Teaching of Ethics in Engineering Courses

Esat Alpay

Department of Chemical and Process Engineering

e.alpay@surrey.ac.uk
www.surrey.ac.uk/cpe/people.esat_alpay

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today

• motivation for ethics education
• challenges and ways to overcome these
• examples of teaching materials and approaches
• evaluation and ongoing issues

"Ethics? Is that near Suthics?"
(Professor in Civil Engineering, Imperial College London)
motivation

• the critical role of engineers to deliver solutions towards a sustainable and equitable world

social and environmental impacts
stakeholder considerations
cultural awareness
personal values and motivations
engineering as a social experiment
needs-based engineering
i.e. the **global dimension** in engineering education for integrating ethics, technology and skills:

- understanding social and ethical responsibilities
  De Graaf and Ravesteijn (2001)

- systems approach for: sustainable production; process and infrastructure design; utility provision; protection of natural environments
  Fenner et al. (2006), Pritchard and Baillie (2006)

- skills for work in multidisciplinary and international communities
  Leitch (2006), Fallows and Steven (2000)
• grounding for skills and personal development

  teamwork
critical thinking
decision making
self-awareness

and ultimately **authentic leadership**
“[An authentic leader is] one who:

(1) is self-aware, humble, always seeking improvement, aware of those being led and looks out for the welfare of others;

(2) fosters high degrees of trust by building an ethical and moral framework;

(3) is committed to organizational success within the construct of social values”

Whitehead (2009)
see Alpay (2012), Being Ethical and Intelligent About Leadership: Awareness, Beliefs and Leadership Development. Engineering Leadership Review.
examples of “honest broking” practices?

• consultation with stakeholders for deliberation and consensus-making
• problem formulation (framing) rather than problem solving
• challenge build-new culture – maintain and refurbish
• consider social, environmental and economic issues
• reflective practice
• wear expertise lightly
good vs. bad decisions

what can help us with decisions?

- codes of conduct
- common issues behind conflict
- moral frameworks

what can hinder responsible action?
• student desires for an ethical career
  “making a difference”
  “work that’s meaningful to society”
  e.g. student-led projects
e.g. student career and life aspirations (Imperial College UG survey; N=2330)

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<td>invent something new</td>
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<td>make a difference to the world</td>
<td>21.9</td>
<td>33.5</td>
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<td>achieve financial security</td>
<td>24.8</td>
<td>23.4</td>
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“climate change”
“poverty reduction”
“human inequalities”

e.g. the special nature of Engineering Ethics

common morality often gives priority to *negative* duties, e.g.: don’t cause harm, break promises, be dishonest

**but** engineering ethics is also about *positive* actions and responsibilities, e.g.: preventing harm, good works and an *aspirational* approach to ethics
• degree accreditation and professional competency

“appreciate the social, environmental, ethical, economic and commercial considerations affecting the exercise of engineering judgement”

“understand the need for a high level of professional and ethical conduct in engineering”

UK-SPEC
but difficulties in ethics education

some typical *pre-course* student views on ethics with my interpretations of meaning…
“it’s woolly”

the content is subjective and ambiguous in nature

the content is too philosophical equations?
“I’m already moral thank you very much, I don’t need a lecture on it”

my personal ethics are strong and this should stand me in good stead with any professional matters

don’t patronise me…
“my ethics come from other sources”
“I can’t see myself being in such a situation and acting so irresponsibly”

poor identification with case / scenario / subject

little appreciation of the negative influences of:

group psychology
stress
stereotypes
defence mechanisms
poor self-awareness
i.e. challenges are associated with:

- the perceived subjective, ambiguous and philosophical nature of ethics
- its unclear relevance to current student interests (and needs)
- its practical application to engineering contexts
- the level of student introspection and self-awareness
overcoming difficulties

• ethics “embedding" across the curriculum
see also “An engineering ethics curriculum map” (RAE)
Imperial College "integration"

a) Year 1 introductory lectures (4-6 hours): framework and motivation

b) Years 2-4 follow-up activities: application and contextualisation; personal reflection

"making the implicit explicit"
ethics intro lectures – aims

1. Raise the importance and value of ethics in engineering work and personal and professional development
2. Provide practical approaches and skills for applying ethical frameworks to decision making, problem solving and conflict resolution
3. Encourage application of ethics concepts to student-life occurrences
4. Provide a framework for ethics education in subsequent courses and learning activities.
ethics intro lectures – core topics

1. Personal, common and professional morality
2. Current issues in <discipline> ethics
3. Skills for ethics
   information analysis; communication; critical thinking; self awareness; leadership; CPD
4. Engineering as a social experiment
5. Aides for effective decision making
   codes; conflict analysis; moral frameworks; key legislation; practical tools / approaches / recipes
ethics intro lectures – examples of classroom activities

1. Discussion and debate on a range of short anecdotes and video clips to demonstrate moral perspectives and frameworks

2. Discussion on the messages behind cartoon and comic-strip depictions of morality

3. Scripted student enactments of moral disagreements

4. Application of paradigm analysis and creative middle-way approaches to decision making

5. Extended discussion on a case study
• interactive use of discipline-specific case studies and scenarios, e.g.:

**structured controversy**  Shallcross and Parkinson (2006)
voting, group discussion and personal reflection on an ethical dilemma

**paradigm analysis**  Quinn (2006)
what would make a decision clearly right or clearly wrong?
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Does this help?

