Why and how teaching ethics to CS and engineering students: current issues and future challenges

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Agenda

- **Bottom-up approach**
  - A **representative example** and its discussion
  - Goals, aims, outcomes, issues
- A **wider framework** but rooted in **concrete cases**
  - Not only ethics
  - Not only education
  - Not only a single institution
- Open **challenges**

Let’s start with an example

- **Computer Ethics** (CE) course taught by me
- 5 ECTS for **master degree** students in **computer engineering** at Politecnico di Milano
- Active from academic year 2015/2016
- 1 semester long
- **Optional**
- Around **120-130 students** each year

CE: goals and aims

- Application of **ethical theories** to **problems** created, aggravated or transformed by **computer technology**
- Chance to reflect on the **ethical**, **social**, and **cultural impact** of **computer technology** by focusing on the issues faced by and brought about by computing professionals
- Possibility to become **aware** of the **ethical** and **social issues** connected to the **design** of **information technologies** and to look at current events through an **ethical lens**

Goals for engineering ethics education (Martin et al., 2021)

Categories	Goals
Moral sensibility*	Developing proficiency in recognizing social and ethical issues in engineering (Harris et al., 1996; Pritchard, 2005; Van de Poel & Royakkers, 2011; Martin & Schinzinger, 2013)
	Encouraging students to take ethics seriously (Harris et al., 1996)
	Increasing students' sensitivity to ethical issues (Davis, 1999; Harris et al., 1996)
Moral analysis*	Analyzing moral problems in terms of facts, values, stakeholders and their interests (Van de Poel & Royakkers, 2011)
	Comprehending, clarifying, and assessing arguments on opposing sides of moral issues (Martin & Schinzinger, 2013)
	Facilitating the analysis of key ethical principles (Harris et al., 1996)
	Exploring the perspective of those in other positions (Lynch & Kline, 2000; Martin et al., 2019)
Moral creativity*	Considering different options for action in the light of (conflicting) moral values and relevant facts (Van de Poel & Royakkers, 2011)
	Stimulating ethical imagination (Coeckelbergh, 2006; Harris et al., 1996; Martin & Schinzinger, 2013; Pritchard, 2005)
	Creatively exploring solutions rather than choosing a dilemma horn (Lynch & Kline, 2000)
	Enhancing divergent thinking (Haws, 2001)
Moral judgment*	Making moral judgments based on different ethical theories or frameworks, including professional ethics and common-sense morality (Van de Poel & Royakkers, 2011)
	Improving ethical judgement (Davis, 1999; Harris et al., 1996; Pritchard, 2005), understood as the ability to reliably respond to any situation with a course of action that makes life better (Davis, 2012)
	Forming consistent and comprehensive viewpoints based on consideration of relevant facts (Martin & Schinzinger, 2013)
Moral decision-making*	Enabling students to make decisions based on different ethical theories and frameworks (Van de Poel & Royakkers, 2011)
	Providing conceptual tools for reflecting on how organizational practices can potentially threaten public safety and welfare and how to counter the normalization of deviance (Lynch & Kline, 2000)
	Helping students deal with ambiguity in decision-making situations (Harris et al., 1996)
Moral argumentation*	Developing the ability to morally justify one's actions and to discuss and evaluate them (Van de Poel & Royakkers, 2011)
Moral knowledge	Gaining knowledge of professional standards, codes and principles (Davis, 1999; Harris et al., 1996; Pritchard, 2005)
	Giving students access to the language of ethics to express and support one's moral views adequately to others (Haws, 2001; Martin & Schinzinger, 2013)
	Grounding one's views and decisions in moral theory (Lynch & Kline, 2000)
Moral design	Considering how values, as well as modes of use and interaction, can be implicitly or explicitly inscribed into engineering artefacts at the design stage (van de Poel & Verbeek, 2006; Verbeek, 2008)
Moral agency and action	Responding wisely and responsibly to situations in a way that satisfies as many potentially Competing constraints as possible (Whitbeck, 1995)
	Empowering students to reshape the social, economic and legal context of practice (Conlon & Zandvoort, 2011)
	Encouraging students to take an activist stance "for what is right, good and just" (Hodson, 1999)
	Inspire the engineers of the future to challenge the status quo and to strengthen the profession (Lawlor, 2021)
Moral character and virtuous development	Increasing students' ethical willpower (Davis, 1999; Harris et al., 1996)
	Cultivating students' sense of professional identity (Loui, 2005; Miller, 2018)
	Cultivating virtues, such as respect for nature for engaging in environment-friendly engineering (Harris et al., 2019), *phronesis* for identifying certain decision situations and actions as ethically relevant (Frigo et al., 2021), objectivity, care and honesty (Moriarty, 2009; Nair & Bulleit, 2020)
Moral emotional development	Reflecting on the role of emotions in the development and acceptability of risky technologies (Roeser, 2012) or in the effects of climate change (Lönngren et al., 2020)
	Engaging learners in their emotional life as to develop a sense of empathy with people across physical, social and cultural distances and a language for emotions (Tormey, 2005; Hess & Fila, 2016; Hess et al., 2017)
Moral situatedness	Understanding the social relations of expertise in connection with technology management and decision-making (Devon, 1999)
	Helping students situate their work in its contribution to their community (Haws, 2001)
	Acknowledging the social dimension of engineering practice (Martin et al., 2019)

