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Responsible Engineering
Responsible Engineers
Engineering Ethics Education

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Contents

Responsible Engineering
Responsible Engineers
Engineering Ethics Education

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Comprehensive Ethics Teaching for Engineering and Design students

Editorial

Remon Rooij,
Chair of 4TU+ Centre for Engineering Education

For CEE, educating responsible engineers and teaching engineering ethics have been longstanding interests and priorities in our portfolio. But honesty compels me to say that it has not been an easy ride for many ethics colleagues in institutions to integrate ethics education into daily teaching practices. And it probably still is challenging, as we all know that our curricula are overloaded with interesting and valuable engineering content, and ethics has too often been regarded as an outlier and a nice-to-have curriculum add-on.

But reality has changed. Society at large asks today's engineers to be sensitive to society, nature, people, and politics. To be a good technician is just not good enough. Engineering practice and, therefore, engineering education as well, have to address society-wide themes, such as climate change, geopolitical tensions, and questions of (intergenerational) justice, diversity, inclusivity, and equity, to name but a few. In parallel, pedagogical approaches such as challenge-based learning and inter- and transdisciplinary project education also pave the way for better integration of a wider range of skills and knowledge.

As a former bachelor's degree program leader in Bouwkunde, I also experienced the challenge to make room in 'our' curriculum for these 'outsiders' from another Faculty. Looking back at that experience, I am only half satisfied with the approach that we took then, fifteen years ago. Today, I have colleagues sitting next to me in my office who lead the *TU Delft Centre for the Just City*. So now, it goes without saying that our departmental teaching practices place considerable attention on questions of spatial justice and ethics in urban and regional (re)development. Things have moved forward, and still are, and definitely still need to.

I am very proud that our first CEE E-Magazine is out, and that responsible engineering is the theme of this first of many issues to come. Thanks so much to all the contributors; your work shows the innovative, engaging teaching practices you use and we, as CEE, would like to put in the spotlight. And that is exactly the aim of this new Magazine. It offers all of us, educators, a way to share our teaching experiences and educational innovations. So, please, feel invited to reach out to 4TU+.CEE, if you would like to contribute to or be a guest editor for a specific thematic Magazine.

And for now: happy reading!

Responsibly imagining different techno-futures

In conversation with Lavinia Marin, Assistant Professor, Ethics and Philosophy of Technology, TU Delft

How sci-fi mapping helps engineering students engage with ethics of technology

"I'm fascinated by educational experiments and thinking about how we can do things differently in education. In the early versions of the COMET (Comprehensive Ethics Teaching for Engineering and Design Students) project, we had already been experimenting with embodied approaches. In the elective course I have been teaching on Sci-Fi, we started exploring how students learn to write creatively and how we can make this a more embodied experience." This is Lavina Marin, (Assistant Professor, TUD), project lead of COMET 3.0 and co-author of 'Sci-Fi storyline mapping starting from writing prompts'.

Engineering education often focuses on solving present-day problems, while the ethical consequences of technology unfold in the future. The sci-fi mapping exercise tackles this mismatch by inviting students to collectively and critically imagine the futures these technologies might shape. Developed within the COMET 3.0 project (funded by a grant from 4TU.CEE) with co-author Gitte van Helden, the exercise is a pedagogical tool to elicit values, assumptions, and responsibilities that would otherwise remain implicit. "This is all about exploring visions. We want to understand how people imagine the future of a technology because this shapes how they will develop technologies today," says Marin.

What the sci-fi mapping exercise is

The sci-fi mapping exercise is a group-based activity in which students collaboratively build a science-fiction storyline starting from a given technology. Students begin from a given sci-fi scenario prompt involving a technology relevant to their field.

They then collaboratively map the story moments, incorporating emotions and values in several steps. Instead of writing a full narrative, they visually map key moments of a story using prompts, value

cards, and emotions. As Marin explains, "They are not writing the story. They are mapping it."

Students move back and forth between imagination and analysis, and they may start to see connections they hadn't considered before, especially between technical design and social impact. The physical setup matters, working with paper allows reordering, negotiation, and collective sense-making.

"Scribbling ideas quickly and using post-its to change the order is the embodied part of it, about having the big picture. Writing on laptops would be a failure because it would become linear and too focused on the choice of words." The result is a shared narrative that makes ethical complexity visible.

Why science fiction works

Students already encounter technological futures daily through films, series, and games. According to Marin, these narratives are already quietly shaping them: "They read, they consume Netflix movies, all of that, and these stories shape how they see technology and how they see themselves as engineers."

The process of science fiction writing creates a productive distance, allowing students to explore ethical tensions without immediately defending technical positions or personal opinions. Additionally, the group dynamic allowed them to set aside their self-expression and move toward a collective identity.

From self-expression to collective responsibility

One of Lavinia's core intentions was to displace the students away from their personal worldviews toward a shared ethical reflection. "I wanted societal values to emerge in their discussion about technology." Writing together can encourage students to ask not only from a personal perspective what they want, but also what do we think about this future? Ethics becomes a collective concern rather than an individual stance.

The first iteration of the exercise revealed an important lesson. The structure of the exercise was too tight, with the pedagogical steps often interrupting the emerging discussions. "Every time they started having interesting discussions, I interrupted them with the next card, the next step. One student said: We wanted more freedom."

Rather than seeing this as a failure, Marin adapted the exercise to give students more autonomy by letting them complete it at their own pace. "I should be invisible, really. They don't need me for this."

Student reflections showed outcomes Marin did not anticipate. Group discussions revealed unconscious assumptions not only about technology but also about values and narratives themselves. "They realised they had unconscious assumptions about what they want from a story." These moments mirror insights from

"If you put yourself personally into the problem by writing a story, making a collage, or writing a poem, then suddenly it really touches you. You can't be clinical and scientific about it."

other COMET exercises: ethical learning often begins with recognising one's own blind spots.

The sci-fi mapping exercise complements theory-heavy curriculum content by activating imagination and embodied reflection without replacing analytical work. "You don't engage with the problem through text, but through your body or through gestures or performances. Students need to make up their own minds about an issue. If you involve yourself into the problem by writing a story, making a collage, or writing a poem, then suddenly it really touches you. You can't be clinical and analytic about it."

For educators, it's a concrete way to address long-term responsibility, and for the students, it supports discussion of values and systemic impact in a way that might resonate with them.

A key strength of the exercise lies in connecting imagined futures back to present-day engineering choices. Students are encouraged to ask: *If this is a possible future, what does that mean for what we design now as engineers?* This shift reframes the engineers' responsibility as anticipatory rather than reactive.

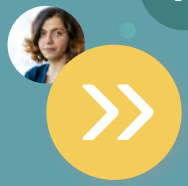
Looking ahead

"At the TUD Education Day, people from all four universities attended our workshop and were excited about what we've been doing with these exercises. They were keen to try them." Marin presented at the SEFI engineering education conference, where educators from other fields saw immediate relevance. "Someone asked if they could use it for a cybersecurity class."

Because the structure is modular and openly shared, the exercise can travel across disciplines. "Any field that needs creative thinking and group reflection can use it."

For Marin, responsible engineering begins with awareness of influence and encompasses a maturity in thinking. "Engineers have power, even through very small design choices. For example, designing an app on a phone and deciding whether to add one button or two for user choice. A responsible engineer is someone who realises they have the power to shape society – I would like them to know themselves and know what they want from others."

The sci-fi mapping exercise helps students recognise that power early, before responsibility feels abstract or distant. "They are not hiding behind the attitude of 'I just did my job'."



