

The Engineering Education Conundrum – Defining a Path for the Future

Dennis Chisman Memorial Lecture – 30th April 2019

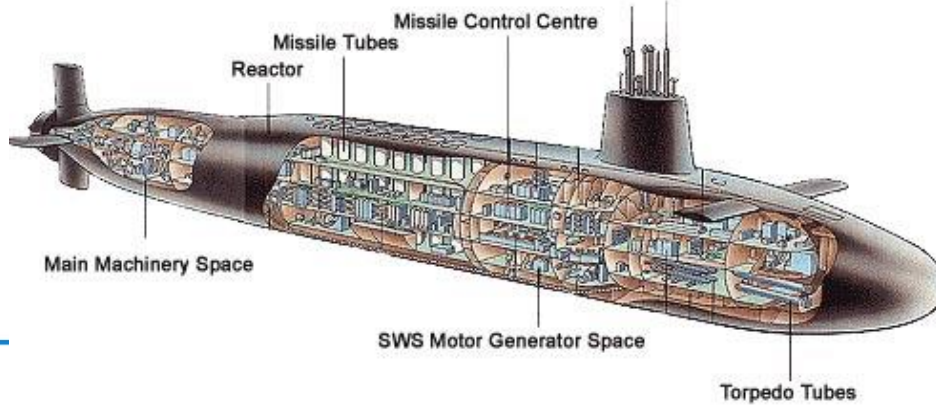
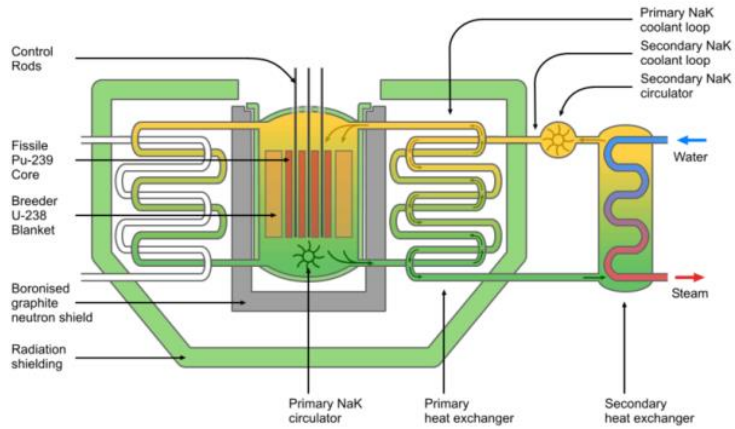
Prof Robin Clark



What I will explore

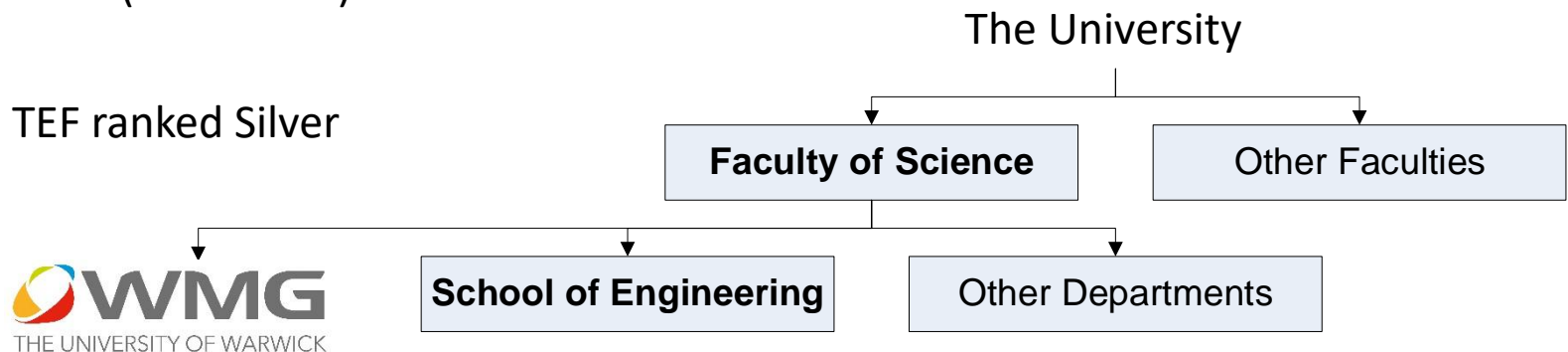


Background



The University of Warwick

- ▶ Founded in 1965, with over 25,000 students and 5,000 staff
- ▶ 9th - The Times and Sunday Times 2019
- ▶ 54th - QS World Rankings 2019
- ▶ 7th - Research Excellence Framework 2014 (latest data)
- ▶ TEF ranked Silver



WMG

- ▶ Established in 1980 by Professor Lord Bhattacharyya
- ▶ World class applied research from manufacturing to healthcare
- ▶ Strong educational programmes – Academy, UG, Degree Apprenticeships, PG, Bespoke Courses
- ▶ Global reach where application is key
- ▶ Over 400 staff in eight buildings



Global Partners with WMG



What do we want to achieve?

- ▶ Interest / Excitement
- ▶ Understanding
- ▶ Connections
- ▶ Basis for choice



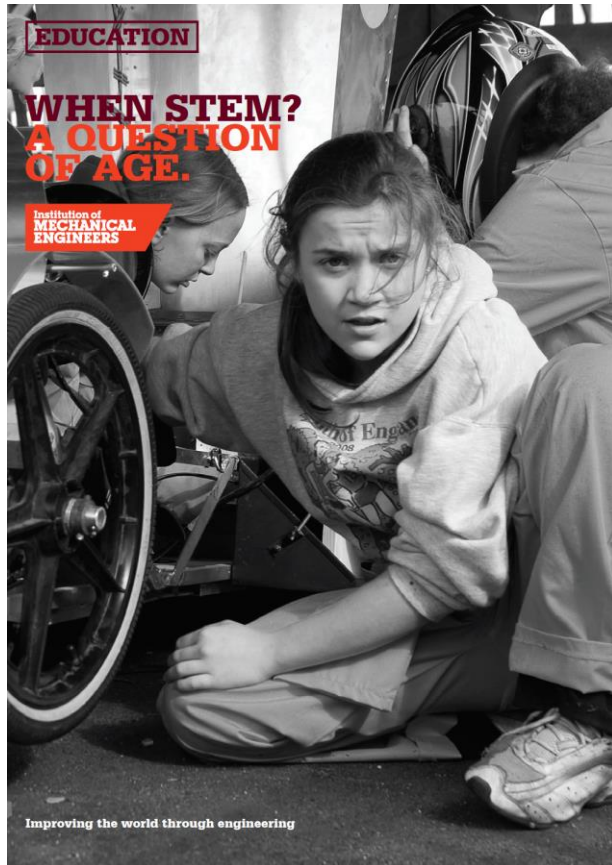
engineer

noun

- 1**
A person who designs, builds, or maintains engines, machines, or structures.
 - 1.1 A person qualified in a branch of engineering, especially as a professional.
'an aeronautical engineer'
- 2**
A person who controls an engine, especially on an aircraft or ship.
- 3**
A skilful contriver or originator of something.
'the prime engineer of the approach'



Key Reports



The UK STEM Education Landscape

May 2016

Outreach

- ▶ Fragmented landscape
- ▶ Lacks co-ordination
- ▶ Poor evaluation
- ▶ An industry!



bp



Popular Culture



Challenging Environment

- ▶ Awareness
- ▶ Space
- ▶ Engagement
- ▶ Confidence / Passion
- ▶ What works?

