Developing an Integrated Curriculum

Engineering Education Master Class

John Mitchell – University College London
j.mitchell@ucl.ac.uk

UCL ENGINEERING
Change the world

Developing an Integrated Curriculum

Robin Clark – University of Warwick
R.Clark.6@warwick.ac.uk

WMG
THE UNIVERSITY OF WARWICK

Day 1

09:30	Arrival and tea/coffee
10:00	Welcome and introductions
10:10	Setting the Scene
10:30	a) Challenges in Curriculum Development (activity)
	b) How do we address the challenges? (activity)
	c) Introducing the Integrated Curriculum
13:00	Lunch
14:00	a) What do we mean by integrated? (activity)
	b) The importance of context
	c) IEP
	d) RVS
16:00	Tea/Coffee
16:30	a) CDIO (activity)
	b) Initial reflections and critique considering the context in South Africa
	Homework – identify a module / unit within one of your programmes for consideration tomorrow
18:00	Break
19:00	Dinner

Activity

- Developing a meaningful curriculum is not without its challenges
- Let's start by identifying what those challenges are
- Discuss in your groups – identify and prioritise the challenges (20 mins)
- You will then be asked to feedback

Feedback

- Legacy systems and practices that hold back integration
- Shared ownership needed, lecturers, educationalists, stakeholders, e.g. students, etc.
- Clarity about the objectives of integration
- Keeping up with change in external bodies (industry etc.)
- Appropriateness of assessment to objectives
- Alignment, horizontally and vertically, too much duplication vs gaps
- Ensuring master of little bits in the integrated whole
- Balance between content and expected skills.

Feedback

- Integration between learning and processes of learning
- Understanding pace and scope
- Expectation of skills in the local context
- Promote Life-long learning within the curriculum
- Tablet of stone approach vs living entity
- Dislocation between learning approaches and assessment
- Find a shared understanding of integration and reasons
- Deep vs surface learning (InQ)

How do we address the challenges?

- How could you address this yourselves?
- What aspiration ideas do you have?
- What needs to change?

- 20 minutes discussion then plenary

Feedback

- Better co-ordination (industry, students etc)
- Change culture of individualism – invite people in as co-facilitators
- Recent alumni on advisory board (what should modern curriculum be)
- Co-ordination between projects and theory – develop year to year – develop anticipation linked to application – colleagues working together
- Jigsaw puzzle analogy
- Curriculum packed and restrictive – introduce flexibility
- Maths – constructivist rather than positivist
- External industry exposure beneficial – promote and better integrate with uni learning
- Appreciation of integration of 3 areas of knowledge – question then becomes how

Feedback

- Radically different and diverse modes of instruction
- Time – leverage off research priority in institutions – mini L+T projects working with others
- Overcome obsession of past – reconceptualise the engineering professional – ongoing change
- Cultural diversity of staff and students, organisation – recognise, address, turn to a positive
- Co-creation – involve students
- Students understanding of what engineering is – academic and industry
- Promote student independence, creative thought …..

Introducing the Integrated Curriculum

Engineering Education

- What is it for?
- It is education – it is not just training or knowledge
- Develop intrinsic-motivation and agency within students
- Develop professional attitudes and competencies
- Develop graduates that appreciate socio-economic and environmental contexts, sustainability, ethics, innovation and entrepreneurship
- Confident communicators and team-workers
- Deep specialist knowledge

What might we integrate?