Teaching guidelines
Sci-Fi storyline mapping starting from writing prompts

Photocredits: Lucas van der Wee

"How did you create your collage?"

"I tried to figure out how people in this situation were feeling. Their home is hit by earthquakes, Kind of a hell. Then their mind is going through a controversial information, uncertainty about their future.

As a starting point I randomly chose 2 books, then started to find a story with images that I found I these. Then I had an idea of what kind of images I needed to finish to write the story I wanted to tell. I used many cutting techniques to give it different emotions."

Collage making for self-discovery

In conversation with Aafke Fraaije, postdoctoral researcher in Art for Climate Solidarity at Delft University of Technology

About collage-making in the classroom and student "Aha"moments

A creative teaching method that uses collage-making to explore ethics in engineering, developed and implemented by Aafke Fraaije, helps students explore how they feel about engineering through making collages. By reflecting on those feelings and instincts, students can gain a better understanding of themselves, which supports stronger ethical reasoning and personal well-being.

Making space for emotions in engineering ethics

Engineering ethics education often begins with theory. There are frameworks and models, and structured reasoning dominates the classroom. The disparity is that ethical questions in engineering rarely feel neutral to students. They are emotional and personal, not just theoretical. Fraaije developed an exercise that emerged from a practical concern in a climate ethics course. Students were learning to analyse ethical problems, yet they gradually stopped speaking from their own experience. "They were almost unlearning how to use their own personal stories in ethical judgement."

Students were motivated and engaged, yet something was missing: their personal stories and emotional responses remained largely invisible. Based on conversations with colleagues, Fraaije concluded that traditional ethics courses often suppress emotions too early. This exercise makes space for what students already feel and know.

Through collage-making and art-based reflection, students are invited to engage ethics as human beings first. The exercise tested in ethics-related engineering courses, like climate ethics or risk ethics works as a short session, or part of a lecture. "Climate is actually such an emotional topic for students. It's very personal."

Collage as an entry point

What happens if students are invited to begin with what they feel, rather than how they analyse?

In the collage-making exercise, students create collages after a lecture or during a design experience. The guidelines ensure that they work intuitively, using images rather than theory initially. No artistic skill is required, because the focus is not artistic skill, but meaning-making. "It's almost like free writing, but then with collages." A discussion then follows, linking emotions to values and ethical reasoning. It is the teacher's role to focus on creating a safe, open atmosphere.

What happens in the room

Aafke describes what the lessons look like. Students cut, arranged, and combined images without a predefined plan. Some worked in silence, and others talked as they worked. In every instance, what mattered was not the outcome, but the process of reflection. "I always tell them to think with their hands."

"It's the skill of being reflective about your feelings that makes an engineer more responsible."

What was surprising was the level of student commitment. Students started immediately, without hesitation or explanation. Another surprise was that many students wanted to explain their collage privately after the session. There was a desire to talk about their findings. "One student didn't know if he should have children because of climate change, he came to this through image selection and finding connections."

The collages gave form to concerns that had never surfaced in class before and made room for ethical reflection, which was grounded in actual lived experience rather than learned theory.

The role of the teacher: holding space

Some students described unexpected insights and connections that surfaced between past experiences and present design choices. The imagery and choices they made when cutting and glueing were signals pointing to what they value, fear, or care about. Students began to see emotions not as bias, but as information. "Emotions point to what is valuable to you."

But the success of the method does not rest on the collage-making alone. The teacher's role is to hold space, invite participation, and not direct outcomes. The interpretation belongs with the student, and this shifts the classroom dynamic. At this point the ethical reasoning becomes something students enter voluntarily, rather than perform correctly.

Looking ahead

This art-based approach challenges a persistent assumption in engineering education. The assumption

that engineers are, or should be, emotionally neutral. In practice, students already bring values, concerns, and moral intuitions, but what they often lack is permission to use them. “Engineers already have ethical frameworks. They just don’t have the language for them.”

By legitimising emotional reflection, this method expands the scope of what counts as ethical reasoning. “What it really does is give a context where it’s legitimate to talk about emotions.”

The collage exercise continues beyond its original context, as some teachers have adapted it independently. Fraaije emphasises that the method is not a blueprint but an invitation to rethink how ethical reflection begins and to recognise engineers as reflective, emotional professionals.

“It’s the skill of being reflective about your feelings that makes an engineer more responsible.” Ethical responsibility grows from self-awareness, not just theory and this approach invites engineers to show up as human beings in their work.

Teaching guidelines

Collage-making-for-self-discovery-in-engineering-ethics

Coping with ambiguity and being critical: CBL ethics education at TU/e

Gunter Bombaerts
Associate Professor, Industrial Engineering and Innovation Sciences, Philosophy & Ethics, TU/e

Teaching ethics to engineering students is often framed as a question of content: which theories to teach, and which dilemmas to discuss. For Gunter Bombaerts, professor of philosophy at Eindhoven University of Technology, the question is also about experience. How do students learn to live with uncertainty, value conflict, and responsibility while still thinking and acting as engineers?

At TU/e, Challenge Based Learning (CBL) has become a key vehicle for answering that latter question. Rather than treating ethics as an abstract add-on, Bombaerts uses real societal challenges to place ethical reflection at the heart of engineering education.

Philosophy in an engineering classroom

Teaching philosophy to engineers comes with a familiar tension. Students are trained to solve problems, optimise systems, and look for correct answers. Ethics, by contrast doesn't come nicely packaged with closure. And this is where Bombaerts steps in – or rather, does not. He does not try to resolve this tension. In his courses, ethical ambiguity is not something to eliminate; rather, it is something students could learn to handle.

"I think for everyone ambiguity is scary. As human beings, we like certainty. A lot of education that students have received in the previous years is very clear formats of filling in textbooks, et cetera, et cetera. They do not experience ambiguity in the classroom. There was a course that ended last week and the students had to hand in their work. The following day a student asked "Can you reassure me that I gave the right answer?" Even after eight weeks some students are still struggling with it. So for me it's really about learning about this ambiguity."

He is also alert to the risk of positioning himself as the moral authority in the room; he sees his role as a guide. His task is not to tell students what the right

answer is, but to help them ask better questions and recognise the value conflicts.

"Sometimes for the students it seems that it's not working and I get very happy, because it's in this struggle that they are learning."

Challenge based learning as a vehicle for ethics

CBL provides a structure that makes this possible. In the CBL ethics courses at TU/e, students work on open-ended challenges provided by real external partners, ranging from smart neighbourhoods and energy systems to data privacy and sustainability transitions. Students prepare ethical theory through a flipped classroom model, then apply it directly to the challenges they face. Ethical frameworks are no longer something to memorise, but tools to think with.

Take the "Brain on Chip technology" for example. The challenge owner was presenting a real ethical dilemma and they didn't have the answers ready. It was a good authentic example of business as it actually is. According to Bombaerts, this is where ethics becomes real. Students are forced to confront competing values and stakeholder perspectives that do not neatly align. The challenge itself carries the ethical weight.

Experiencing responsibility

Over the years of his teaching, Bombaerts has observed a shift in awareness. "More and more students are aware of the importance of ethics in their curriculum and their future job. Sustainability and A I became more central in the minds of the students and along with it came more questions about their societal role. Ten years ago we had to convince students about this, but that's not necessary anymore because they know it."