CE: topics

- Responsibility in an engineering perspective
- Normative ethics and its tools
- Ethical issues in the design of technology and Design Ethics
- Ethics in IT-configured societies
- Information flow, privacy, and surveillance
- Digital intellectual property
- Digital order
- Codes of conduct for computing professionals
- Invited lectures on specific topics

The case of responsibility

- Accident causation and responsibility
- **Not only first-order causes**
  - Immediate production pressures, poor communication, lack of training
- But also **second-order** underlying **mechanisms** that generate them (Tombs, 2007)
  - Factors present at distinct levels such as **individual agents**, the **contexts** in which they operate, the **workplace culture**, the **political environment** in which a company is based
- **Backward-looking approach** (passive responsibility) and **anticipation** (active responsibility) (van de Poel & Royakkers, 2011)

CE: approach

- **Not only case-studies**
- Integration of representative **examples** and **theoretical frameworks**
  - Looking for a balance between **practice** and **theory**
- Focus on **depth** rather than extension
  - Important from a **methodological point of view**
- Focus **not only** on **computer science** and **engineering** topics
  - Responsibility and engineering design

A problem of method (Martin et al., 2021)

- Various **teaching methods** discussed in the literature (e.g., Harding et al., 2013)
  - Case studies, lectures and presentations, roleplaying activities, in-class or online discussion, debates, voting, games, online courses, films and videos, creative fiction, science fiction, community service, field trips and visits
  - Still **limited empirical research** that could elucidate the **effectiveness** of each teaching approach and their impact on student engagement

CE: learning outcomes

- To acquire a **broad perspective** on the **ethical and social impacts** and **implications** of **information technologies**
- To recognize and analyze **ethical** and **social aspects** and issues **inherent in information technology**
- To use **critical skills** in **clarifying** and **ethically analyzing** case-studies involving information technology
- To explore and assess **possibilities for solving or diminishing** existing and emerging ethical and social **problems** that attach information
- To be **better prepared** to **future professional life** in an **ethically** and **socially responsible way**

CE: assessment

- **Class presentation, written essay, oral examination**
- **Huge effort** but **necessary** to avoid standardized tests which can be interpreted as an attempt to bring the positivist approach characteristic of the technical culture into a nontechnical subject
- Ethics is **neither a checklist neither a manual** with the right answers

Future reflective professionals

- **Awareness** of **philosophical**, **ethical** and **social** issues of **computer science**, in particular, and of **science** and **technology**, in general
- Now this is almost obvious …

Skeptisism

- **Long process** to overcome **skepticism** (usually colleagues and not students!)
- New forms of **reasoning**
  - It is possible to be **rigorous** even in the absence of numbers, formulas and equations
  - The **conceptual tools** of a **philosophical argument**
- Adding **new contents** means eliminating some of the old ones
  - This is a purely **practical problem** but a **serious** one indeed

The Times They Are A-Changin'

- The strong **impact of science and technology** on society is becoming increasingly clear
  - Examples of the impact of information technologies are common in everyday life
- **Ethics** has a **central role** for a number of reasons
  - Ethical issues are **easier** to be understood for non experts
  - It is also becoming a matter of **fashion** and **visibility** (ethicswashing as a risk)