- ▶ A role for engineering?
- ▶ Build Capital

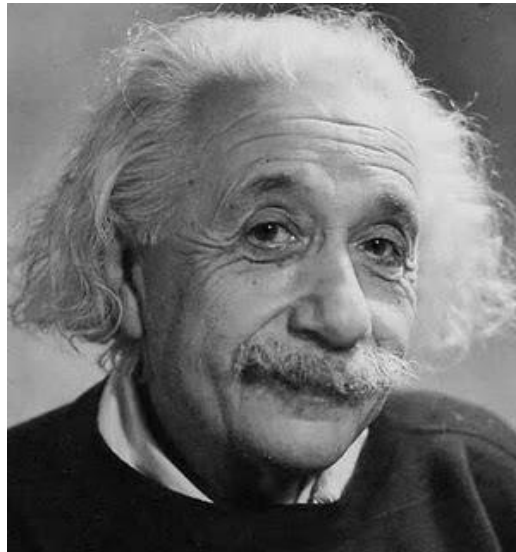




CONNECTIONS



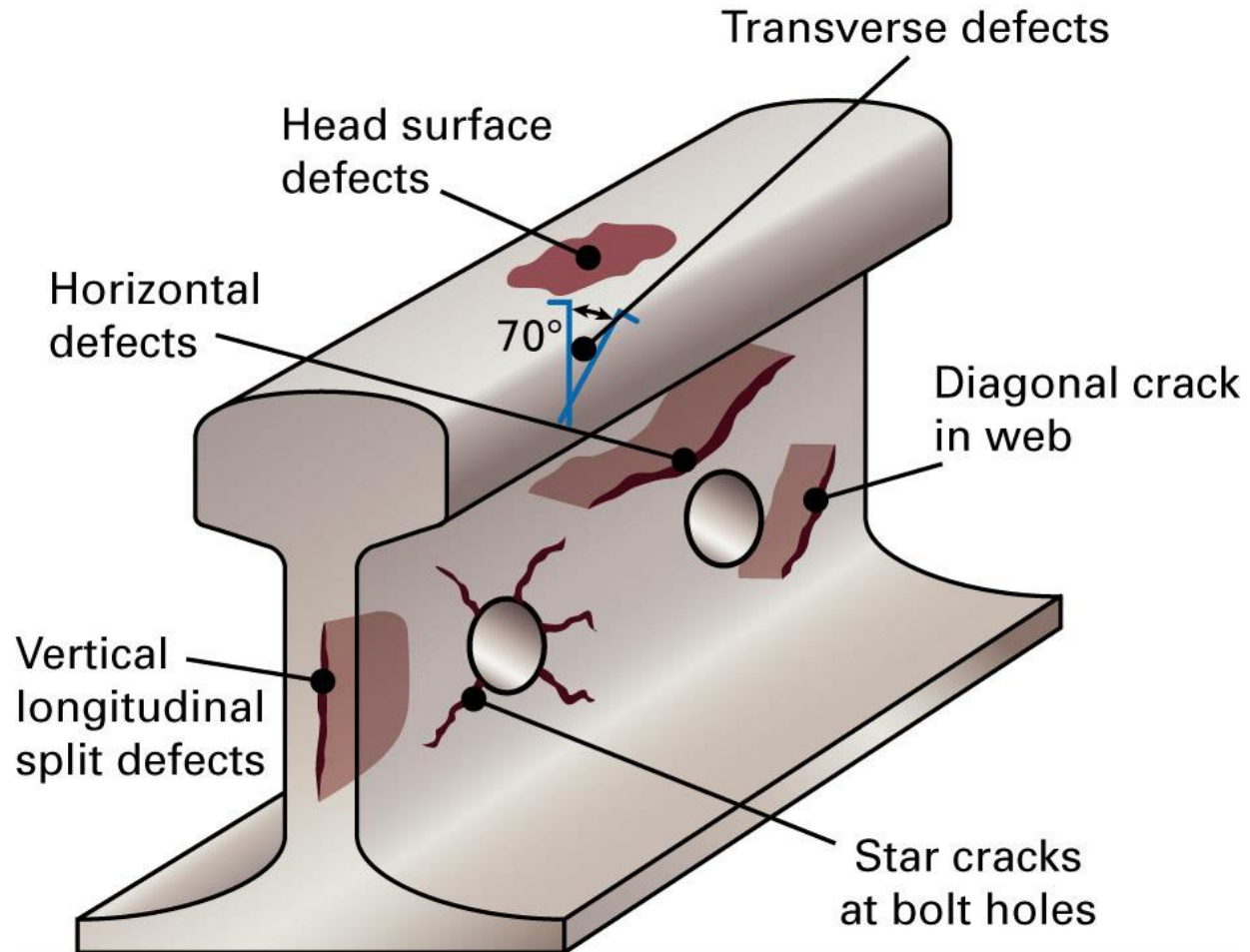
***"If at first the idea is not absurd,
then there is no hope for it"***



A Simple Example



NDT of Rail



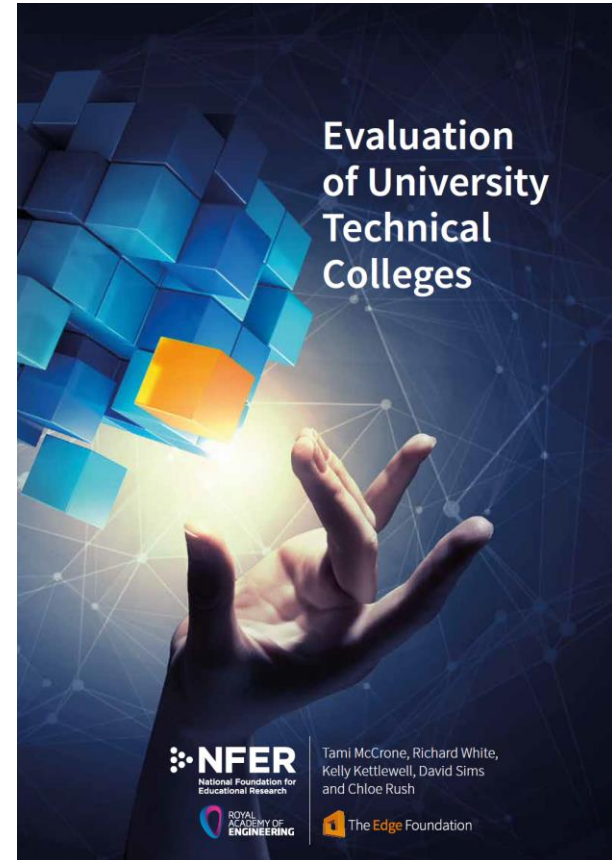
Action



Transitions

- ▶ Environment
- ▶ Peer pressure
- ▶ Excitement
- ▶ Teachers

WMG
Academy for Young 
engineers

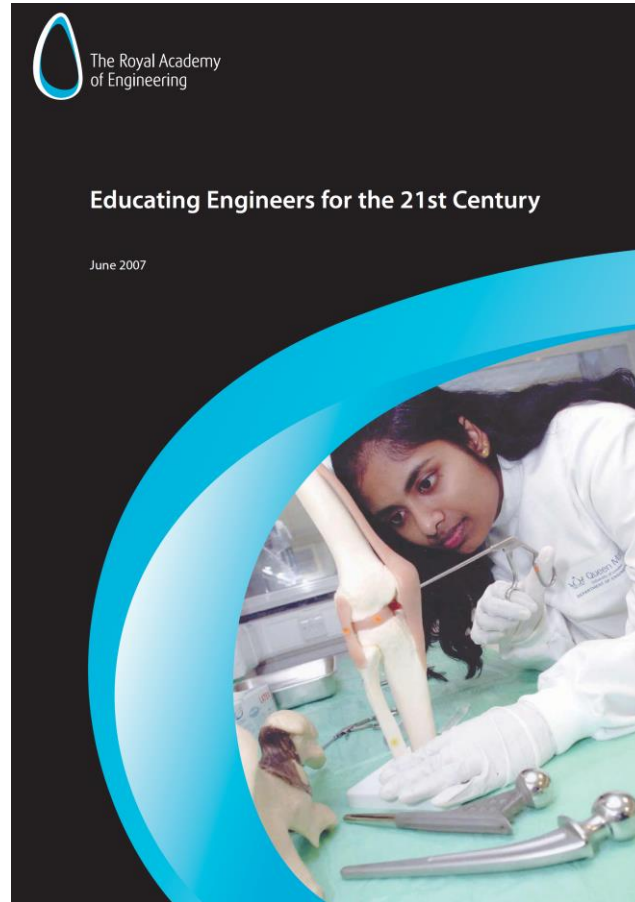


Transitions

- ▶ Engineering Capital
- ▶ Maths and Physics
- ▶ Approach to Learning
- ▶ Belonging
- ▶ Environment



Driving Change in Engineering Education



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UCL



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Inspiring & Preparing Our Engineers for the 21st Century



New approaches to engineering higher education

Case studies of six UK universities leading the way for change in the sector.




theiet.org/skills

E4E
Education for Engineering

ROYAL ACADEMY OF ENGINEERING

Engineering skills for the future
The 2013 Perkins Review revisited




The Environment



Sharing Employable
Students
Value Recognition
Assessment Engagement
Innovation
Challenge Feedback Active
Support Time TEF
Teaching Community
Observation Action
Learning
Experience TEL



POSTGRADUATE
TAUGHT EXPERIENCE
SURVEY

What is the TEF?