At the same time there is also a shift happening during the course. Students begin to see that engineering decisions are never neutral. Responsibility does not begin after a technology is built; it is present from the earliest framing of a problem. CBL supports this shift because it makes students co-owners of the process. They must negotiate within teams, justify decisions to external partners, and reflect on the societal impact of their proposals. This experiential aspect is central.

Designing the course: ambiguity and structure

The course design balances structure and ambiguity. Ethical theories provide a shared language, while the challenges leave room for interpretation and debate. Bombaerts is explicit that too much structure can undermine ethical learning.

"Of course I wanted the stakeholders to be part of it, which stakeholders do I know and what can I ask from them? We decided that we would see them three times in an eight-week course, at the beginning, in the middle and at the end. This year for example we had 350 students, that's a big course with 11 clients – manageability is an important factor. In those 8 weeks you have a big difference in students and how they approach this ambiguity and how they can cope with it. You have to make choices about where the focus is – giving space to do the group work, focus more on the company, focus more on the societal situation.

"In these last seven to eight years while we have been experimenting with the challenge based learning we got a lot of freedom in how to design and what to do. I'm not designing curricula, but we are still linked to a curriculum and a course with its limits." Drawing on earlier iterations of the course, he adjusted the design to allow more space for student ownership, discussion, and iteration.

This reflects his broader view of education: responsibility cannot be taught by prescription, it is something that takes practice – in a safe environment where students are able to formulate their own

concerns authentically but in a way that will be understood and ultimately accepted by the company. Bombaerts sees a change happening. Ethics is becoming more embedded in engineering curricula, particularly through approaches like CBL that integrate societal questions into core courses rather than isolating them. Still, he is cautious. Embedding ethics is not only about curriculum design, but about institutional culture and the willingness to accept 'uncertainty' in education.

So what does a responsible engineer look like?

"Here I challenge the use of the singular," When asked what responsible engineering looks like, he does not describe a fixed profile. Responsibility, for him, is situational, relational, and critical. A responsible engineer is someone who recognises the broader consequences of their work, understands ambiguity, reflects on their own values, and remains accountable but also critical to society, even when solutions are unclear.

TU/e's work with ethics through CBL shows that responsible engineering cannot be taught through theory alone. It requires learning environments where students experience moral complexity as part of engineering practice itself.

Where am I drawing the box, and who disappears when I do?

Annusuya Ghimire,
Student MSc Humanitarian Engineering,
University of Twente

The plastic coffee cup lid , with its neat little tear tab. The blunt end of a thumb tack. The pipes behind a tap that reliably give us clean water. Everything physical (and digital) around us has been drawn, calculated, tested, and approved by someone. We live inside other people's engineering work, even when we don't see it. The world around us is a culmination of someone else's choices.

Every "trivial" object and every piece of infrastructure carries a trail of decisions: how durable the product is, where the material is sourced from, whose convenience is prioritised, whose discomfort is ignored. None of this appears by accident.

Seen through that lens, the world starts to look less like a given and more like a vast, ongoing engineering project. Engineers help construct not only our buildings and bridges, but also many of the conditions under which people live. That makes it difficult to avoid the question: what responsibility do we carry, as engineers, for the kind of world we are helping to create?

As engineering students, we are often taught to operate at an abstract layer: draw a box around a system, define the inputs and outputs, and decide what happens inside. It's a useful way to make complexity manageable, but where we draw that box is never neutral. A design that looks brilliant when the box only includes efficiency and cost can look very different once we widen it to include emissions, labour conditions, cascading effects, or the impact on those who were not accounted for while we made the decisions.

For almost any engineering solution, you can redraw the boundary and make it appear responsible or irresponsible. The box is a choice: someone decides what counts as relevant, whose experience is inside the frame, and whose is left out. Once we see that,

it becomes much harder to hide behind the idea that engineering is neutral.

My fieldwork in Calais made this distance between my assumptions and people's realities very clear to me. I worked with grassroots organisations alongside refugees, in spaces held together by improvisation, care, and constant adjustment. On paper, I was a knowledgeable master's student, "the engineer in training." In practice, I was the person who understood the least about how things there actually worked. I arrived assuming there were many things they would need my help with. Instead, I found people who were already solving most problems themselves. They did not need help with everything; they needed us to listen to what they actually wanted support with, and to respect what they were already doing.

During my project in the Jacuí Delta in Brazil, this shifted from individual tasks to a broader way of working. "Living with floods" sounded at first like a technical challenge: risk maps, defences, scenarios. But people in the delta were already living with water, adapting their routines, and building local strategies. Any intervention that ignored that would not only miss the point, it would likely be resisted or undone. Co-design there meant starting from their understanding of the river, their history with previous projects, and their sense of what was actually desirable, not just what looked elegant from a distance.

Together, these experiences shifted my understanding of responsibility. It was no longer about coming up with the best possible solution. It was about accepting that my definition of the problem might not be accurate in the first place. The community was not a passive recipient of my future engineering work; they were already engineering their own survival within the limits imposed on them. My role, if I had one, was to work with, not for. I realised how easily my education could have led me to confuse having tools with understanding the problem. From a distance, it is tempting to assume we know what "the best solution" is. In reality, we often do not even fully grasp the problems we are trying to solve because we are so far removed from the lives and histories it is entangled with.

"We are taught how to make things work, but very little on how to decide which things are worth making, or when the most responsible choice is to walk away."

This distance is also visible in how we are trained. Engineering curricula excel at training us to "solve the problem." Across many disciplines, students are rewarded for speed, optimisation, and technical elegance. There is a certain pride in being able to tolerate heavy workloads, late nights, and difficult courses. What there is less room for is reflection: whose problem is this, actually? Who do these requirements serve?

There are consequences when this "solve at all costs" mindset graduates into industry unchanged. Every year, waves of students leave with strong analytical skills, a high tolerance for discomfort, and very little practice saying, "No, I don't think we should build this." We are taught how to make things work, but very little on how to decide which things are worth making, or when the most responsible choice is to walk away.

I don't believe engineers carry some mystical moral burden that other professions do not, or that

choosing this degree automatically makes me more responsible for "the betterment of mankind" than anyone else. But I do believe we have a certain level of power that comes from the education we receive, the backgrounds we bring, and the positions we occupy.

As engineers, we are often the ones who see what a new process will do to resource use, or how the infrastructure will play out in the long run, even when others treat it as a minor technical detail. That kind of insight is a form of power, and power comes with responsibility.

So what does responsible engineering mean for me, as someone who is still learning? It means moving beyond the technical details and also thinking about the people- not just the stakeholder who comes to us with the budget, but the communities that will live with the infrastructure and those labelled as "beneficiaries." In practice, it has meant asking in a project meeting: who will be affected by this design that is not represented here? It means noticing when my own work is drifting towards serving the needs of already powerful actors at the expense of those with less voice.

I often return to that feeling of living in a world full of things I didn't understand. When I look at something as simple as a plastic coffee cup lid or a "temporary shelter," I try to see the systems that produced it, the hands that assembled it, the places where its waste will end up, the people who will live with its consequences. I also see myself and the role I can play as an active participant in the world rather than an outsider observing a neutral world.

I still don't have a neat definition of a "responsible engineer." What I do have is a set of questions I carry with me: Where am I drawing the box, and who disappears when I do? What am I enabling and for whom?

Being a responsible engineer, for me, has meant staying with these questions long enough to let them change how I work, who I work with, and what I am willing to build.

"On paper, I was a knowledgeable master's student, (...) in practice, I was the person who understood the least about how things there actually worked. They did not need help with everything; they needed us to listen to what they actually wanted support with, and to respect what they were already doing."