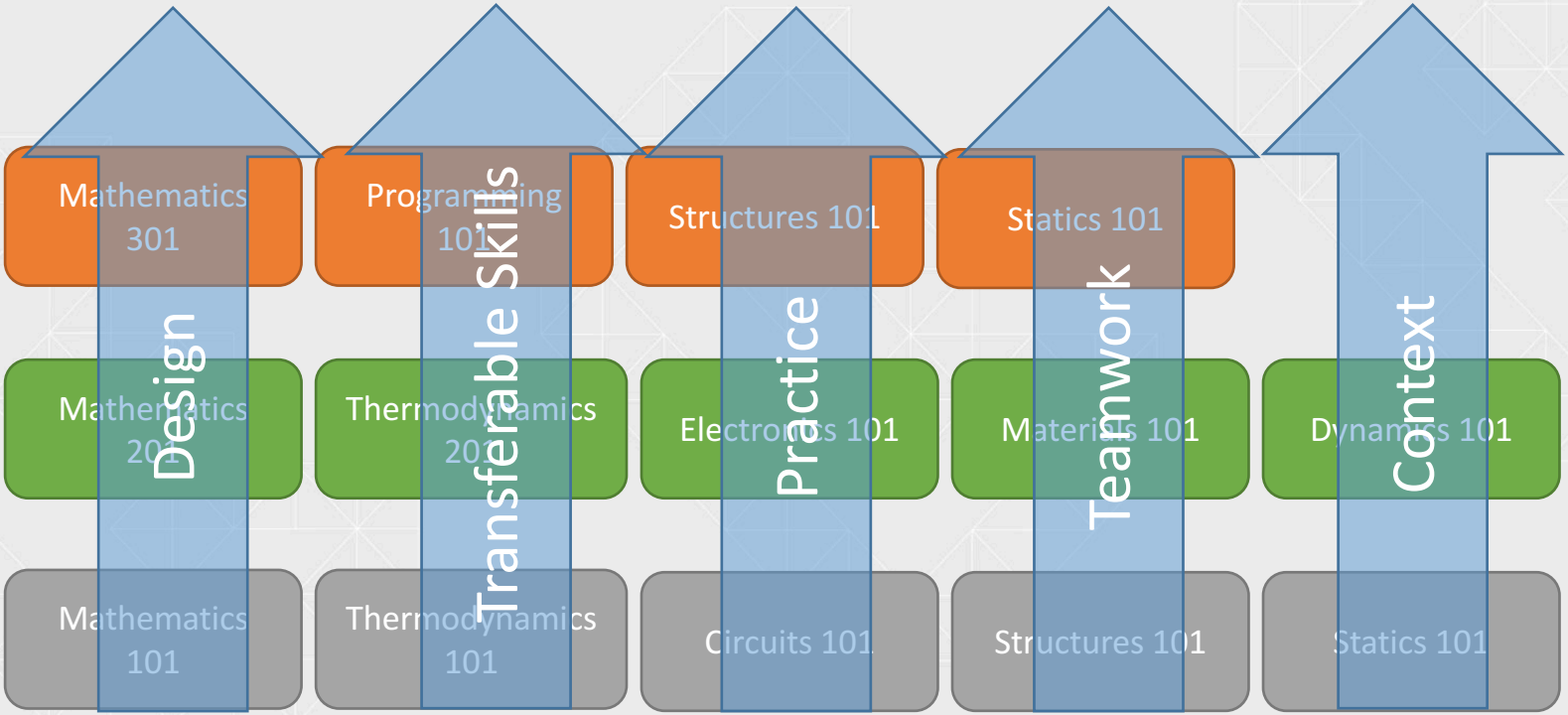
Mathematics 301	Project		Programming 101	Structures 101	Statics 201
Mathematics 201	Thermodynamics 201	Design 201	Electronics 101	Materials 101	Dynamics 101
Mathematics 101	Thermodynamics 101	Design 101	Circuits 101	Structures 101	Statics 101

What might we integrate?

What might we integrate?

- Critical thinking
- Problem Solving
- The Design Cycle
- Project Lifecycle
- Product Design
- Visualisation
- Teamworking
- Leadership
- Ethics / Sustainability
- Professionalism
- Entrepreneurship
- Sourcing information
- Technical argument
- Presentations
- Writing
- Legal Aspects

What might we integrate?



Others

- Disciplines
- Modules
- Transferable Skills
- Psychology Practice
- Culture
- Resilience/Self-reflection
- Organisational culture
- Pedagogic Integrated?

What do you mean by integrated?

- What areas of the curriculum do you feel are important to integrate in your context?
- Which might be achievable?

- 30 minute activity

- Disciplines
- Modules
- Transferable Skills
- Psychology Practice
- Culture
- Resilience/Self-reflection
- Organizational culture
- Pedagogic Integrated?

The importance of context

- What do we mean when we talk about context in Engineering Education?