(subsequent British authorities approach at LHR...)
online case resources for engineering, e.g.:

Harris et al. (2009) – Engineering Ethics$^1,2$
RAE - Engineering Ethics in Practice$^3$
NAE Ethics Online$^4$
BBC Active Videos$^5$
Leeds IDEA CETL$^6$
Television for the Environment$^7$

1 http://wadsworth.com/philosophy_d/templates/student_resources/0534605796_harris/cases/Cases.htm;
4 www.onlineethics.org; 5 www.bbcactivevideoforlearning.com; 6 www.idea.leeds.ac.uk;
7 http://tve.org/
### e.g. (ethics intro lectures - Chemical Engineering)

<table>
<thead>
<tr>
<th>video clips</th>
<th>anecdotes for discussion</th>
<th>extended analysis</th>
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<td>• cosmetic industry</td>
<td>• industrial pollution: spillages; benzene emissions</td>
<td>• design flaws in a chemical plant – what would you do?</td>
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<td>• nanotechnology</td>
<td>• copyright / IPR / plagiarism</td>
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<td>• privacy rights</td>
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<td>• group issues</td>
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see also Alpay (2011), Student-inspired activities for the teaching and learning of engineering ethics. Science and Engineering Ethics, July, 1353 – 3452.
• **student-inspired / designed teaching resources**
  http://www3.imperial.ac.uk/engineering/staff/teachingsupport/ethicseducation

"Propose a resource, method or activity that engages *<discipline>* students in ethics in a fun and meaningful way. A 2-side description of the proposal is needed, with a statement of the key ethical concepts being addressed"
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<th>category</th>
<th>example</th>
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<tr>
<td>games</td>
<td>modelled on TV game shows; charades; CSI</td>
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<td>role plays</td>
<td>forum theatre</td>
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<td>debates</td>
<td>&quot;research debate&quot;; &quot;balloon debate&quot;; vote-box</td>
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<tr>
<td>images</td>
<td>screensavers for lab computers; posters</td>
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<td>videos</td>
<td>student-recorded documentaries / dramatizations; &quot;viral&quot; videos</td>
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<td>visits</td>
<td>user-groups; patients</td>
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<td>pledges</td>
<td>c.f. &quot;iron ring&quot;</td>
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<td>student society &amp; prizes</td>
<td>reward student contributions to engineering ethics</td>
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<tr>
<td>written</td>
<td>essay prizes (&quot;best ethical answer&quot;); student-designed ethical guidelines</td>
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• opportunities for feedback and reflection on beliefs, biases, strengths / weaknesses

e.g. group-based assignment (and peer feedback) with a remit to practice ethical work

“skills should not be left to emerge as accidental competences”

David Radcliffe
(Epistemology Prof. of Eng. Educ., University of Purdue)
• normalisation - engage as many academic staff in ethics education support as e.g. the use of a personal tutorial on an ethics-related assignment
generally, keeping it fun but real!

- video / audio
- clickers
- cartoons
- role plays
- controversy
- debates
“You do as you’re told. We pay as we please. You work like a slave. We punish at random. That, in a nutshell, is our corporate culture.”
Imperial College "integration"

a) Years 2-4 follow-up activities:
   application and contextualisation;
   personal reflection

examples:
   • final-year design project ethics statements
   • post work-experience ethics statements
   • peer feedback – group work, leadership
   • presentations skills – ethics topics
   • Y4 Research Ethics lectures
   • technical course examples (esp. Y2 and Y3)
   • the “Engineering Debate”
e.g. the Engineering Debate (2010)

Should engineering students be discouraged from working in the military?

Graduates who work outside engineering: have they sold their souls?
e.g. final-year design project ethics statement

7. Statement on Business Integrity and Ethics

• summary of the ethical values underpinning the business proposal
• exceptional practices for maintaining and / or enhancing business integrity
• social impact considerations, issues or measures

(2 sides maximum)
evaluation (see also HEA Teaching Award Case Study¹)

some student comments
“[taught] us how to think about these things…realise things we didn’t realise before”

“it was interesting for thinking about…ethical companies, helping me think about which company I might want to work for – [issues raised] helped me ask these questions of employers for me to reflect on”

“[in] a degree we don’t always appreciate the seriousness of what we are doing and the ethical implications of it”

“…[good] to have it in the first year as we start thinking about ethics in our professional development but must keep it in mind every time we do anything…more sessions [would] be good”

¹. https://dspace.lboro.ac.uk/dspace-jspui/bitstream/2134/8634/1/110620-TACase%20Study-Alpay.pdf
ongoing issues

• still a struggle for a few students, e.g.: cultural / personality factors; “more detail in slides”

• technical course embedding requires much senior management push; coherency through design spine?