Tinkering to bring values to life

In conversation with Janna van Grunsven, Assistant Professor Ethics and Philosophy of Technology, TU Delft

A creative pedagogical activity that uses hands-on tinkering to explore ethics in engineering design

There is a familiar problem for teachers in engineering ethics education: students understand the theories, but the values may remain abstract and ethical reflection can feel distant from practice. The tinkering exercise approaches this problem from a new angle, instead of asking students to analyse values first, it asks them to make them.

"The idea was really: how can we make ethics more concrete, more tangible? Not only something you talk about, but something you experience. Does it really sink in? Does experiencing something with your body make it more concrete and alive?"

The tinkering exercise is an elective, hands-on ethics activity developed by Janna van Grunsven and several of her colleagues at the Ethics and Philosophy of Technology Section at the Faculty of Technology, Policy, and Management. Students work in small groups to redesign existing healthcare technologies, such as wheelchairs, hearing aids, or dementia phones. Using everyday materials such as cardboard, fabric, elastic, and tape, they physically alter these artefacts; with the intention that the modifications should reflect a value, such as inclusivity, accessibility, or care.

"They are not just changing an object. They are changing how they think about what that object means." What matters is not technical improvement, but the fostering of ethical awareness or sensitivity. "The goal is not to tell students what the right values are, but to help them see how values always shape design."

Embodied learning

The exercise, rooted in embodied learning, assumes that students do not learn ethics solely through language and logic, but also through touch and movement. Engineering students are already used to thinking with their heads, and so the tinkering exercise deliberately invites them to think with their hands. The idea that artefacts embody values to make them more concrete so the student might think, "Oh, if I if I change it like this, it will have that outcome.

"When students physically work with an artefact, it suddenly becomes very real. (...) something worn or depended upon, changes perspective. And then the ethical questions shift, reducing the distance between the conceptual issue and the designer.."

You can explain ableism or inclusivity in words, but when students physically work with an artefact, it suddenly becomes very real. Handling an artefact close to the body, for example, something worn or depended upon, changes perspective. And then the ethical questions shift, reducing the distance between the conceptual issue and the designer. It is brought to life from "what should engineers do?" to "what does this do to someone's life?"

Preparation matters

Before the workshop, students were asked to study user experiences and stakeholder testimonies to understand how people actually live with these technologies. "Some groups really came prepared, having read all of these personal user testimonials, and it really featured in their decision-making processes together.

There was also one group that worked with a phone designed for people with Alzheimer's disease or other forms of dementia. The mother of one of the students worked in a nursing home for people with Alzheimer's; the student was also calling her once in a while during the tinkering workshop to ask for firsthand experience: "Would this choice make sense to you? Would this make things easier for them?" During the workshop, groups negotiated which value they want to prioritise and made design choices together, justifying them ethically.

Students challenge each other's assumptions and suggest alternative values or users and the peer feedback deepens the process. "They have to explain every choice they make. Why this value? Why this user? Why this design?" which anchors the creativity in ethical reasoning.

Enjoyable ethics elective

One very relevant outcome of the activity is enjoyment. Van Grunsven noticed that students engage deeply, and some groups become visibly invested

in their designs. They test ideas, revise them, and even look for extra materials. “One student actually left the classroom, hopped on his bike to the Gamma to buy something because they really wanted their design to work.” And it’s this engagement that matters because when students enjoy the process, ethical reflection no longer feels like an obligation.

They forget that this is ‘ethics’. They are just busy thinking, making, discussing. And they are discovering something about themselves. Students often realise how strong their own assumptions are, especially around disability and care. They suddenly see: Oh wow, I assumed this was helpful, but for users it’s actually frustrating or stigmatising. And it really made them think more about how intimate the relationship is between people and the objects they use to navigate their daily lives.” Students reported that the exercise changed how they perceive technology, not only medical devices but also everyday designs.

How it fits into engineering curricula

The tinkering exercise does not replace theory. It complements lectures, readings, and ethical frameworks and, because it is modular, educators can adapt it easily. It has been used in bachelor’s and master’s programmes, PhD courses, and DEI-focused education. “Even when students are sceptical at first, they usually give in to the process.”

The exercise creates a bridge between abstract ethics and concrete engineering practice and offers a transferable model for ethics education that is concrete, scalable, and adaptable. It speaks directly to a common challenge: how to make ethics stick with technically oriented students.

The tinkering exercise will continue, it’s not a finished story. but one that, in van Grunsven’s opinion, fits responsible engineering quite well. Like engineering itself, ethics is something to be practised, with care, creativity, and attention to the human body.

Read the paper: 4E cognition, moral imagination, and engineering ethics education: shaping affordances for diverse embodied perspectives

Available by download via the Comet 3.0 website on 4TU+.CEE Innovation Map

Three ways to practise responsibility without real-world consequences

These learning activities simulate engineering decision-making through realistic scenarios and ethical dilemmas. Instead of asking students to identify a single correct moral answer, "games" invite them to consider competing values, trade-offs, and contingencies to decide on the most appropriate course of action in context.

From the perspective of situated learning, playful learning can help steer students away from a right-or-wrong mindset and toward authentic reasoning, done on-the-spot like real world engineering practice.

UNEXPECTED VALUES
Navigating incentives
1

BIOTECH DILEMMA GAME
Negotiating values
2

CLIMATE FRESK
Understanding systems
3

UnExpected Values

THE FREE MARKET (RUG)

CORE TENSION: PROFIT VS ETHICS VS SOCIETAL IMPACT

UnExpected Values: The Free Market is a role-playing strategy game in which participants act as CEOs and face dilemmas inspired by real corporate scandals and ethical crises. It is designed to sharpen ethical reasoning, reveal tensions between profit and ethics, and stimulate discussion about whether systemic change is needed. It shows how structures shape behaviour, not just individual ethics. This is the game that sparks debate rather than giving answers.

We asked Angelos Konstantinidis about the development of the game UnExpected Values: The Free Market.

How can we learn to act responsibly within systems that shape the choices we make?

This question sits at the heart of UnExpected Values: The Free Market, an educational strategy board game I developed. Too often, discussions about ethics assume that individuals are free to choose the "right" option if they simply know better. But in reality, decisions are never made in a vacuum. Market pressures, competition, and the constant drive for growth and profit shape what feels possible.

In such environments, the pursuit of wealth is not just a personal ambition; it is embedded in the system itself. It rewards those who prioritize financial growth and can push decision-makers toward short-term gains at the expense of social and environmental responsibility.

The game is designed to bring these tensions to the surface. Players take on the role of CEOs and face dilemmas inspired by real-world cases, where the most profitable option is in conflict with the most responsible one. As they play, they begin to recognize how ethical compromises emerge-not only from personal values, but from the incentives and constraints of the system they are part of.

This is where the title UnExpected Values comes from. Players often know what the ethically responsible choice is, yet still choose the more profitable path. In doing so, they reveal values they might not have expected to act upon-values shaped by pressure, competition, and the logic of the system itself.

Experiencing this tension in a low-stakes environment allows players to reflect on their own priorities and develop the awareness needed to make different choices-before real consequences are on the line. What stands out immediately is how quickly players become emotionally and intellectually invested.

Because the game is grounded in real-world cases, it cultivates a strong sense of reality. Each dilemma

card includes a QR code linking to the actual story behind it. Even when players do not scan it, simply knowing that these situations are real changes the tone and encourages deeper engagement.

