



The Royal Academy
of Engineering



Inter-Disciplinary
Ethics Applied
A Centre for Excellence in Teaching and Learning

Teaching Engineering Ethics

**A report of a workshop held on Thursday 10th April 2008
at the University of Leeds Interdisciplinary Ethics
Applied CETL**

This is a report of a small workshop of experienced teachers of engineering ethics. The aim of the workshop was to share ideas and experiences concerning the teaching of ethics to engineering students. The intended output was a set of hints, tips and suggestions for new and experienced teachers of engineering ethics.

What follows is a summary of the presentations and the discussion sessions at the workshop. Powerpoint presentations are available online at:

Professor Chris Megone

Interdisciplinary Ethics Applied Centre for Excellence in Teaching and Learning at the University of Leeds

The challenge of teaching engineering ethics – what makes engineering different?

The aim of the IDEA CETL is to allow students in different disciplines to respond to the ethical issues in their personal and professional lives. The centre either currently teaches, or will shortly be introducing, courses on the ethical aspects of and issues in Business, Engineering, Biosciences, Computer Science, Nanotechnology, Media, Law, Psychology, Education, Social Work and Performing Arts.

Medicine is the longest-standing of these subjects. Initially students found it difficult to deal with the disagreement and lack of correct answers, and had low levels of appreciation of key ethical concepts such as consent. However, a change in curriculum allowed for the introduction of ethics teaching right from the beginning of the degree, in order to give students a better grounding in the concepts and methods of ethics. There is now also an intercalated year in Biomedical Ethics available.

In 2006 the CETL launched an online resource, 'An Introduction to Ethical Thinking'. This is a ten-module course available freely online, which is intended as a 'pick and mix' from which disciplines can choose relevant courses.

The approach in medicine, and in other subjects, is to aim for genuinely interdisciplinary teaching and research, with philosophers and medics working together rather than philosophers simply talking to medical students. The aim is thorough integration of ethics into a subject so that ethics is seen, in the case of engineering, as a part of what it is to be a good engineer.

In teaching engineering ethics the CETL uses an engineering ethics 'theme team', which discusses the strategy for incorporating ethics into the engineering degree. The theme team includes the teachers of engineering ethics, other ethicists, engineers and students. There are about 30 engineers from across the discipline involved in the engineering ethics teaching. The centre actively solicits feedback from students generally, to find out what they feel works and does not work.

It has been found that case studies are of great benefit in teaching ethics. The centre has produced 11 case studies with the support of the Higher Education Academy Engineering Subject Centre, which are available online here:

<http://www.engsc.ac.uk/er/ethics/ethicscases.asp>

The ethics component of a module is always assessed. This does not involve adding extra assessment, but modifying existing exam papers or projects to bring out the ethical aspects of a topic.

Dr Chris Kent

Department of Chemical Engineering, the University of Birmingham

The Birmingham experience – with an introduction to The Royal Academy of Engineering and EPC ‘curriculum map’

The University of Birmingham set up a new programmes group for Engineering, which included some Royal Academy of Engineering visiting professors. This group was very keen on getting ethics into the engineering curriculum.

They appointed a small team led by Dr Chris Kent to develop such a module. The result was ‘Ethics, Technology and Policy’, which links ethics to the practice and propagation of technology and science in a democratic society. The aims of the module are to: draw out the ethical implications of the application of science and technology; introduce students to ways of approaching ethical dilemmas; discuss how controversial aspects of science and technology are debated and regulated; explore government and business attitudes to the exploitation of science and technology; encourage students to appreciate the importance of engineers working as better professionals in a morally defensible manner.

The module looks at a variety of issues such as the ethical implications of technologies; codes of ethics and their limitations; perceptions of risk; models of consultation; the basics of ethical theory.

The module was developed with the input of Forum for the Future as external advisors. A multidisciplinary team from the Departments of Chemical and Civil Engineering and Philosophy and the Schools of Biosciences and Geography, Earth and environmental Sciences has provided the teaching resources.

A major component of the module is a group project, in which teams of 4-6 students carry out an ethical analysis of a current science/technology issue. This is worth 60% of the final module mark. The students’ work is self-managed with support from facilitators and workshops in essay writing and communication skills are provided for the students.