Teaching Excellence and Student Outcomes Framework Specification

October 2017

- ▶ Student Experience (NSS)
- ▶ Employment Destinations (Graduate Outcomes)
- ▶ Look at for different groups of students

- ▶ Rating – Gold, Silver, Bronze



The Aspiration

Gold: The Panel will award a provider a rating of Gold if it appears likely, based on the evidence available to the Panel, that provision is consistently outstanding and of the highest quality found in the UK Higher Education sector; that is:

The provider achieves consistently outstanding outcomes for its students from all backgrounds, in particular with regards to retention and progression to highly skilled employment and further study. Course design and assessment practices provide scope for outstanding levels of stretch that ensures all students are significantly challenged to achieve their full potential, and acquire knowledge, skills and understanding that are most highly valued by employers. Optimum levels of contact time, including outstanding personalised provision secures the highest levels of engagement and active commitment to learning and study from students.

Outstanding physical and digital resources are actively and consistently used by students to enhance learning. Students are consistently and frequently engaged with developments from the forefront of research, scholarship or practice, and are consistently and frequently involved in these activities. An institutional culture that facilitates, recognises and rewards excellent teaching is embedded across the provider.



A sobering thought

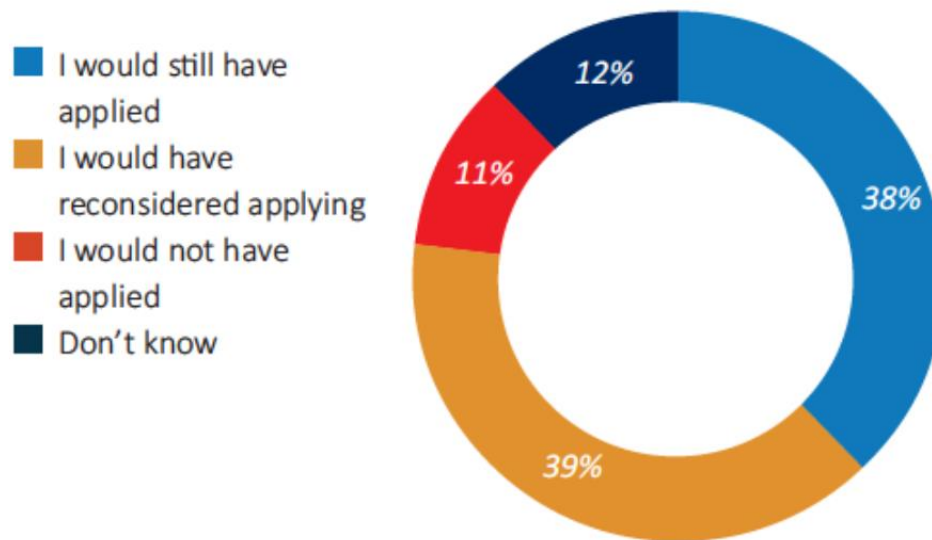
- ▶ Study of 9000 students across 123 institutions
- ▶ 50% would not have applied or would have reconsidered applying to a bronze rated university



**Teaching excellence:
the student perspective**

Research commissioned by a consortium of students' unions

If your university had been given a Bronze rating when you applied, would it have affected your decision to apply?



UK Trendence Research, 2017



Industry engagement

- ▶ Not always easy
- ▶ Increasing competition
- ▶ Relationships need effort
- ▶ Economy and Brexit present challenges
- ▶ TEF requiring action in this space

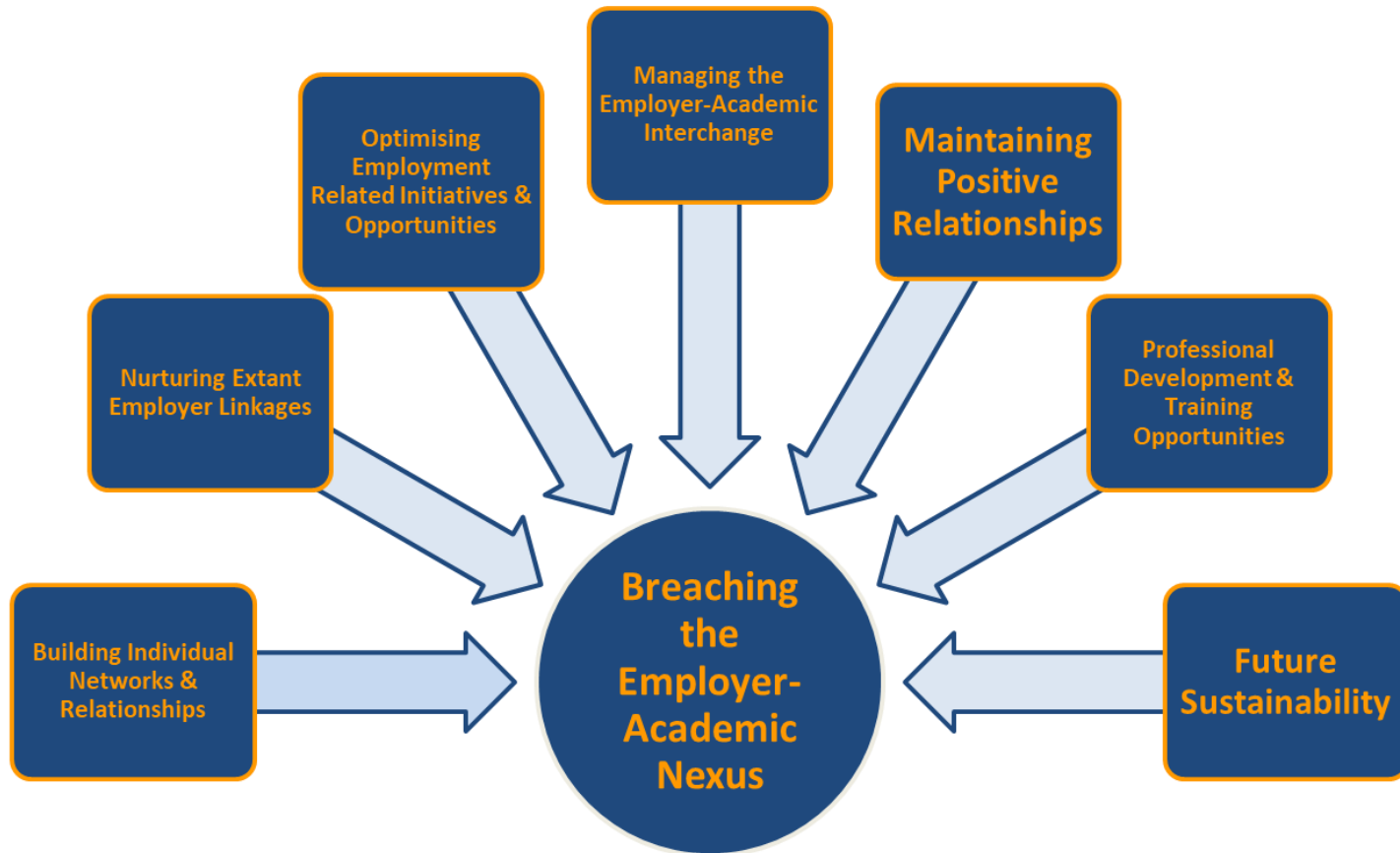


What does industry want?

- ▶ Everything!
- ▶ A sound technical foundation
- ▶ A multitude of other interpersonal, personal and business skills
- ▶ Variable engagement by industry
- ▶ Articulate win-win



Engagement Model



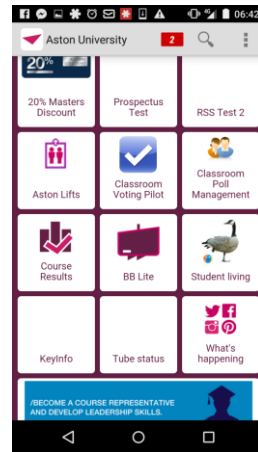
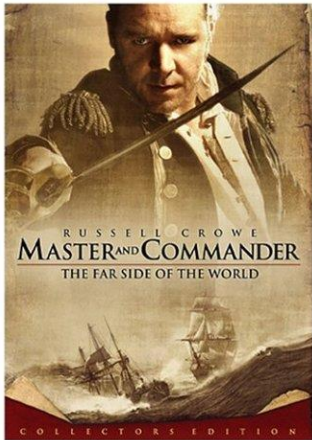
R+V+S = Student Success

- ▶ **Relationships** – between us all as, despite technology, contact is valued
- ▶ **Variety** – how we engage students in different ways
- ▶ **Synergy** – beyond alignment – pre-university to LLL
- ▶ A way to communicate priorities – basis for a plan of action



Innovation in the University

- ▶ Variety and Active Learning
- ▶ Authentic Learning Experiences



'Educating Engineers for the 21st Century',
Royal Academy of Engineering,
Report, June 2007