As dilemmas are read aloud, players listen closely and often react in the moment-encouraging or challenging each other's decisions. The possibility of taking others to court adds another layer. Players can challenge profit-driven choices, with outcomes determined by a dice roll. If the plaintiff wins, the defendant must pay damages. This creates a clear tension: pursuing profit can be rewarding, but it also comes with increasing risk.

Although this does not fully mirror reality-where accountability is often limited-it creates both tension and a sense of justice. When a player who has repeatedly chosen profit is held accountable, there is often a visible reaction: relief, satisfaction, a feeling that balance has been restored. These moments are particularly valuable to unpack.

In the debrief, I often ask: Why did that feel fair? What made certain decisions acceptable or uncomfortable? These conversations help players see that responsibility is not only about individual choices, but also about how systems enable, constrain, or fail to regulate those choices.

One striking pattern is how easily profit-driven decisions are justified under pressure. As players compete to stay ahead, their reasoning shifts. At the same time, there are moments when players hesitate-usually when a dilemma feels personally relevant. That discomfort is important. It slows the game down and creates space for reflection, discussion, and sometimes disagreement.

For educators, my main recommendation is to treat the game not as a standalone activity, but as a structured learning experience. The real value lies in the debrief. Create space for reflection, encourage participants to connect their in-game decisions to real-world contexts, and invite them to question the systems shaping those decisions.

It is also important to embrace different forms of engagement. Some players focus on winning, others on ethical consistency, and others shift depending on the situation. This diversity is not a limitation-it is what makes the discussion meaningful. Moments of hesitation or discomfort are especially valuable, as they open up deeper reflection.

Ultimately, UnExpected Values does not aim to prescribe ethical behavior or responsibility. Instead, it creates a space where players can experience how responsibility operates within systems-and begin to ask what it would take to act differently within them.

Bio

Angelos Konstantinidis, PhD, is an Educational Advisor at the University of Groningen, the Netherlands. His research and practice focus on open educational practices, course design, student well-being, learning-oriented assessment, game-based learning, online intercultural exchange, and the ethical dimensions of digital technologies.

He has recently designed UnExpected Values- an open board game that supports multiple configurations, ranging from examining the social and financial dynamics that shape ethical behavior in business to the factors that enable or constrain innovation adoption.

More about Angelos at https://angeloskonstantinidis.eu

Biotech Dilemma Game

NATURE INCLUSIVE EXERCISE (WUR)

PLAYERS CONFRONT CONFLICTING VALUES WITH NO CLEAN SOLUTION

The Dilemma Game is a scenario-based, discussion-oriented tool that presents ethical dilemmas and asks participants to choose, reflect, and discuss different perspectives. In WUR-related versions, it is used to develop moral sensitivity, empathy, teamwork, and awareness of value diversity in research and scientific integrity contexts. With an emphasis on multi-stakeholder perspectives, the Dilemma Game is good for showing that "responsible" is often context-dependent.

We asked Carlos Serrano Fajardo at Wageningen University & Research about his experiences with The Biotech Dilemma Game.

Which game or tool do you work with?

I developed the 'The Biotech Dilemma Game', it is a card-based roleplaying game to help students work through the ethics aspects of biotechnology. Students take on roles of different worldviews - like those of a family shop owner, an investor, a school parent representative, or a scientist – not to 'solve' a problem, but to navigate it through the lens of different worldviews.

Using the worldviews framework of Annick de Witt, we tried to address complex decision-making processes to integrate the whole spectrum of systems thinking with each character's hopes and fears. In daily-life decisions, not only cognitive arguments play a role, but also our values, beliefs, and hopes, and we need to acknowledge these human drivers to bridge the gap between different perspectives.

What do you notice when people play? Are there things that surprise you?

What surprised me most was how much students enjoyed not having to be 'purely academic' for a moment. In today's academic studies, we spend so much time on the cognitive side - data, logic, and 'brain' work - but that isn't the whole picture. When the game starts, the vibe in the room changes because the students finally get to engage with other parts of being human, like their core beliefs and values.

To be honest, I was initially a bit worried they might reject it for being 'not scientific enough,' but it was the opposite. They were actually grateful to shift the focus away from their brains for a day and just have fun together. It really showed me that for a serious game to work, the 'fun' factor has to be real. It can't feel like another chore from the course syllabus; it has to feel like an actual game.

Are there moments when participants get stuck?

Definitely. Usually, it's because they get 'zoomed in' too much on a specific technical problem and lose sight of the bigger picture. In our studies, we aren't

always trained to see how everything connects holistically to society. As a facilitator, one has to nudge them to 'zoom out' and see the whole system. I'd ask things like: 'If you approve this technology, what does that mean for a different group of people down the line?' or 'What if we took this decision to the absolute extreme?' It's all about practising the skill of seeing the implications of our choices across society, not just in the lab.

Is there a noticeable difference in the way players react depending on their angle?

What's really interesting is how people polarise. Because they want to 'fully embody' their role, they sometimes push their character's agenda even harder than a real person might! It was fascinating to watch how power dynamics play out on a small scale in a game. I remember one session where a 'lobby' formed: the CEO of a biotech firm and an applied researcher teamed up to lobby hard against low-income consumers to push a certain product into the market.

By the end, the consumer was left totally powerless facing a new technology and product that they didn't really need or want. Seeing those power plays happen in a safe environment is a big eye-opener for the students.

Does anything change after the session?

This is a difficult one. With this type of educational intervention, we are not dealing with knowledge that can be easily transferred from one brain to another. Instead, we are dealing with worldviews, values, and beliefs, which are 'hard-wired' into who we are. You don't change someone's entire outlook on life in a 90-minute session.

However, I do see tiny steps towards awareness. Students start challenging each other's opinions more thoughtfully, they impersonate someone they do not necessarily agree with, and they realise that even scientific knowledge and what we teach stems from a specific 'modern' technical worldview.

I believe that planting this seed of self-reflection is essential. Awareness of your own responsibility and the impact of your actions on others' lives is the start of a responsible changemaker's journey.

Bio

Carlos Serrano Fajardo, MSc, is a Lecturer in Bioprocess Engineering at Wageningen University & Research (Agrotechnology & Food Sciences Group). His PhD research focuses on integrated bioprocess design. He teaches bioprocess engineering and coordinates the soft skills learning trajectory at the BSc Biotechnology at WUR. He developed the Biotech Dilemma game, a serious game that brings ethical reasoning into the bioprocess engineering curriculum.

Photocredits: Foto Carlos Serrano, babypro.art

Climate Fresk

CLIMATE LITERACY IN ACTION

STRONG FOCUS ON SYSTEMS THINKING AND EMOTIONAL ENGAGEMENT

Climate Fresk

Climate Fresk is a facilitated, collaborative workshop based on the reports of the Intergovernmental Panel on Climate Change (IPCC). In approximately three hours, participants work together to build a "fresk" using a set of cards that represent the causes, mechanisms, and consequences of climate change. The workshop is designed to foster systems thinking, shared learning, and action.

Climate Fresk is entirely collaborative: participants collectively construct their understanding of the climate change system, while facilitators guide the process without directing outcomes unless necessary. This collaborative nature is central to its educational value.

In contrast to competitive games such as UnExpected Values: The Free Market, Climate Fresk emphasises collective knowledge creation rather than strategic competition. Participants develop a common understanding of climate change through discussion, negotiation, and interpretation. As a result, learning becomes a cognitive process that is also a social, and often emotional, experience. The learning finally translates into specific actions to address Climate Change.