• variable academic staff experience of engineering ethics

• assessing student ethical development concept maps; questionnaires / tests around scenarios

• improved connection to authentic leadership development
summary

1. Movement from embedded to integrated ethics:
   (i) define framework/fundamentals and inspire students;
   (ii) apply and revisit through a range of teaching activities

2. Many teaching material options, but need:
   (i) active learning methods;
   (ii) both discipline and student-life connection

3. Emphasis on skills development, e.g. decision making and leadership

4. Subject normalisation through wide faculty involvement

5. Student involvement in resource and teaching design; platform for student-led projects
good vs. bad decisions

what can help us with decisions?

- codes of conduct
- common issues behind conflict
- moral frameworks

what can hinder responsible action?
ECUK guidelines – Codes of Conduct:

“…members to act with integrity, in the public interest, and to exercise all reasonable professional skill and care to:”

1. Prevent avoidable danger to health or safety.
2. Prevent avoidable adverse impact on the environment.
3. Maintain their competence. “Continued Professional Development”
   Undertake only professional tasks for which they are competent.
   Disclose relevant limitations of competence. “Honest broker”

…

6. Observe the proper duties of confidentiality owed to appropriate parties. But…

…

examples of “honest broking” practices?

- consultation with stakeholders for deliberation and consensus-making
- problem formulation (framing) rather than problem solving
- challenge build-new culture – maintain and refurbish
- consider social, environmental and economic issues
- reflective practice
- wear expertise lightly
“I’m already moral thank you very much!”

time for some acting!

Given things like Codes of Ethics and common morality, why do ethical dilemmas, issues or conflicts still arise?

“I don’t agree!”
(material adapted from Harris et al., 2004)

What’s some of the fundamental issues causing conflict in this situation?
factual issues
e.g. data, evidence, regulations, laws

conceptual issues
e.g. definitions of key terms (safety, risk, welfare, bribery, extortion, etc…); application of concepts to given situation

moral principles
conflicting principles; personal vs. professional morality

conflicting goals
e.g. deadline pressures; costs; priorities
scenario 2
You used to work for a small firm that specialises in the production of low-volume, high-value pharmaceuticals from rare plants. You designed a computer program and database for logging the operational, material and product-quality details of each batch of production. The software also has an innovative “expert system” which analyses variations in product quality based on the properties of the feed, and then guides towards optimum reactor operation. You now work for a much larger company and realise the same program would be perfect for a major production line. It would only need a few minor modifications to set up, and is likely to secure you a promotion to Production Manager. Would you do this?
press T if yes; press F if no
did any of these concepts / issues come out?

producing the most good, i.e. utilitarianism

right/wrong in one situation is also right/wrong in another i.e. universality

“what would I think if the role was reversed?” i.e. reversibility

giving equal respect to all persons; rights and duties

showing good character as defined by one’s virtues e.g. competence, honesty, loyalty

personal motivation

laws and legislation
some legislation (UK)

- Copyright, Designs and Patents Act 1988
  unlawful copying of software and databases
  operating in a fraudulent manner
- Computer Misuse Act 1990
  hacking
- Data Protection Act 1984, 1998
  processing of personal data
- Obscene Publications Act 1959; Protection of Children Act 1978
  uploading / downloading of images
- Bribery Act 2010
  (ignorance not a valid excuse!)
- Public Interest Disclosure Act, 1998
  protection of whistle-blowers
what might hinder responsible action?

- fear
- groupthink
- self-deception
- self-interest
- acceptance of authority
- limited perspective
e.g. airport x-ray screening device*
An airport begins using a new x-ray machine to screen a randomly chosen subset of the ticketed passengers for concealed weapons. The x-rays produce an explicit black-and-white image of each passenger’s nude body. With clothing rendered invisible, the human operators of these machines can easily spot concealed objects. Some passengers complain that the use of these x-ray machines violates their privacy rights.

press T if the use of the machine is ethical
press F if the use of the machine is unethical

* adapted from M.J. Quinn, 2006, “Case-Based Analysis: A Practical Tool for Teaching Computer Ethics”
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does this help?

(subsequent British authorities approach at LHR…)
a recipe for ethical decision making

• **clarity on:**
  facts and concepts
  conflicting goals / motivations
  professional codes / statements; laws / regulations
  moral principle(s) being applied / compromised

• **tools and approaches:**
  relevant case studies / analogies
  wider consultation
  creativity: problem reversal, middle-way paradigm cases
  design-like approach
e.g. imposter syndrome & stereotype threat

• females avoiding leadership roles for “non-threatening subordinate roles” Davies et al. (2005)

• repressed entrepreneurial intentions Ghupta and Bhawe (2007)

• higher levels of anxiety in those experiencing stereotype threat, leading to a drop in achievement Osborne (2001)

• under conditions of high stress, higher intelligence (IQ) more likely to hinder leadership success Fiedler (2002)