Approaches - Activities

- ▶ Discussion
- ▶ Video
- ▶ Audio
- ▶ Case study
- ▶ Role play
- ▶ Games and Puzzles
- ▶ Buzz group
- ▶ Labs
- ▶ Workshop
- ▶ Visits
- ▶ Think / Pair / Share
- ▶ Presentation
- ▶ Shared experiences
- ▶ Placement
- ▶ Service learning
- ▶ **Polling**
- ▶ Lecture (teacher, student, external)
- ▶ **Flipping**
- ▶



Learner Response Systems

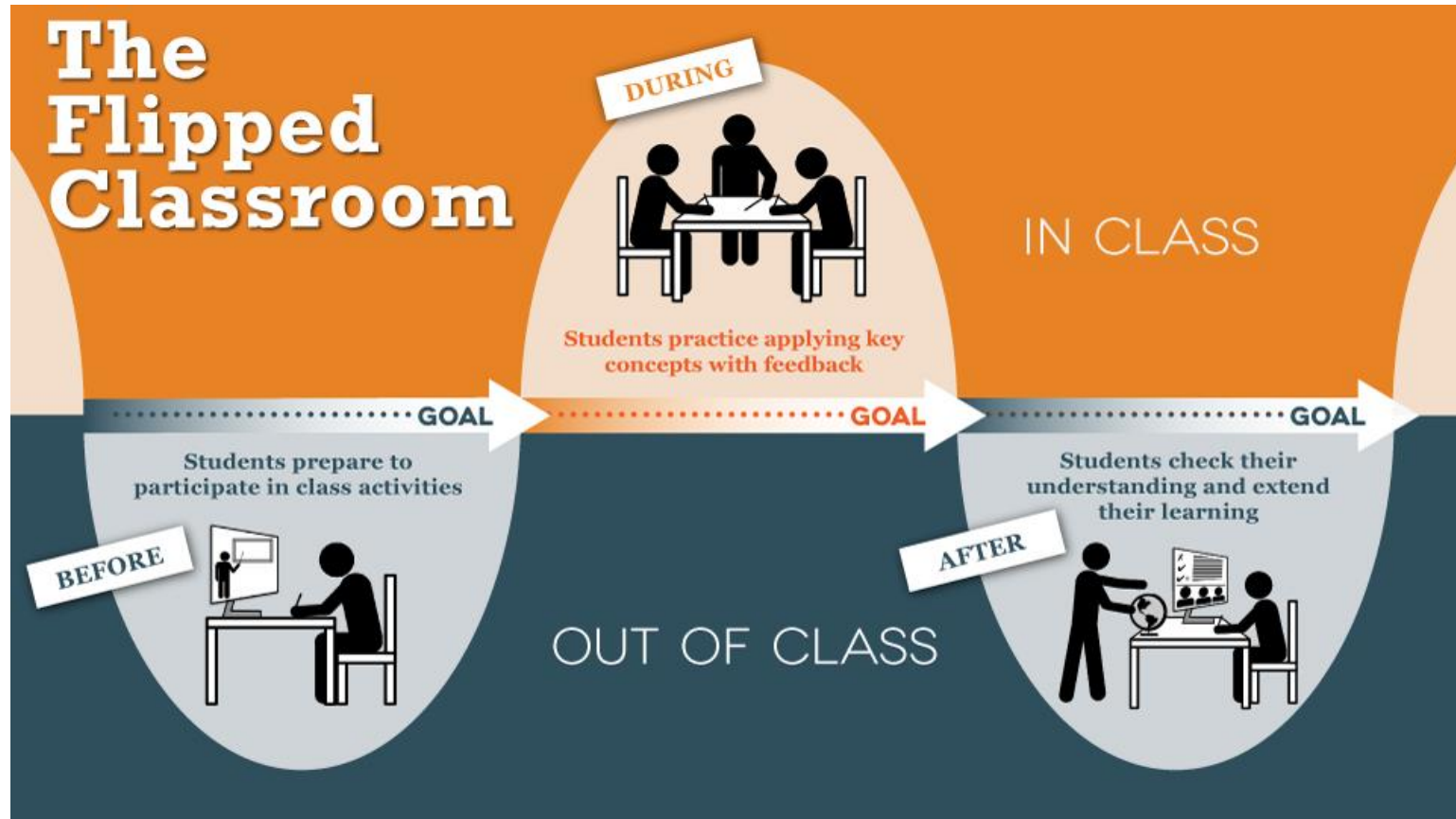
- ▶ Many options
 - In VLE's
 - Turning Point
 - Kahoot
- ▶ Value to both student and lecturer
 - Checking progress
 - Confirming pre-work
 - Promoting participation

Kahoot!

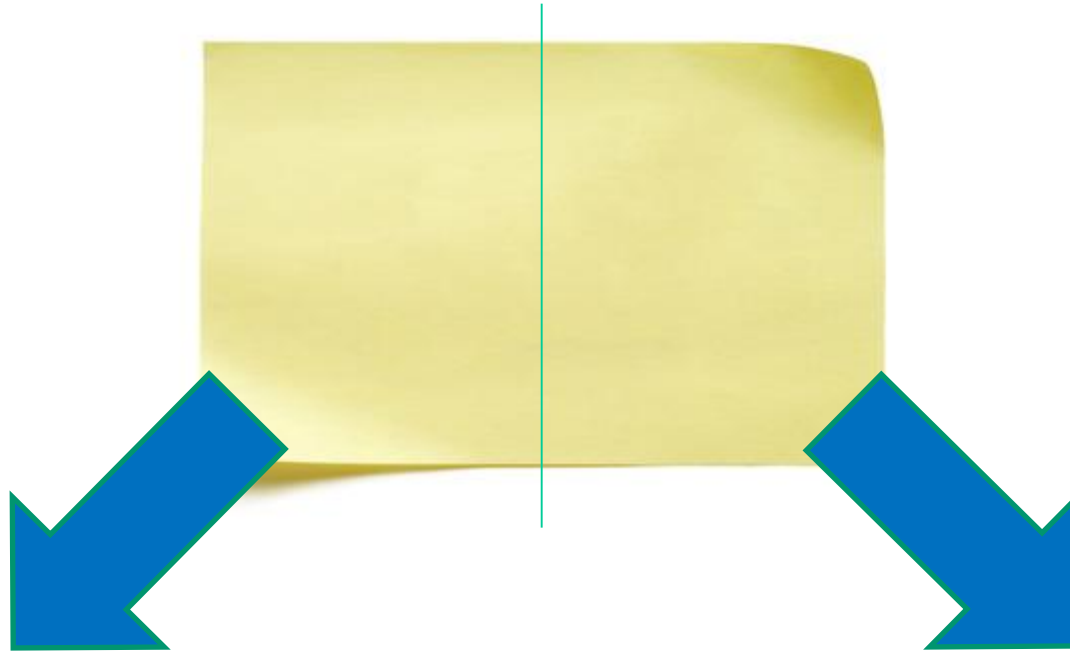
[Example](#)



Flipping



Informal Feedback



3 things that are good
about the module

3 things that are not so
good about the module

No names, no pressure – capture on a sheet of paper, review and feedback the next week (both good and not so good)

Create a dialogue

- ▶ Talk
- ▶ Discuss
- ▶ Question / Answer
- ▶ Share
- ▶ Create



Approaches - Frameworks

- ▶ Problem Based Learning
- ▶ Project Based Learning

- ▶ Structure and Guidance
- ▶ Output or Process or Both
- ▶ Assessment challenge
- ▶ Scale and Variety
- ▶ Network Support