Feedback from the students suggests that they welcome this module as it is so different from the others offered, and they enjoy the teaching by members of the philosophy department.

Currently this is offered as an optional course only, but the vision at Birmingham is to infuse all engineering degrees with ethics. This is likely to involve moving ethics from a stand-alone module and embedding it as a theme within existing modules, impossibly after the manner of The Royal Academy of Engineering/Engineering Professors’ Council ‘curriculum map’, which provides guidance on introducing ethical issues into the engineering degree.

The advantage of embedding ethics into the entire degree is that all students will have exposure to it, and not just those with sufficient interest to choose an ethics module. It also helps to establish a culture of discussing ethical issues when they arise. Of course, there is value in still offering the in-depth module, and inviting science, philosophy, politics and other humanities students to join, to create a genuinely interdisciplinary atmosphere.

Discussion Session: Finding opportunities for ethics – placing ethics in existing modules

Experience from the Open University is quite unusual in that no students have to follow named degrees and therefore a set curriculum. In this context, it is more difficult to incorporate ethics as a continuous thread through a degree. It implies that if ethics matters then all courses should include considerations of ethics in order to prevent students from following a pathway which does not include any study of ethics.

Open entry means the enrolment for an experimental OU course in ethics and technology is half philosophy and half technology students – both groups having an awareness and experience of each others' subject. There are challenges in pitching such multidisciplinary courses at the right level. A course in Environmental Ethics at the University of Leeds turned out to be quite easy for philosophy students while it was quite challenging for engineering and science students.

Accommodating different levels and backgrounds is particularly difficult when it comes to assessing courses, so it is helpful to offer different options for responding to a question or assignment. For example, an answer to a question could be written either as an essay or a technical report.

Although there are advantages to having a module that can be taken by students from mixed disciplines, it is also useful to dedicate some teaching to engineering ethics specifically. It is also important to get across the idea that engineering is a social and political discipline in its own right, rather than simply touching on independent social and ethical issues.

There are therefore three (non-exclusive) options for incorporating ethics into the engineering degree:

Embedding: Embedding ensures that every student has experience of engineering ethics. It means that ethics can be incorporated into the existing curriculum without having to find space in an already full engineering timetable.

Engineering module: Gives an opportunity to look in greater depth at the kinds of ethical issues that are likely to arise in engineering specifically. Gives an opportunity to look at things such as engineering codes of conduct and regulatory issues in engineering.

Interdisciplinary module: Offers an opportunity to delve deeper into ethical theory – looking at the methods for justifying ethical reasoning and decision-making. Offers opportunities for fruitful discussion and learning between students from different disciplines.

All three of these options can be used in the degree. It is important to embed ethics into the degree regardless of whether additional modules are offered. This allows all students to develop vital skills that ethics can help to develop. These include skills of communication – all engineers have to be able to argue their case in the work they do – and awareness of political issues which are often inextricably linked with practical engineering issues. Encouraging engineering students to be awake to the wider issues surrounding the work that they do will hopefully lead to a generation of engineers who are more engaged in political issues. This may eventually lead to a greater involvement by engineers in political life.

Dr Sarah Bell

Department of Civil Engineering, UCL

Ethics in the engineering classroom – different styles of teaching and learning

The Department of Civil Engineering and Geomatics at UCL is now two years into a new degree programme. The aim of this programme is to teach engineering as a subject that is inherently social and political, bringing the technical and wider aspects of engineering together.

The course brings to the fore such issues as engineering *agency* – the power, choices and influence that an engineer can have; the role of engineering in society and politics; and the impact of engineering on the environment. The course aims to convey the concept that technical decisions are always also ethical decisions, and that engineers cannot expect ethical decisions to be dealt with by others.

The degree course does not teach ethics as a separate subject, but teaches engineering in the context within which it takes place. This naturally brings ethics to the fore. The course prepares the students for their professional careers.