The format is simple yet carefully structured. Participants work in small groups with a set of 42 cards derived from IPCC reports. Each card represents a driver, process, or consequence within the broader climate change system, including socio-economic drivers and environmental effects such as human activities, emissions, feedback loops, and climate impacts. Participants arrange the cards into a systemic fresk that illustrates how different elements of the system interact. In doing so, they gain a deeper awareness of the complexity and interconnectedness of climate change, as well as a clear map that helps them start addressing it.

Victor Garcia Galofré shares his experience working with Climate Fresk at TU Eindhoven

Within engineering education, students are often trained to break problems down into manageable parts and find solutions. Climate Fresk encourages an alternative view: stepping back and examining how those parts interact within a larger system.

In that way, engineering students can gain a better understanding of what complexity looks like and how interventions in one part of a system can produce consequences elsewhere. It also helps in fostering engineers who understand that solutions are rarely absolute, sometimes even uncertain; they are embedded within networks of dependencies, feedback loops, and trade-offs.

At TU Delft, Climate Fresk appears in faculty-level sustainability initiatives, library workshops, and student onboarding activities, particularly in programmes such as Industrial Design Engineering. What stands out at TU Delft is that Climate Fresk is not treated as a standalone awareness exercise. In several cases, it is positioned as part of a broader educational trajectory, especially in early-year experiences such as climate bootcamps.

Advocates tend to come from teaching staff and sustainability coordinators rather than from top-down institutional mandates. At TU Delft, facilitators such as Irene Fernandez Villegas, Alice Biolchini, and Lise Magnier have been involved in running sessions across faculties and student programmes. Their role is less about ownership of the tool and more about embedding it into existing educational contexts where systems thinking is already being discussed.

At Eindhoven University of Technology (TU/e), Climate Fresk is organised through the Sustainability Office in collaboration with the GO Green Office and Innovation Space, which regularly host workshops for students and staff across the university. The format has featured in campus-wide sustainability initiatives such as TU/e Green Week, where it has been offered alongside activities on biodiversity, sustainable life-styles, climate anxiety, and the energy transition.

Climate Fresk at TU/e primarily functions as a community-building and engagement tool. Through the efforts of Sustainability Office staff, student sustainability ambassadors, and TU/e Innovation Space, participants from different faculties come together to explore climate change as an inter-connected socio-technical system and to develop a shared language for discussing sustainability challenges.

The value of Climate Fresk lies in alignment. After a session, participants tend to share a common reference point for discussing climate complexity. This shared mental model makes sub-sequent conversations about engineering choices, responsibility, and sustainability trade-offs more concrete and less abstract. By helping participants visualise the interconnected causes and consequences of climate change, Climate Fresk creates a foundation for more informed dialogue and decision.

For those inspired by the experience, participation does not have to end when the workshop finishes. Climate Fresk actively encourages participants to become facilitators themselves, helping spread climate literacy within their own institutions, organisations, and communities. After attending a workshop, individuals can follow facilitator training and join an international network of volunteers and practitioners who organise sessions around the world. In this way, Climate Fresk functions not only as a learning activity but also as a scalable peer-to-peer initiative, enabling participants to foster systems thinking and climate awareness wherever they are.

Bio

Víctor García Galofré, is a CEE PhD Candidate at Eindhoven University of Technology and Wageningen University & Research. His research focuses on designing entrepreneurship education for grand societal challenges and exploring how engineering students can be prepared as change agents through entrepreneurship.

Alongside his research, he facilitates workshops such as Climate Fresk and collaborates with researchers and educators to co-create learning experiences that foster responsible entrepreneur-ship and meaningful societal impact.


1
2
3
Worldview overview

Anticipating responsibility

In conversation with Martin Sand, Assistant Professor, Ethics and Philosophy of Technology, TU Delft

About combining critical analysis and creative making

Engineering education often focuses on solving present-day problems. Yet the ethical consequences of technology tend to unfold in futures that are uncertain or contested. The Responsible Anticipation and Visioneering exercise, developed by Martin Sand within the COMET 3.0 project, addresses this gap by asking students to engage directly with those futures. Rather than predicting what will happen, students learn to question how futures are imagined, and by whom.

We spoke with Sand about why that shift matters, and what students discover when they begin to question the futures they are working towards.

What problem in engineering ethics education does your exercise respond to most directly?

"One of the key problems is that students often take visions of the future for granted." They adopt them without really questioning what is behind them, what values they contain, or who they serve."

One example discussed is the idea of colonising Mars. At first glance, it appears as an exciting and almost inevitable next step. But when students analyse it more closely, questions emerge about why this future is prioritised, whose interests it serves, and what assumptions it carries about life on Earth.

Sand uses space colonisation as a typical future vision that feels exciting but goes largely unquestioned. These visions are often presented as natural progress ("of course we will go to Mars"), and they carry hidden assumptions about technology and human priorities. In his experience, students initially accept the narrative without critique.

He highlights that once students analyse visions like this one, they begin to ask different questions: for example. Why is colonising Mars even desirable? and "Who benefits from this vision?" Sand points to a familiar pattern. Technologies are developed with implicit ideas about progress and efficiency, or improvement, but these ideas are rarely examined. "If engineers don't reflect on these kinds of visions, they risk reproducing them without questioning them.

What qualities come to mind when you think of a responsible engineer?

Rather than offering a fixed definition, Sand describes a mindset. "A responsible engineer is someone who reflects on the broader implications of their work, including the futures they are contributing to."

This includes awareness of how seemingly small design decisions connect to larger societal trajectories. Responsibility, in this sense, is not only about solving problems, but about questioning how those problems are framed.

How does visioneering help students develop those qualities?

The exercise has two steps. First, students analyse existing technological visions. Then they create their own. "We start from the idea that visions are never neutral descriptions of the future." By unpacking these visions, students begin to see how values shape them. But the awareness starts to fall in place when they start creating. "The moment they start creating, they realise how many choices they have to make." That process makes ethics tangible. Students experience that every vision holds priorities, exclusions, and assumptions.

The exercise sometimes includes looking at online historical or contemporary images of imagined futures. These range from mid-century illustrations of space-age living to more recent visions of AI-driven societies.

These kinds of images or visions show how people at a certain time imagined the future, and they reveal what they valued or expected from technology. The images are technologically optimistic and socially simplistic (with little diversity and little conflict). Students are asked to unpack what these images assume about technology, society, and progress. The images function as entry points for critique.

What are the risks if engineers don't reflect on future visions?

The risk is primarily societal. "If you don't reflect on these visions, you simply follow dominant narratives without questioning them." This can lead to reinforcing existing inequalities or overlooking alternative futures. "Visions guide action. If they remain implicit, they still shape what we build." In that sense, not reflecting is already a choice.

How do students connect this to their own engineering decisions?

There is often a clear turning point. “They start asking themselves: what kind of future is my own project contributing to?” This question brings the exercise back to practice. Students begin to link abstract futures to concrete design choices. “They realise that a vision is always selective. It highlights some aspects and ignores others.” It’s a moment of recognition that often marks a deeper level of engagement.

Is this approach relevant across engineering disciplines?

For Sand, the answer is clear. “These kinds of questions are relevant wherever technology shapes the future, which is basically everywhere in engineering.” While the examples may differ, the underlying challenge remains the same. Every field operates with implicit ideas about what the future should look like. The exercise offers a way to surface and question those ideas.