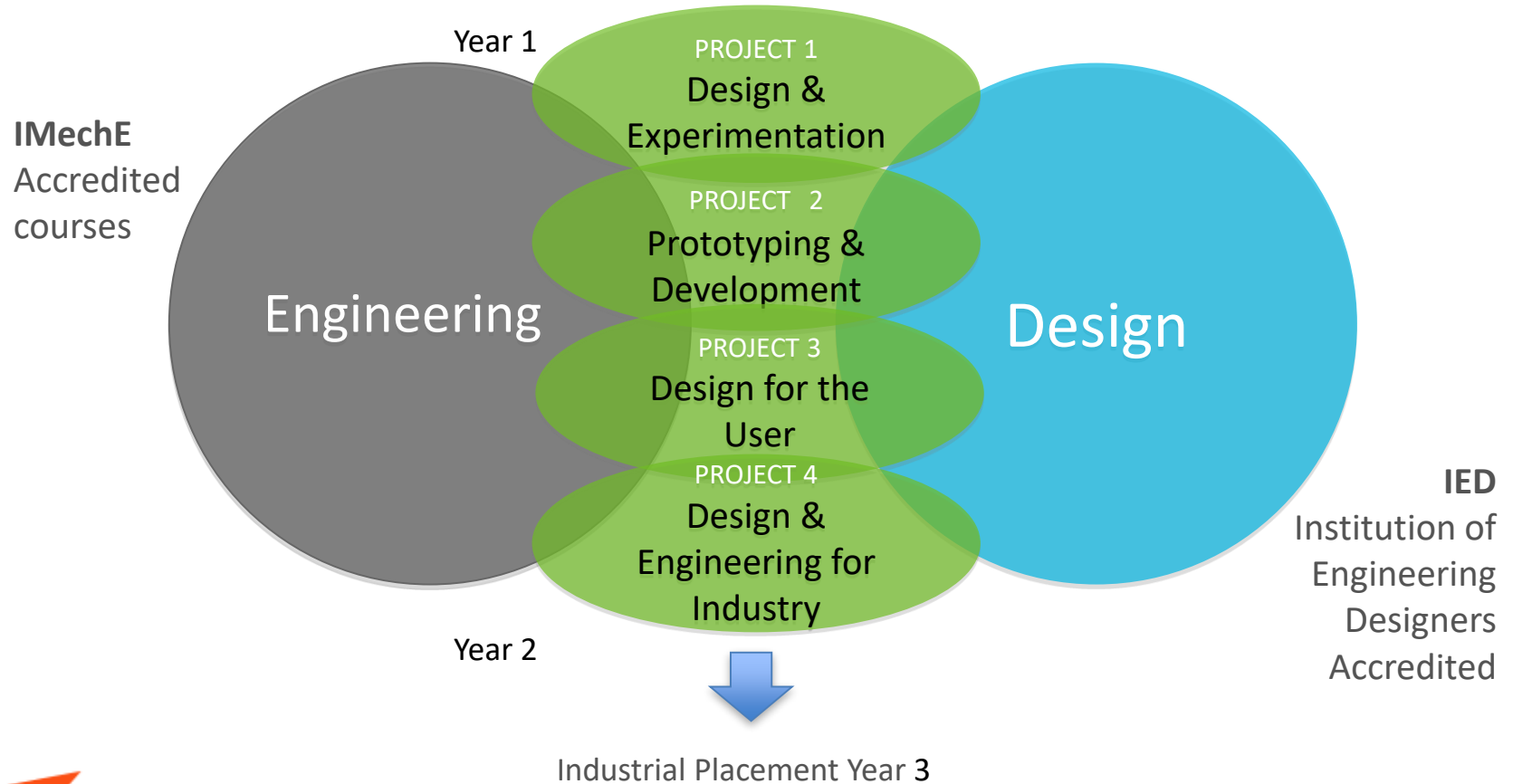


CDIO - Standards

- ▶ **STANDARD 1: The Context**
- ▶ **STANDARD 2: Learning Outcomes**
- ▶ **STANDARD 3: Integrated Curriculum**
- ▶ **STANDARD 4: Introduction to Engineering**
- ▶ **STANDARD 5: Design-Implement Experiences**
- ▶ **STANDARD 6: Engineering Workspaces**
- ▶ **STANDARD 7: Integrated Learning Experiences**
- ▶ **STANDARD 8: Active Learning**
- ▶ **STANDARD 9: Enhancement of Faculty Competence**
- ▶ **STANDARD 10: Enhancement of Faculty Teaching Competence**
- ▶ **STANDARD 11: Learning Assessment**
- ▶ **STANDARD 12: Program Evaluation**



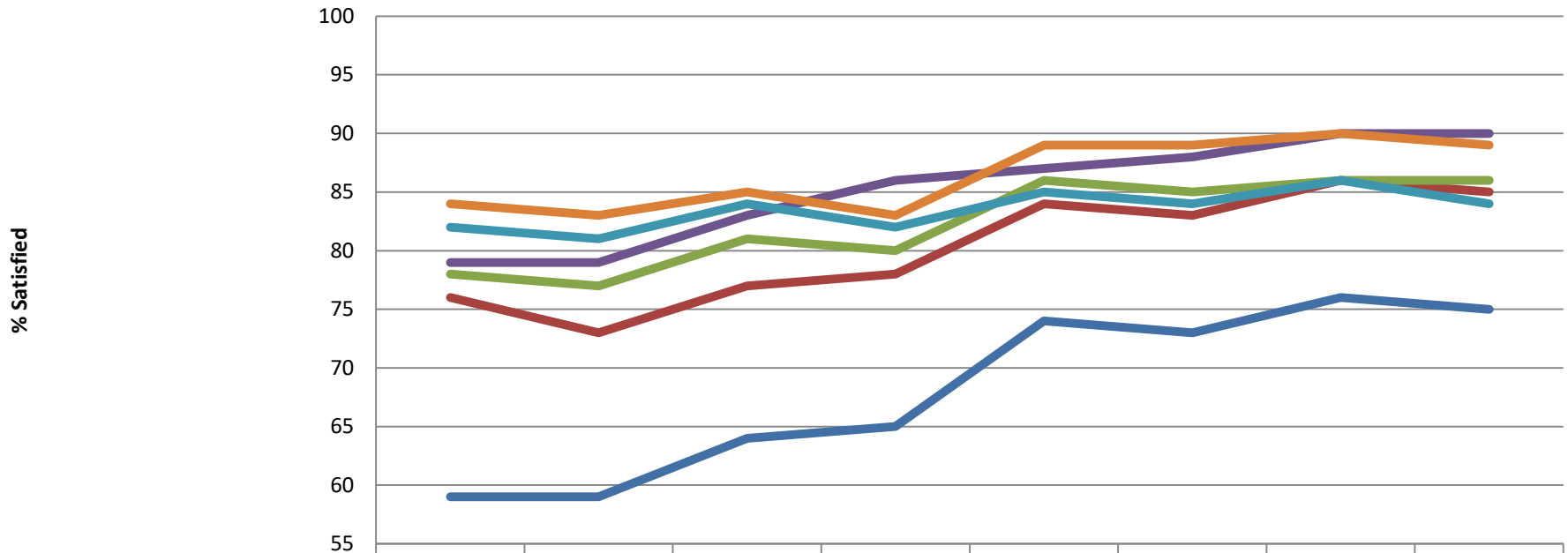
Structure Years 1 and 2



Evolution



Aston Student Satisfaction in National Student Survey since 2008

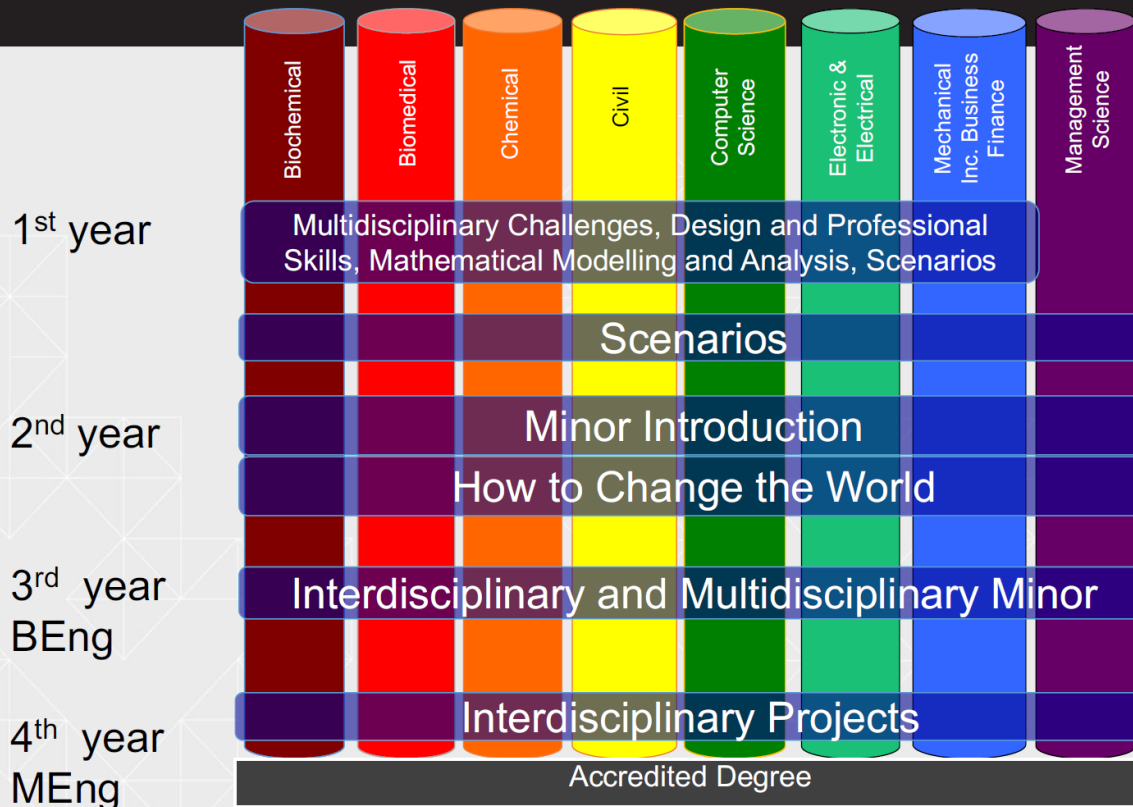


	2009	2010	2011	2012	2013	2014	2015	2016
Assessment and Feedback	59	59	64	65	74	73	76	75
Academic Support	76	73	77	78	84	83	86	85
Organisation and Management	78	77	81	80	86	85	86	86
Learning Resources	79	79	83	86	87	88	90	90
Personal Development	82	81	84	82	85	84	86	84
Overall Satisfaction	84	83	85	83	89	89	90	89

Student Reflections

“CDIO helped me during my placement year as it allowed me to approach problems with a open minded, can do attitude, without being intimidated by the size and complexity of the task ahead.”