A wider framework

- Times are changing but these topics require to be addressed within a **wider framework** to move toward a **real paradigm shift**
  - Not only ethics
  - Not only education
  - Not only a single institution

Not only ethics

- To **broaden the constellation of courses** from the humanities and social sciences in computer science and engineering curricula
  - Philosophy of science, philosophy of technology
  - Science and technology studies (STS)
  - Sociology
  - History
  - …
- Importance to add **further dimensions** and **bypass the rhetoric of soft skills**
- **How to make room** for new contents in crowded curricula in which technical and scientific concepts are given priority

Not only education

- This type of **education** needs to be strongly integrated with **research of interdisciplinary nature**
- Research shows the **complexities** of these topics and the **integration** can **avoid**
  - Instructors' lack of familiarity and training in teaching ethics such that **simplistic teaching** might lead to **simplistic messages**
  - Engineering instructors **lacking guidance** and training on how to teach ethics (Harding et al., 2009)
- Need of a **new generation of scholars** trained in the humanities and social sciences
  - Deeply acquainted to technical and scientific areas
  - Working in **departments** of science and engineering
  - Knowledgeable in **teaching** to students not in the humanities neither in the social sciences

A possible example

- **Interdisciplinary** network of scholars from humanities and social sciences (about 20 people)
- Expertise in **philosophical**, **ethical** and **social** issues related to **science**, **technology**, and **engineering**
- **META disciplines** (from the Greek meaning of '**reflecting on**')
- www.meta.polimi.it

META teaching

- Courses in the **humanities** and **social sciences** to (mostly) **master** and **doctoral students**
  - **Stand alone courses:** *Ethics for Technology, Computer Ethics, Critical Thinking, Philosophy of Science and Technology, Sociology of Science, …*
  - **Integrated courses**: *Power Systems: Ethical Issues and Social Implications, Gender and Technology*
- **Instructors** with specific **expertise** in the **humanities** and **social sciences** and working in a technical university on topics at the i**ntersection** of **humanities/social sciences** and **science/engineering**

Challenges

- **Co-teaching activities** (integrated courses) involving engineering and philosophy or social sciences instructors
  - To address the **problem of expertise** and convey to students a message about the importance of this subject
  - **Expensive**, **time and labour-intensive approach**, which requires long-term contact and research efforts (Bombaerts et al., 2021)
  - **'Second- rate academic work'** (Taebi & Kastenberg, 2019)

META research

- **Humanists** and **social scientists embedded** in different departments
- Researches **in collaboration** with engineering, architecture and design colleagues
- Hiring **young scholars**: new departments, new fields, **early integration**

Institutional change

- Necessity of a **cohesive** and **purposeful strategy** for **implementing ethics** in a **systematic manner**
- Ideally an **implementation strategy** should take precedence over the introduction of ethics learning activities (Li & Fu, 2012)
- A systematic implementation of ethics requires a **wide scale transformation** undertaken **at institutional level** (LeBlanc, 2002)
- Several **challenges**
  - **Budgetary** pressures
  - **Limited institutional resources** for hiring external scholars with an expertise in this area
  - **Insufficient space** in the curriculum
  - **Lack of guidance**

The complexities of interdisciplinarity

- **Sociotechnical divide** and the **two cultures** still present (Snow 1959)
- Need of a **hybrid** and **comprehensive paradigm** integrating the scientific, technical, social, political and environmental dimensions of science and engineering (van den Hoven, 2019)
- **Interdisciplinarity** is recognized as important in **theory**, but then the **practice** is **different**
    - Schemes of **funding**
    - Venues of **publication**

Why is this integration is important?

- **Critical thinking** to deal with **complex problems**
- **Avoiding ethical** and **social risk** with the tools of humanities and social sciences (technology is not neutral)
- **Collaborative model** within the research system
- Universities and their **social commitments** towards communities

A look at the future

- At **PoliMi** level
  - **Bachelor students** still missing
  - **Mandatory** or **elective** courses
- At a **general** level
  - Educating a **future generation of humanists** and integrating them
  - Not following the **current fashion** but **exploiting** it in a systematic way
  - Promoting a '**real**' and **long standing integration**
- Several **questions**, no answers, importance of **open debate**


#THANKYOU
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Issues

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