The course avoids the module structure, having a fixed curriculum for the first two years of the degree. There are four streams in the degree:

- Methods: including mathematics, computing and communication skills
- Mechanisms: looking at the processes involved in civil and environmental engineering, such as soil mechanics
- Change: involving ‘scenarios’ – 1 week projects carried out in groups, focussed on design
- Context: including sustainable development, professional practice, stakeholder engagement, engineering history

The engineering history section of the course, presented in the second year of the degree, focuses on one particular historical project: the construction of the London Sewers. This is a useful example as it demonstrates to the students the good that engineering can do and enthuses them in their subject. The students also look at the

millennium challenge goals which similarly encourage them to appreciate the good that engineering can do.

Teaching and mentoring methods include case studies, lectures, workshops, invited speakers, practical projects. Providing role models by giving students an opportunity to meet engineering leaders is especially valuable, particularly those who have chosen an ethical career path.

Some of the reasons behind changing the degree structure were to make the degree more attractive to students, to make the first and second year courses more attractive to students, and to attract a different cohort of students.

Professor John Monk

The Open University

Teaching engineering ethics using plays and novels

Ethical issues in the context of engineering practice can be explored through plays and novels that raise them. These works of fiction can be used in a similar way to case studies, initiating discussion about the situations depicted and the choices and behaviour of characters in those situations.

Fictional works involving ethical issues in engineering include: *Major Barbara* (play) by George Bernard Shaw; *All My Sons* (play) by Arthur Miller; *The First Circle* (novel) Aleksandr Solzhenitsyn; *Landscape with Weapon* (play) Joe Penhall.

The advantage that novels and plays have over standard cases studies is their ability to transport the reader or observer into the situation, giving them room to explore the imagined situation. They can be used in a number of ways. Students can watch the plays performed by theatre groups, or listen to radio plays. Students can also be encouraged to create their own dramatisations of ethical dilemmas. These would be short plays or acts – even just short scenes.

The particular value of dramatisations is that they can illustrate the complexity of an ethical problem, as the variety of relationships between disparate individuals involved in a situation can be depicted and their differences accentuated. Dramatisations also promote emotional engagement, portraying the emotions that often, on reflection, distort rational consideration of ethical issues and lead to harmful consequences. Drama is also an effective catalyst for discussion.

Ways to teach engineering ethics – tips and suggestions

<u>What to teach</u>	<u>How to teach</u>
<ul style="list-style-type: none"> - Check what is already being taught by colleagues that involves ethics or could be used to illustrate an ethical issue - Raise ethical issues in design projects and encourage students to look for them – design decisions usually involve judgement and ethical considerations - Teach good ethical behaviour as well as disasters – demonstrate that engineering can be a force for good - Draw on your own experiences and decisions - Look at existing codes of ethics – compare them, apply them, critique them - Discuss specific issues that are likely to appear in codes of conduct – such as working within levels of competence - Look at topical issues as they arise – such as current affairs 	<ul style="list-style-type: none"> - Recognise that ethical issues have no right answers - BUT – demand rigour from the students; don't make things too easy - Use case studies and role play to illustrate and explore dilemmas. Particular sources are the Texas A&M case studies; Case Western case studies; HEA Engineering Subject Centre case studies; BBC disaster DVD series - Look for ways to incorporate ethics into the existing curriculum - Be prepared to critique establishment views - Allow students to discover for themselves – don't teach the 'right' approaches or responses - ...but be prepared to prompt students to encourage them to pick up on ethical issues. Be a facilitator. - Opportunities for informal discussion – coffee groups or pub nights - Invite practising engineers to speak - Try to vary teaching methods as far as possible
<p><u>Approaches to teaching ethics</u></p> <ul style="list-style-type: none"> - Work with departments in arts and humanities, including creative writing and film studies to bring ethical issues to life - Seek out institutions and bodies to work with who can provide resources - Don't always talk about ethics explicitly – approach the subject laterally, as part of other issues - Link ethics with other topics such as CSR, economics and sustainability - No right answer ≠ no assessment – use assessment to facilitate as well as check learning - Involve multidisciplinary teams, including philosophy, sociology, politics. Get to know academics in other departments who have dealt with these issues. 	<p><u>Outcomes</u></p> <ul style="list-style-type: none"> - Develop professional identity in broad terms – including the economic, social, historical and personal <p>Opportunities for informal discussion, coffee groups or pub nights help to establish a 'culture of ethics'</p>