Suraj Sudera, Former placement student



Prince (2004)

For example, students will remember more content if brief activities are introduced to the lecture. Contrast this to the prevalent content tyranny that encourages faculty to push through as much material as possible in a given session. Similarly, the support for collaborative and cooperative learning calls into question the traditional assumptions that individual work and competition best promote achievement. The best available evidence suggests that faculty should structure their courses to promote collaborative and cooperative environments. The entire course need not be team-based, as seen by the evidence in Springer et al. [43], nor must individual responsibility be absent, as seen by the emphasis on individual accountability in cooperative learning. Nevertheless, extensive and credible evidence suggests that faculty consider a nontraditional model for promoting academic achievement and positive student attitudes.



Growth in Active Learning

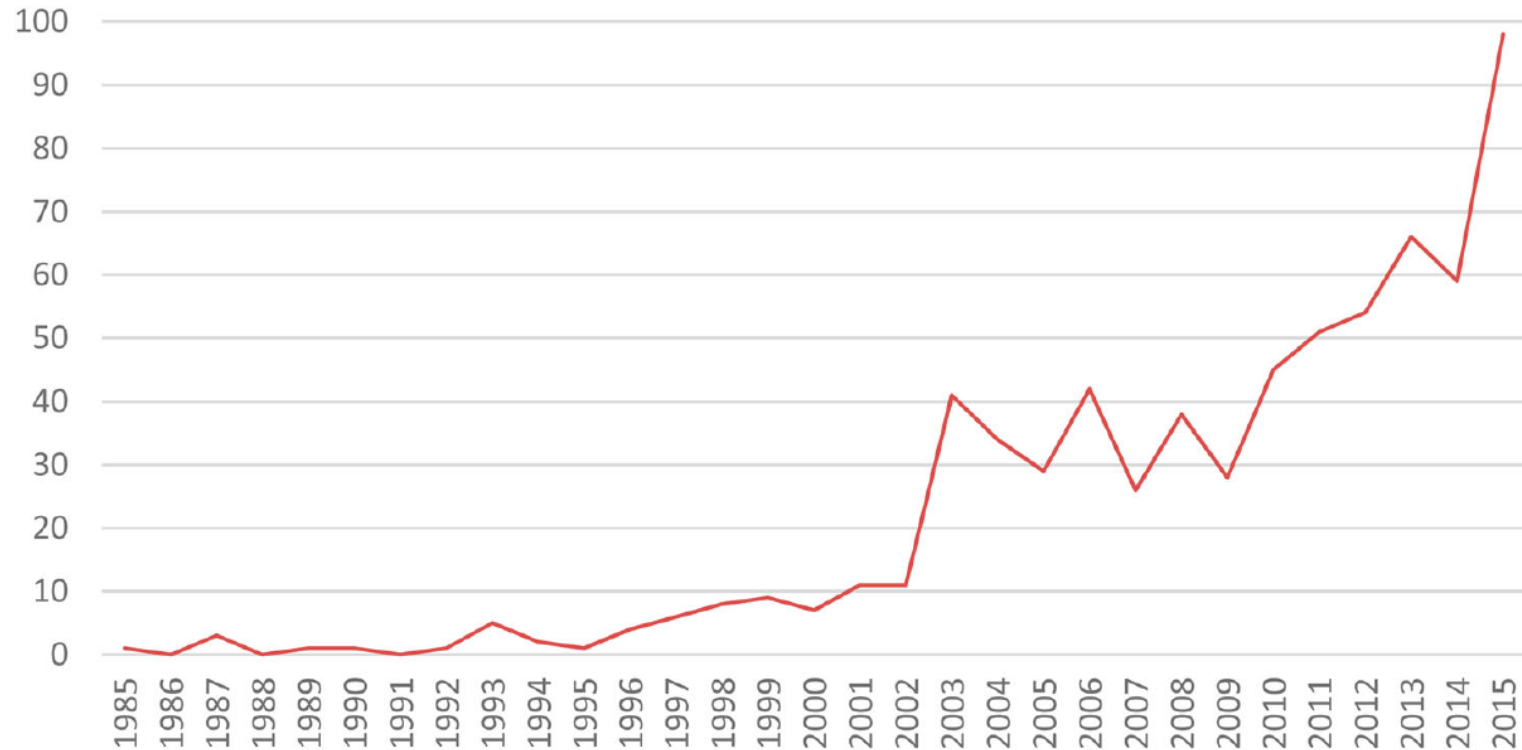
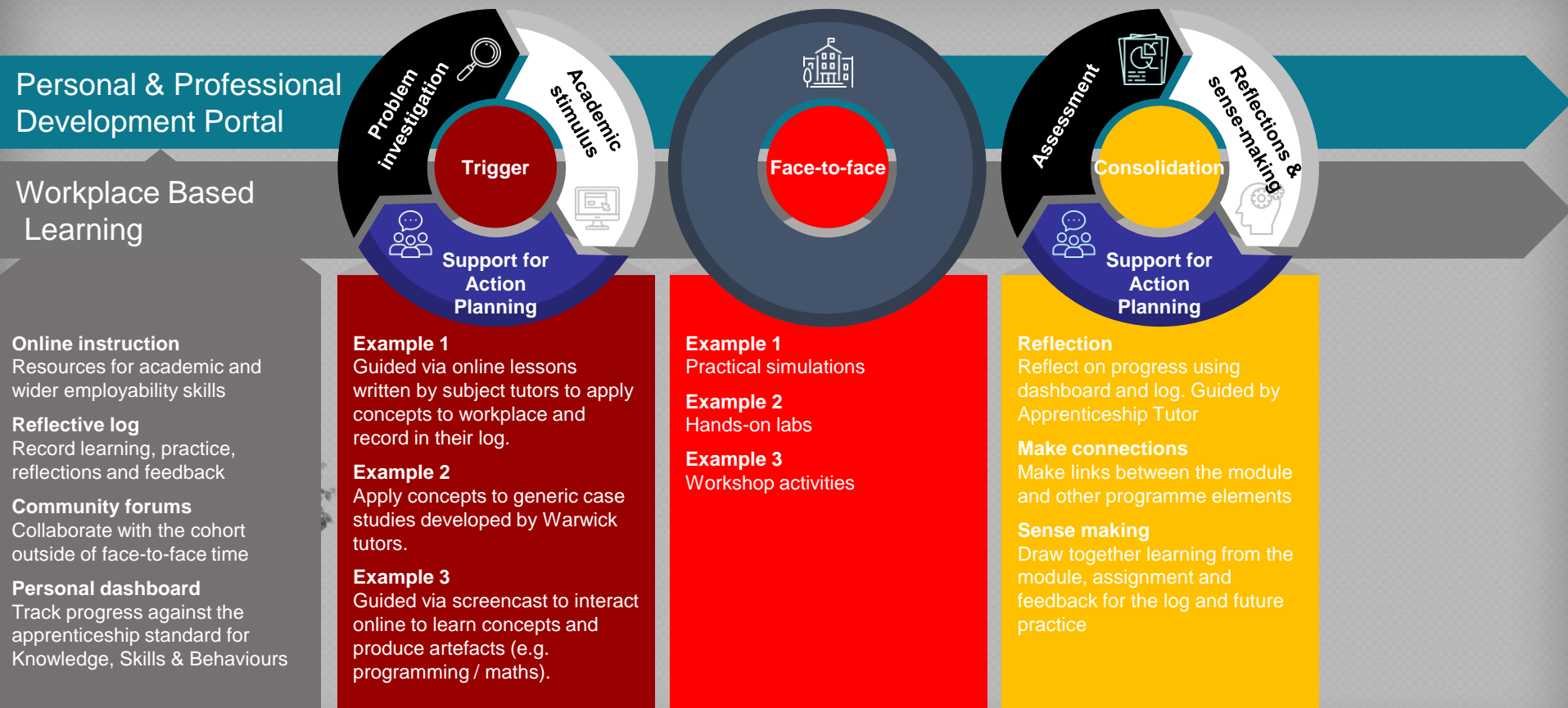


Figure 1. A perspective about the growth of published documents on Active Learning in Engineering Education.

