkit materials to the participants before the event. In the workshop participants work in small groups (break-out rooms), where each group is asked to start building a CBE intended to be taught in an ethics/

philosophy of technology course for engineering students. They will go through the following activities (time indications assuming a 60 minute workshop):

1. The workshop conveyors introduce the project and toolkit to the groups (10 minutes).
2. Each of the groups starts building a CBE from scratch, using the toolkit and choosing a story they would like to focus on, resulting a first sketch for a new CBE, facilitated by the workshop conveyors (30 minutes)
3. Groups exchange sketches and give feedback on each others work (15 minutes
4. Wrap up (5 minutes)

## 3   DESCRIPTION OF THE WORKSHOP

The workshop was attended by 12 participants. The workshop convenors introduced them to the task, creating a CBE, and the main tool supporting it: the stepwise construction of a CBE out of a story, introducing the topic, followed by a series of steps, each posing a set of questions to be answered by the students, using a suitable educational activity. A step can have multiple "inputs", results from previous steps or materials provided by the teacher, and has a tangible "output", e.g. a list of stakeholder and their values, a list of arguments for and against an option for action, requirements for designing a device, etc. A template for applying this construction was provided as an online form.

The participants  were split into three groups (Zoom breakout rooms), each tasked with creating a CBE. In every group one member was appointed to fill in the online form as a record of the group's design process. For each group,  one of the workshop convenors was present  to provide  instructions and guide the process where needed. Discussion on thecase design also brought out wider issues entailed by the creation of open-source educational materials in ethics.

In group 1, the participants proposed a CBE based on one of their research, namely concerning an ethical issue encountered by engineers in day to day life. Based on interviews with engineers in various companies, the participant noticed that the ethical problems are not so much about ethics of technology or design, but about what he called "HR issues", namely workplace conflicts arising from insufficient communication and from not involving the engineers in the sales process. The case proposed singled out such a problematic moment, namely when an engineering team needs to deliver a project in unrealistic time because the sales team promised something unfeasible to the client. The engineers are then faced with the choice between doing an imperfect project, asking for more time, or failing to deliver it on time. All choices are considered problematic for the future of the engineers in that company. In group 1, we discussed the options that the students had to choose from and we discovered that it was too simplistic to attribute responsibilities and assign blameworthiness. Rather, in choosing

the goal of moral sensitivity and moral deliberation, we proposed some pedagogical activities that entailed first that students do a role play of how the decision was made (to oversell their capacity) and then, after students had decided who was to blame, to allow them to role-play a time-travel: if students could go back in time, what moment would they choose where they could intervene? What kind of interventsions would they enact? We also discussed how the students should be encouraged to see the problem as systemic – namely one of company procedures and approaches – instead of trying to attribute blame to single individuals.

Group 2 started from a technology, assistive robots in elderly care. One of the group members performs as a musician in elderly homes, and from his experience music plays an important role in the well-being of elderly people, including those with ailing health, especially when the music is from their younger years and they can make requests to the musicians. This became the topic of the CBE: design a robot that can interact with elderly people and play music for them. The first step in the exercise is to investigate both the opportunities and dangers in the use of such a robot, addressing questions like: How can the robot be used assist to increase quality of life? Can it be adaptive to support different health needs? How much control do the end-users/patients have – are they activilty involved and being encouraged to positively engage. The second step in the exercise was to engage in "negative design": thinks of all the ways in which such a robot could be designed for unethical uses, for instance: could the robot's algorithms manipulate the mood and play music that has a desired outcome for others, e.g. make the elderly more docile for the care home owner? The third step is to collect requirements, preferences and constraints for the design of the robot, taking the outcomes of steps 1 and 2 into account. Here the discussion turned to participatory design methods, which could help to incorporate the relevant values into the design, but might be difficult to apply with some stakeholders in this context, in particular elderly suffering from dementia.

Group 3 chose to take the challenging topic of cryptocurrency/ blockchain. This turned out to be an adequate choice, as the workshop members knew some things about it, but not as much as engineering students might. As such there was a clear distinction between empirical knowledge and ethical reflection. The members decided to start from a single impression: an image of a house in a wintery landscape, where the snow had disappeared around the ceiling and walls of the house – because inside, cryptocurrency was being mined. From the impression of this image, the following steps were quickly conceived. The group chose to create a set-up for a structured, plenary discussion about the (dis)advantages of this new, disruptive technology. In principle, blockchain-technology could inspire an entirely new economic system by excluding the middle party currently fulfilled by banks. Although Venezuela has recently made bitcoin an official currency in the country, this kind of development has not been seen in many other instances. Furthermore, the consequences of such a transition cannot be predicted. These kinds of deliberations were gathered in statements for the discussion. Finally, roles for students partaking in the discussion were defined to enable a structured debate.

## 4   RESULTS

All groups were able to use the construction method for case-based exercises presented in the workshop, and commented favorably on it during the exchange of experiences at the end of the workshop. Given the time constraints, it was not possible for the groups to finish the CBE they started to design. The workshop conveyers have offered to help the participants to develop their sketch into a full-fledged exercise, and publish it exercise as Open Educational Material in the project's online collection[2].

A finding across groups was that participants really appreciated designing a CBE in a group compared to doing this by themselves, as is common practice. Discussing one's idea with others brings out many more possible directions in which the CBE can be developed, both in terms of the story and in terms of the ethical issues that one would like to address. This wealth of options brought a second issue to the fore. In designing an exercise, there is a tendency to start developing the idea without first deciding on the learning outcomes. This makes it difficult to ensure that the educational activities chosen for answering the questions in each of the steps contribute to the goal of the exercise. Achieving alignment between the activities and the desired outcome of an exercise is easier when the learning outcomes are established before designing the steps.

Overall, the workshop achieved its goal of introducing the participants to the toolkit method of building CBEs. By making the construction of exercises explicit and piecemeal, we managed to show that creating open educational materials is an achievable goal for many ethics teachers.

## 5   ACKNOWLEDGEMENTS

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[2] To be found online here: https://edusources.nl/communities/62f26a9c-d593-49a5-9330-f4a71a1fd370/