“If you don’t reflect on these future visions, you simply follow dominant narratives without questioning them.”

A strength of the exercise is its combination of structure and openness. The analytical phase provides grounding, while the creative phase allows ownership and exploration. At the same time, this openness can be challenging. Some students initially look for the “correct” interpretation or struggle with the ambiguity of creating their own visions. “They are used to solving problems, not to questioning the frame of the problem itself.” With guidance, students can move beyond this certainty and solution-driven thinking. They engage more critically, and often more personally, with the material.

Do you see the exercise being adopted or reused by others?

“Yes, because the structure is quite flexible.” The exercise is designed to be modular. Educators can adapt it to different contexts, technologies, or levels of study. This flexibility makes it easier to integrate alongside existing courses, rather than replacing them.

If this approach were widely adopted, what would change?

Sand points to a shift in mindset rather than content. “I think engineers would become more aware that they are not just solving problems, but also shaping futures.” This would move responsibility earlier in the process. Not as an afterthought, but as part of design itself. Instead of asking what works, students would also ask what kind of future does this create?

The Visioneering exercise makes futures visible and open to critique, inviting students to engage responsibly before decisions are finalised. In doing so, it reframes engineering beyond a purely technical practice to a way of shaping the world to come.

Ethics in practice at WUR: Learning responsibility through real-world encounters

At Wageningen University & Research (WUR), ethics is treated less as an abstract "add-on" and more as something that is already embedded in how engineers, life scientists and social scientists learn to act in the world. The podcast *Teaching Ethics in Practice* makes this visible by asking teachers to reflect on ethical questions that arise in concrete teaching situations, such as excursions, fieldwork, design projects, and encounters with stakeholders.

For PhD candidate Thijs Loonstra (Philosophy and Educational Sciences, WUR), this practice-first approach connects directly to his 4TU.CEE-funded project Integrating Ethics in Environmental Education, which investigates how higher education frames responsibility and sustainability and how curricula can better support students in navigating socio-ecological complexity. "We already make normative choices when we decide which models, narratives and cases to teach," he notes. "The question is whether we help students recognise and critically engage with those choices."

Ethics as encounter, not only argument

One example that crystallises this approach is the Migrant Tour Utrecht, used in second-year courses in tourism studies and engineering. Students join a guided city walk led by migrants, who present local cultural heritage from their own perspectives and experiences. The exercise is deliberately designed to be affective as well as cognitive: students prepare by studying concepts like justice, inclusion and belonging, and afterwards work in a hands-on redesign session where they analyse the ethics of social entrepreneurship and tourism initiatives.

"An approach like this engages emotions and vulnerability," Loonstra explains. "We do not want students to feel they fully understand why the world is going wrong and why nothing can be

done. We want them to be motivated to make a change (affective), cooperative in making a change (social), and have the know-how to make a change (practical)." The underlying assumption is that responsible professionals are formed not only through conceptual clarity, but also through situated encounters with real people and real frictions. The podcast episode brings this to life through multiple voices in the WUR community.

Lecturer-researcher Jijen (Trista) Ling (Cultural Geography) discusses how tourism students confront questions of power and representation. Ethicist of technology Zoë Robaey (Philosophy Group) reflects on teaching ethics to biotechnology, molecular life sciences and engineering doctorate students, where issues of uncertainty, risk and control are central. Educational trainer and advisor Hubertie Krohn (Teaching and Learning Center) adds the perspective of the *Skills* project, which sought to integrate ethics as a transversal skill across the curriculum. Together, they show how ethics in practice becomes a shared project between subject lecturers, philosophers and educational developers.

Mapping paradigms in environmental education

Loonstra's research zooms out from individual courses to the broader landscape of environmental education. His starting point is that how we construct knowledge about nature, through scientific models, political narratives or anthropological stories, shapes the norms and responsibilities that students take for granted.

To investigate this, he developed a taxonomy of environmental paradigms (scientific, socio-political, anthropological) and analysed how these are represented in course materials, alongside learning domains (cognitive, affective, behavioural). Using deductive content analysis, he coded a diverse set of environmental course study guides and associated documents, cross-referencing them with terminology from these paradigms. This makes visible where curricula lean heavily on a particular worldview, for example, portraying environmental problems mainly as issues of technical optimisation or primarily as governance struggles. A key pattern emerging from this work is that cognitive learning outcomes and disciplinary silos dominate, while affective and practical dimensions of responsibility receive much less explicit attention.

This empirical mapping builds on theoretical work showing that students interpret the world through worldviews that structure both their moral intuitions and their understanding of science. It suggests that the impact of ethics education depends on more than offering "an ethics course" as a standalone module. Instead, Loonstra argues for "microdosing" ethics across multiple courses, so that students repeatedly encounter tensions between paradigms and are invited to reflect on their own position.

From smartness to wisdom

Asked how this connects to responsible engineering, Loonstra draws a distinction between being "smart" and being "wise". Smartness, in his terms, refers mainly to cognitive performance within a given paradigm; wisdom adds the ability to recognise ethically salient features of a situation, to see problems at multiple levels of description, and to care about what is at stake.

Take plastic pollution: at one level it is a matter of polymer chemistry and degradation; at another, it reflects political choices, infrastructural lock-ins and cultural habits. Responsible professionals must learn to shift between these levels and understand what each demands from them, whether technically, socially and politically.

Current curricula, he suggests, are good at cultivating smartness but less intentional about wisdom.

The Biotech Dilemma Game developed with colleague Carlos Serrano is one attempt to address this. Students are confronted with a real-life ethical dilemma and asked to analyse it from different worldviews, surfacing their own blind spots and learning to live with plural, sometimes conflicting, perspectives. Rather than searching for one correct ethical answer, they practice articulating and negotiating reasonable positions within and across paradigms.

At the institutional level, Loonstra worries about what he calls a "strong utilitarian approach to education". The persistent student question "Will this be on the exam?" is understandable in a competitive and expensive system, but it narrows attention to short-term performance and discourages curiosity and reflexivity. Yet those qualities are vital if students are to cross disciplinary boundaries and engage sincerely with the social and ecological consequences of their work. He sees hopeful signs in the way students and teachers increasingly question academic culture itself, even as institutional and cultural conditions still dampen deeper change.

Implications for engineering educators

Loonstra's work raises highly relevant questions for engineering programmes across the technical universities. Many engineering curricula grapple with similar patterns: tight disciplinary structures, emphasis on cognitive mastery, and limited explicit space for affective and practical learning about responsibility.

WUR's experiments with ethics-in-practice (city tours with migrant guides, worldview-based dilemma games, cross-faculty collaboration between subject teachers, ethicists and educational developers) offer concrete formats that could be adapted to engineering contexts. For the 4TU.CEE community, this case suggests several directions. One is to treat ethics not as a separate specialist domain but as a shared responsibility distributed across courses, supported by targeted initiatives (such as the Skills project). Another is to use tools such as paradigm taxonomies and content analysis to make the implicit worldviews in engineering curricula visible, and to ask whether they equip students to navigate socio-technical complexity or mainly reinforce a single way of seeing.

Finally, the emphasis on aligning head, heart and hands invites educators to design learning experiences in which technical analysis, stakeholder engagement and emotional responses to real-world problems are intentionally connected rather than kept apart.

As universities reconsider what it means to educate responsible engineers, WUR's ethics-in-practice approach demonstrates how much can be gained from real-world encounters, interdisciplinary collaboration, and careful attention to the paradigms that quietly influence our teaching.