Degree Apprenticeship Model



Example 1

Guided via online lessons written by subject tutors to apply concepts to workplace and record in their log.

Example 2

Apply concepts to generic case studies developed by Warwick tutors.

Example 3

Guided via screencast to interact online to learn concepts and produce artefacts (e.g. programming / maths).

Example 1

Practical simulations

Example 2

Hands-on labs

Example 3

Workshop activities

Reflection

Reflect on progress using dashboard and log. Guided by Apprenticeship Tutor

Make connections

Make links between the module and other programme elements

Sense making

Draw together learning from the module, assignment and feedback for the log and future practice

Examples

▶ WMG

- Applied Engineering Programme (BEng)
- Postgraduate Engineer (MSc)
- Senior Leader (MSc)



▶ Aston

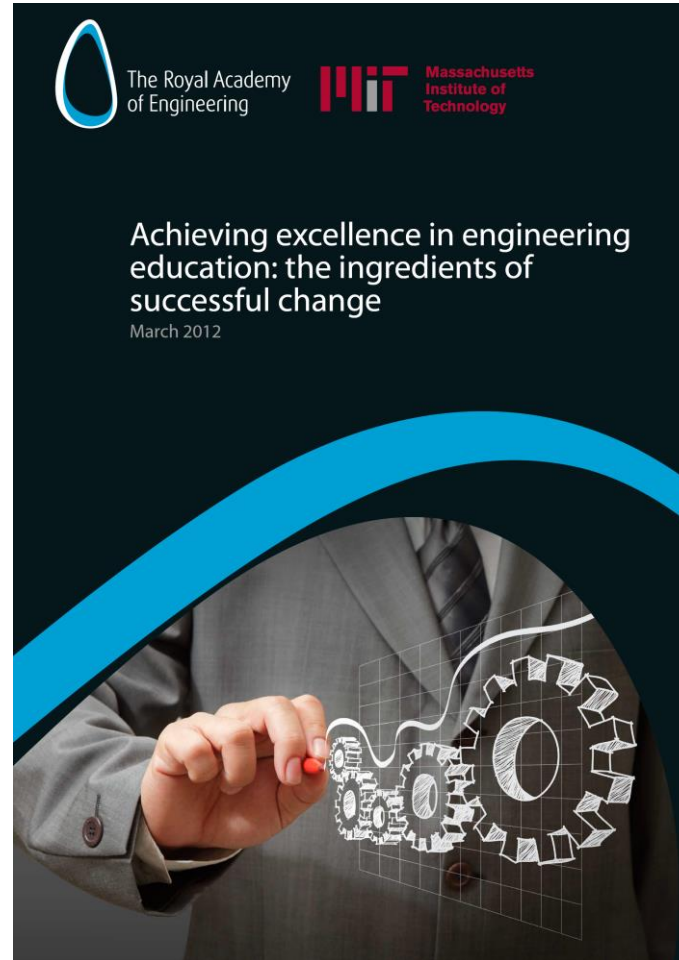
- MSc Professional Engineering



"The MSc helped me to develop particular skills and strengths within the workplace, engendering a greater technical ability and more innovative approach to engineering activities and projects."



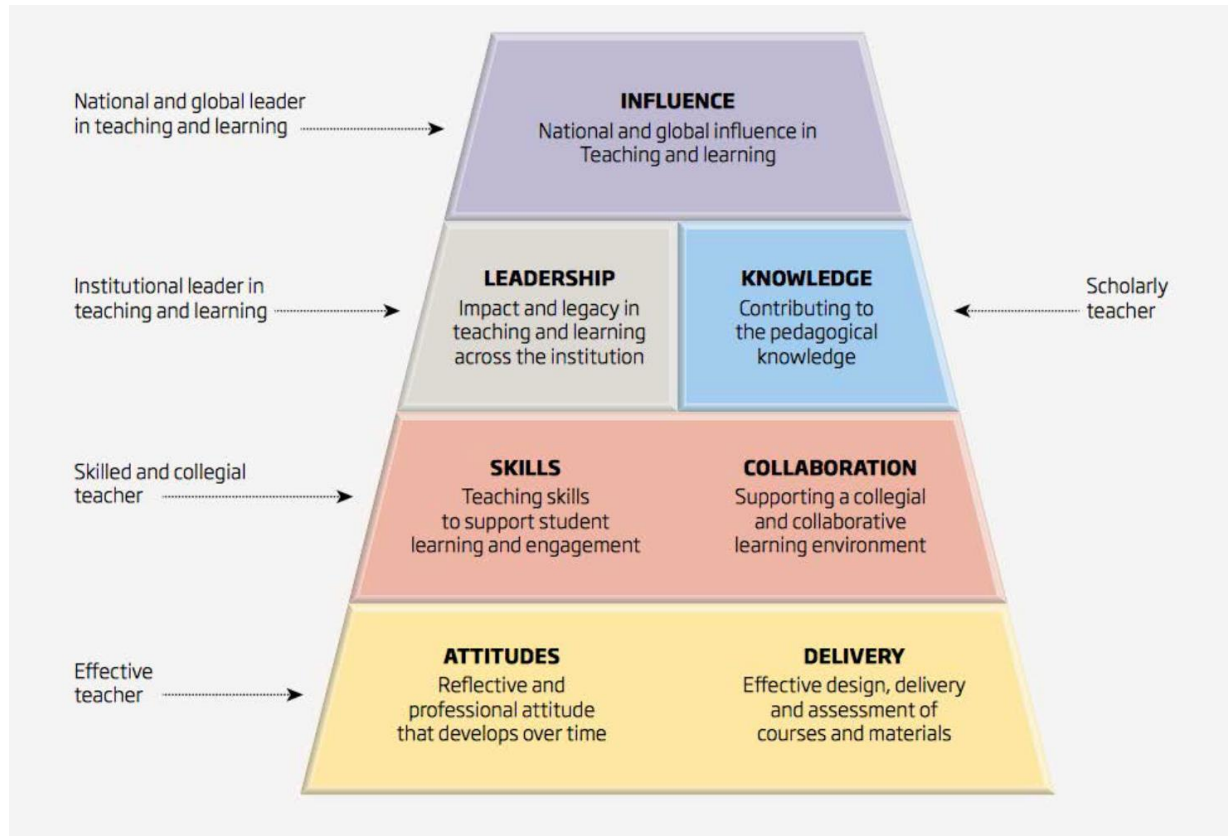
Achieving Excellence (2012)



