Engineering Education: how can we do it better?

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Some vocabulary

Programme = degree course (3 or 4 years)
Module = unit, class, course (one semester)
Engineer = Ingenieur, Professional Engineer
Engineer ≠ Technician, Mechanic, Techniker (?)

An apology: My perspective is UK-centred, but I hope it is enhanced by some knowledge of engineering education in other countries
Some background

Engineering education is rather important to our societies (and their economies):

• Engineers design and make things and processes;
• Engineering is essential to address many of the world’s problems;
• There are already more Engineers than doctors or teachers or accountants or lawyers;
• A graduate will probably work for 50-60 years

• Most engineering programmes were established many years ago
• Over the past 100 years there has been a great deal of research into learning
Today’s agenda

**Why** innovation is needed

**What** might be done

**How** we might do it
Innovation in engineering education is overdue

Drivers are:
- Employers’ requirements
- Students’ expectations
- Teachers’ perceptions
- The changing world

RAEng reports: Educating Engineers for the 21st Century (2007); Engineering graduates for industry (2010); Educating Engineers to drive the innovation economy (2012)
“Engineering graduates should be able to do something”
I use lectures to catch up on sleep, or to update my Facebook page

The answer is “very little”
Can teachers of engineering do better?

Yes, for example:

Active learning
Flipped classroom
Team working
Design, build, test
Concept questions
Engineering Habits of Mind (EHOM)

Thinking like an engineer
Implications for the education system

Summary report, May 2014
Some issues worthy of debate and development

Systems
Feedback
Assessment, teams, pass mark
Design, build, test, cost, compete

End of life, sustainability
Critical thinking
Risk
A concept question

You are sitting in a boat in a small pond [Teich]. You have a six-pack of beer. You throw it into the water and it sinks to the bottom.

Does the level of the water in the pond:
1. Rise?
2. Fall?
3. Stay the same?
“I learn more from being asked questions, and having to respond”
The textbook updated

teachingengineering.liv.ac.uk

2014

Commentable

Print on demand

Updated every 6-12 months
Introduction

It might be helpful to clarify what engineering education (in the context of this book) is not.

It is not about the acquisition of specific practical skills, however useful or interesting they might be to any individual. It is not about training people to run CFD codes or send CAD designs to a CNC machine or to grow crystals or to sign off structural steelwork. It is about the conceptual, planning and design skills which should precede all these activities.

Video on this site is responsive, and will automatically resize for different screen sizes. To add a video, just paste the video’s YouTube or Vimeo URL into the content.
How?

Can we persuade engineering teachers to change?

Externally-driven need
A coherent approach and plan
Internal leadership
(A modified learning environment)

Graham, The Ingredients of Successful Change (RAEng / MIT)
Another concept question

A ladder [Leiter] is upright against a vertical wall. Both the wall and the floor are perfectly slippery (no friction between ladder and floor or wall). You pull the bottom of the ladder away from the wall slightly and it starts to slip down. At some angle it loses contact with the wall. What does this angle depend on?

1. The mass of the ladder
2. The length of the ladder
3. g (gravity)
4. None of these
5. All of these
Some barriers to improvement

- Research
- Arrogance
- Externally-imposed quality procedures

- Students and staff from different educational cultures
- Few metrics and slow evidence for excellent teaching
“It is rare for Engineering faculty to come together to talk about education”
Active engineering students

Externally-driven need
A coherent approach and plan
Internal leadership
A modified learning environment
Questions for university programme directors

How do you assess the learning outcomes given in this module specification?

Where do you assess deep learning?

Where and how do you assess creativity?

Why is the pass mark x%?

Why do you allow a choice of questions in written exams?

Do you scale marks and if so why?

How do you assess individual contributions to team work?

How do you eliminate the influence of the supervisor when assessing student project work?

Have you detected any plagiarism? What do you do about it?

What is the process and timescale by which my comments will be taken account of?

And of course: Have you read Peter Goodhew’s book?
What might the future hold?

Modest advances in engineering
MOOCs?
Unknown technology and social behaviour
Global challenges
What will you remember from this presentation?

1. The titles of the RAEng reports?
2. The bridge shown in slide 4?
3. The name of the new teaching space at Liverpool?
4. The question about the boat and the beer?
5. My smiling face?
Over to you

... for questions, comments and debate!