Read more about Thijs's work on the CEE Innovation Map

Integrating Ethics in Environmental Education
An Applied Taxonomy for Ethics in Higher Education

Caring for and recognising distant others

In conversation with Andrea Gammon, Assistant Professor, Ethics and Philosophy of Technology, TU Delft

Caring from a distance: What does responsibility mean when those affected by an engineering innovation are absent from the room?

Andrea Gammon's Comet 3.0 exercise was developed for the master's course Environmental Ethics at TU Delft, the activity invited students to think about their responsibility in sociotechnical systems. It was an exercise that went beyond practicing empathy, by considering others that are often invisible in engineering decision-making.

Although Gammon herself considers the exercise only partly successful, the experience led to important insights about responsibility, agency and the realities (young) engineers face. "They're maybe not sensitive to the ways that their decisions impact other people." Their decision-making also bears weight on non-human life and ecosystems. "Part of the ethics teaching is kind of sensitising them to all of these different potential impacts or consequences or dimensions that they don't see." So the educational problem is not lack of ethical rules. It is a lack of awareness of distant impacts and excluded stakeholders.

The exercise was an iteration of earlier work on the idea of "Caring from a distance". COMET researchers in a previous phase of the project had proposed this concept as a way of understanding engineering as a relationship of dependency rather than a one-off act of delivering technology.

Gammon saw particular relevance for environmental challenges, where the consequences of technological decisions often extend across time and space. "There are problems in thinking about future generations because they can't agree, they can't represent themselves. And so if we care about them, which we probably should, it's really difficult to think about how to represent them and how to give them a voice."

A matrix of technologies and distant others

The activity consisted of two tutorial sessions. Students worked in groups and explored forms of climate engineering. Each group selected a

combination from a matrix. On one axis stood different climate technologies. On the other stood three categories of "distant others":

- future generations;
- "shadow others", communities that bear hidden social or environmental costs;
- non-human others, such as species or ecosystems.

The idea of shadow others comes from ecofeminist thinking. Gammon describes these as people whose experiences remain largely hidden, for example, from those living in affluent Western societies. "When we're mining lithium in Chile, the shadow others are the populations and communities who are paying the cost of those extractive burdens". After choosing a pair, students were asked to imagine how these absent stakeholders could somehow be included in the development or use of the technology. Groups then presented their ideas and discussed them with their peers.

An unexpected outcome

The results surprised Gammon. Students rarely proposed technological redesigns. Instead, they consistently suggested social or political mechanisms. Deliberative processes and representation were recurring themes. "They really didn't see these technologies as changeable. They focused on social or political ways that these others could be included, but not on changing the technology itself. It was as if they decided, this is not what I'm in charge of. As if they're outsourcing this to another group of non engineers."

The discussions also became repetitive and the depth of analysis fell short of her expectations. For Gammon, this meant the exercise had not achieved what she had hoped. "I wanted them really to be thinking about how they could redesign a technology." Yet, the experience also challenged some assumptions within engineering ethics education. Initially, Gammon had hoped the language of care would provide a useful entry point. Instead, she discovered that many engineering students did not identify with this vocabulary. "I want you to think about care. They're like, what? And then you've already lost a lot of them. Asking them to then do something that's like very imaginative and makes them very vulnerable, I feel like it's just too much to ask. Some students love it, but a lot of others just don't feel comfortable doing it. Caring is not the predominant frame through which they understand their work. The word Caring is laden with an identity that they don't have, but I still tried to use this idea of distance."

"Caring is not the predominant frame through which they understand their work. The word Caring is laden with an identity that they don't have, but I still tried to use this idea of distance.."

Rather than insisting on the language of care, she now emphasises relationships and dependencies

that are not easy to ignore. “There are people or groups who are disenfranchised through engineering processes that need to be thought more carefully about.”

Responsibility, in her view, is not about individual heroics. Engineers operate within larger socio-technical systems and often have less freedom than ethics educators assume. “We maybe often assume that these individual engineers have way more agency to make change in the systems in which they work than they actually do”.

Students themselves often recognise these limits. Many expect to work in large organisations where decisions are shared or already determined by clients and regulations. “Part of the ethics teaching is kind of sensitising them to all of these different potential impacts or consequences or dimensions that they don’t see”.

This level of awareness is not something you acquire once and for all. New forms of exclusion continue to emerge, and ethical attention needs to evolve alongside society. “We try to have them understand that their work is not technically isolated from larger sociotechnical systems.”

Who is missing?

Although the original exercise has not been repeated, the element of introducing distant others is valuable. Gammon believes the categories of distant others could easily be incorporated into stakeholder analyses in different engineering contexts.

More fundamentally, the “Caring from a distance” exercise highlighted a dimension of responsible engineering that often remains hidden and rather than focusing on finding the right answer, it asks a different question: who might be missing from the conversation?

“Engineering students are advancing a specific idea of what a solution looks like … and having at least an awareness of that, and that those “others” are knowledgeable and should be thought of. That’s what I would imagine is a conception of respon-sibility.”

Teaching guidelines: Caring from a distance

Read

The Routledge International Handbook of Engineering Ethics Education (2025)

Developed within the SEFI (European Society for Engineering Education) Ethics Special Interest Group, this handbook reflects a wide international community - including magazine contributors Gunter Bombaerts and Lavinia Marin - working to advance ethics and responsible engineering education.

This open-access handbook offers a comprehensive overview of engineering ethics education and brings together over 100 international experts to map key themes, debates, and teaching practices. It covers foundations, interdisciplinary perspectives, and practical approaches to integrating ethics into engineering curricula, including AI, sustainability, and global responsibility. Designed for educators, researchers, and curriculum designers, it provides both theoretical insights and actionable guidance for strengthening ethical competence in future engineers.

The Routledge International Handbook of Engineering Ethics Education (Open Access)

Listen

EELISE Podcast: With Great Tech, Great Responsibility: Welcome to Tech Diplomacy

This episode explores tech diplomacy, specifically how technology increasingly shapes international relations and global power, and highlights the growing role of universities, companies, and engineers in this arena.

"Students need to understand not just how to build tech, but how it impacts the world."

It discusses Europe's value-driven approach to regulating technology, balancing ethics, human rights, and competitiveness in areas like AI and data governance. The episode emphasises the importance of educating engineers to understand the societal and geopolitical impact of their work and to contribute to inclusive, responsible technological development.

Marta Olea, Vice-Rector for Communication and International Relations at Universidad Politécnica de Madrid

Try it out

Challenge Up - Advice Wizard

A free digital tool designed to support engineering educators in adopting Challenge-Based Learning (CBL), an interdisciplinary approach where students tackle real-world societal challenges. Using the CBL Implementation Continuum, teachers can assess their current teaching practices, set their desired level of CBL integration, and receive tailored, practice-informed guidance.

Transitioning to CBL can be challenging, requiring educators to shift from knowledge providers to facilitators. Challenge Up makes this transition more manageable by offering step-by-step advice for gradually redesigning courses. It is a practical resource for educators seeking to foster interdisciplinary learning and equip future engineers with the skills needed for responsible innovation.

Adina Imanbayeva, Robin de Graaf, Cindy Poortman (University of Twente, the Netherlands)

COLOFON

sCEEne is a magazine by the Centre for Engineering Education. In every issue, we present articles and interviews with colleagues on educational innovations from across 4TU, each of them a forerunner in their field. Our first issue dives into Responsible Engineering Education.

If you would like to contribute to future issues, please contact H.D.Hartmann@tudelft.nl

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