Something to consider



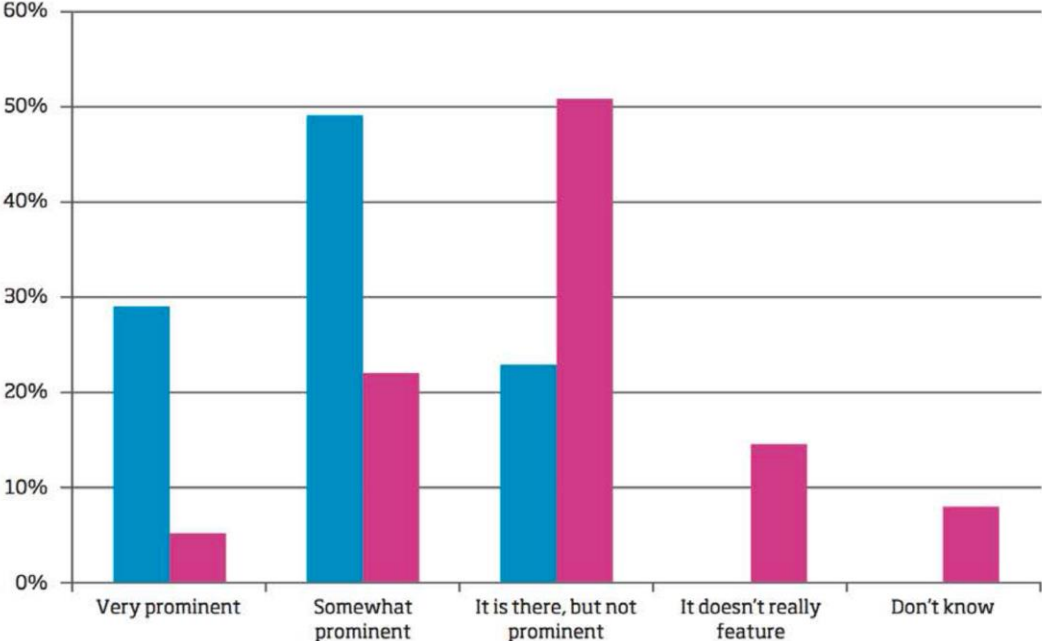
Recognition



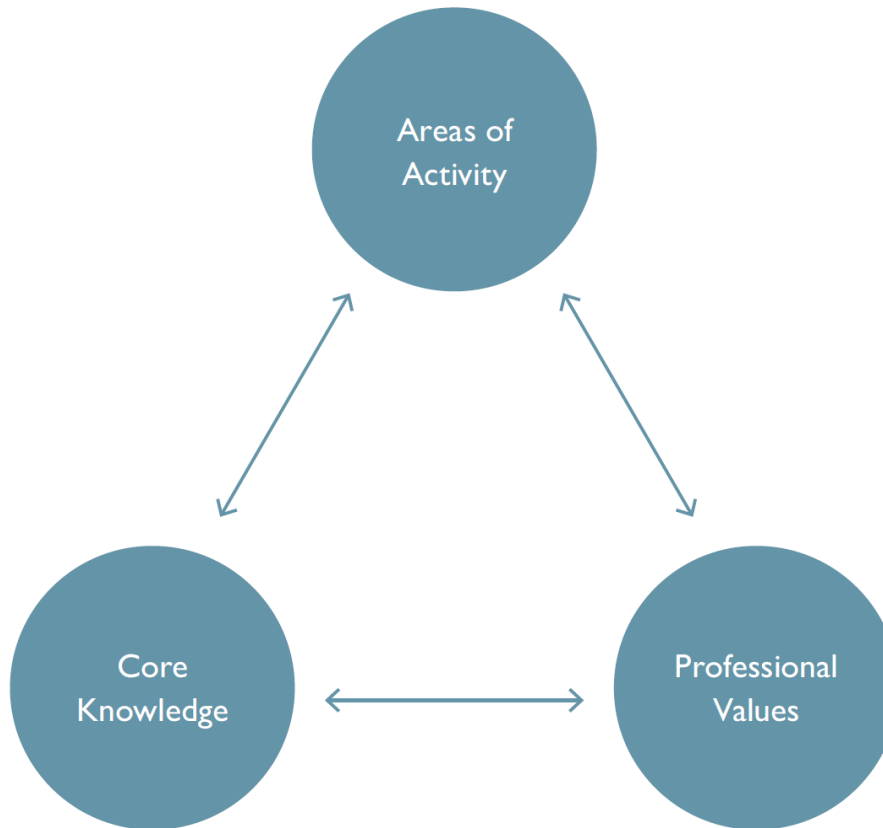
Royal Academy of Engineering (2016)
'Does Teaching Advance your Academic Career'

Figure 5. Responses to the question “How prominent is teaching excellence in your university’s promotion policies?”, for heads of department, deans and university managers (blue) and academic staff (magenta)

■ Head of department/dean or senior management
■ Post-doc, researcher, lecturer, senior lecturer, reader



UK PSF



Engineering EDGE

*Summary Report of
The Engineering EDGE Project*

*Are Engineering Educators
'Fit for Purpose'?*

March 2019



- ▶ 10 UK HEI's
- ▶ 174 / 40
- ▶ Yes but.....
- ▶ Training
- ▶ Inclusive
- ▶ Time
- ▶ Transition
- ▶ Work together
- ▶ Scholarship

EER and Scholarship



- ▶ Formed in 2009
- ▶ 6th Annual Symposium
Portsmouth 2018
- ▶ 100+ members
- ▶ RAEng and EPC support
- ▶ Network to promote understanding, sharing and debate

Our community

IfM



UCL Centre for Engineering Education



Visibility

Home - Higher Educatic X Home - Royal Academy of E Home - Royal Academy of E snapshot tool - Bing

hefocus.raeng.org.uk

ROYAL ACADEMY OF ENGINEERING Higher Education Focus

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Creating cultures where all engineers thrive

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Engineering Education Support

The Academy is committed to engaging higher education (HE) and supporting engineering work in academia.

We have supported a programme of HE STEM

Type here to search 20:39 15/11/2017

Community Value

- ▶ Creating a linked network
- ▶ Support and collaboration
- ▶ Raising the profile of EER
- ▶ Teaching excellence and relevance
- ▶ Creating graduates 'of value'
- ▶ Routes to promotion
- ▶ Global contribution e.g EXTEND

EXTEND

Co-funded by the
Erasmus+ Programme
of the European Union



engineering

noun

mass noun

1

The branch of science and technology concerned with the design, building, and use of engines, machines, and structures.

1.1 A field of study or activity concerned with modification or development in a particular area.

‘software engineering’

2

The action of working artfully to bring something about.

‘if not for his shrewd engineering, the election would have been lost’



Recommendations

- ▶ **Connections**
- ▶ STeM to STEM
- ▶ Early action with young people
- ▶ Invest in teachers
- ▶ REF and TEF – make universities ‘fit for purpose’
- ▶ Establish what works – longitudinal studies
- ▶ Broader view of engineering – more inclusive
- ▶ New models for learning
- ▶ Clear leadership



Future Engineering Education

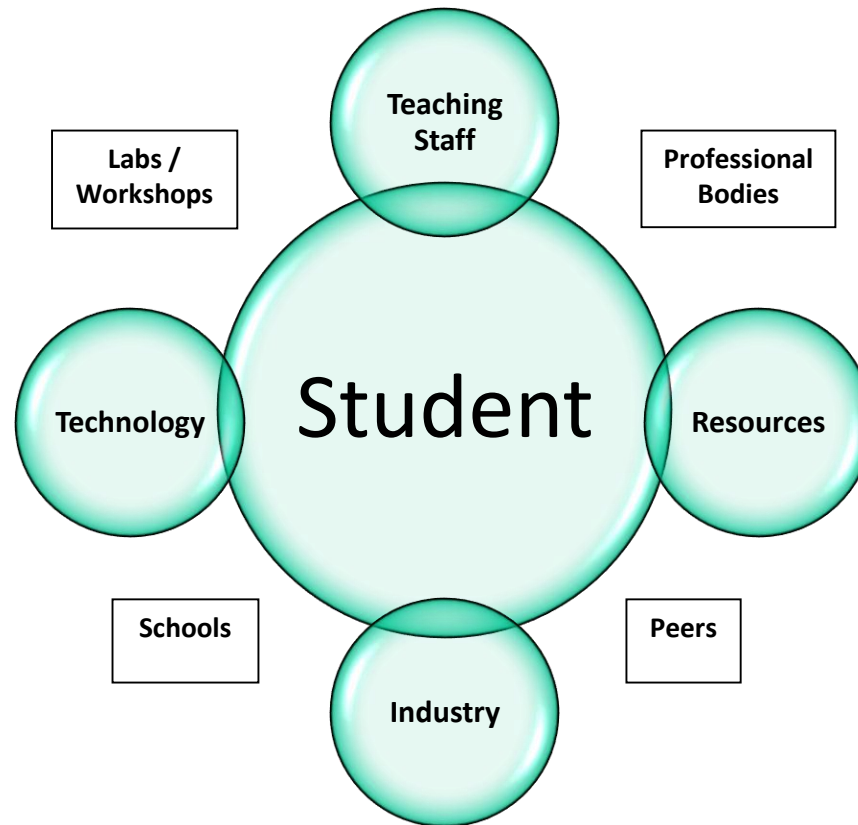
▶ Engineer



▶ Engineering



Student 'truly' at the centre



Soweto, 2017



To conclude

- ▶ EE is an exciting and dynamic space
- ▶ Change is a given
- ▶ We must lead and challenge

Prof Robin Clark

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My Reality



Education Strategy

Learning beyond boundaries

WARWICK
THE UNIVERSITY OF WARWICK

A Warwick education will be more research-led and international in outlook, achieved through our staff and students working in partnership to co-create the educational experience. The effects will be truly transformative and enriching – for our students and their impact on society.



References

- ▶ Lima et al (2017), 'Active Learning in Engineering Education: a (re)introduction', EJEE, 42(1), pp 1-4
- ▶ Prince (2004), 'Does Active Learning Work? A Review of the Research', JEE, 93(3), pp 223-231
- ▶ Royal Academy of Engineering Reports can be found at
<https://www.raeng.org.uk/publications/reports>
- ▶ Thanks to colleagues at WMG, Aston, UCL and the wider EER Network



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