The Environment

NSS
National Student Survey

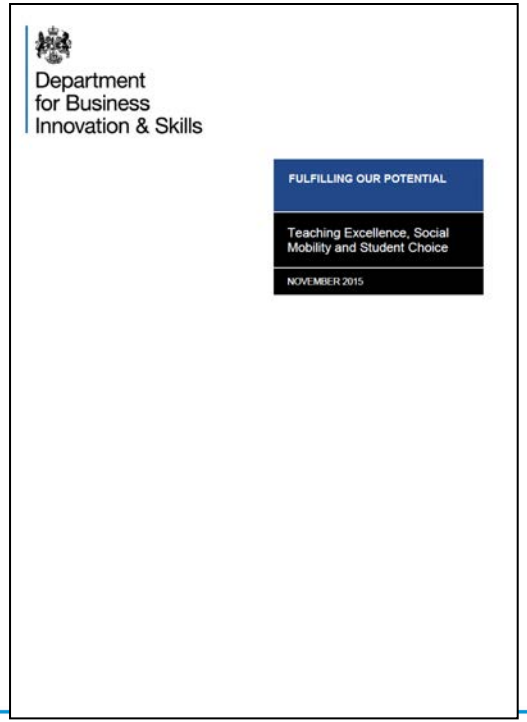
Postgraduate
Taught
Experience
Survey

	Total number of students (1 000)	of which, studying (%)						
		Humanities and arts	Social sciences, business and law	Science, mathematics and computing	Engineering, manufacturing and construction	Agriculture and veterinary	Health and welfare	Services
EU-28	20 283	12.0	33.3	10.3	15.0	1.8	14.0	4.2
Belgium	462	10.4	29.4	5.2	10.4	2.4	22.3	1.8
Bulgaria	285	7.9	41.3	5.2	18.8	2.4	7.3	8.5
Czech Republic	446	8.9	32.3	11.2	13.8	3.7	10.7	5.3
Denmark	259	12.8	33.6	8.5	10.6	1.5	20.8	2.5
Germany	2 763	13.3	25.7	14.3	17.8	1.5	17.2	2.7
Estonia	69	13.7	33.8	11.2	14.4	2.3	9.3	8.0
Ireland	196	13.1	24.8	14.4	11.8	1.6	15.9	4.3
Greece	661	13.6	31.7	14.4	18.0	4.7	7.8	2.8
Spain	1 951	11.0	31.2	9.8	17.7	1.6	12.7	5.3
France	2 259	13.5	36.6	12.2	13.2	1.2	16.0	3.4
Croatia	154	9.6	42.2	8.2	15.3	3.7	9.0	7.7
Italy	1 968	12.9	34.8	8.1	17.7	2.2	13.1	3.4
Cyprus	32	10.4	48.6	8.7	10.8	0.5	7.6	4.5
Latvia	104	8.9	46.0	6.1	13.8	1.2	10.2	7.0
Lithuania	187	7.4	46.4	5.2	16.7	1.9	9.6	3.0
Luxembourg	6	11.2	46.3	11.0	7.2	0.4	7.3	:
Hungary	382	9.3	39.8	7.2	14.9	2.4	9.4	10.4
Malta	11	17.2	32.7	11.1	9.6	0.2	17.8	1.3
Netherlands	780	8.6	39.3	6.2	7.7	1.1	17.8	6.5
Austria	362	12.9	36.5	11.0	14.5	1.3	7.6	2.4
Poland	2 080	9.1	38.3	8.0	14.0	1.8	8.1	7.3
Portugal	396	9.3	31.8	7.2	21.6	1.8	16.2	6.4
Romania	872	8.1	49.0	5.2	20.1	2.2	9.2	4.2
Slovenia	107	8.5	34.7	7.0	19.5	3.2	10.0	9.5
Slovakia	226	7.3	31.0	8.5	15.2	2.2	17.2	6.2
Finland	308	14.1	23.0	10.1	23.9	2.2	16.2	5.4
Sweden	464	13.4	27.0	9.2	16.7	1.0	17.3	2.5
United Kingdom	2 492	16.1	27.8	13.5	8.5	1.1	17.6	1.7
Iceland	19	14.8	36.1	8.9	9.3	0.8	13.3	2.2
Liechtenstein	1	0.0	75.4	0.0	21.3	0.0	3.3	0.0
Norway	230	10.4	31.8	8.5	8.1	0.8	19.9	4.9
Switzerland	258	11.8	35.8	9.8	13.8	1.0	13.4	4.5
FYR of Macedonia	68	13.9	36.3	12.1	11.3	2.7	10.3	7.2
Turkey	3 817	9.0	54.7	7.3	10.4	2.7	4.7	3.5
Japan	3 881	15.5	28.8	2.9	15.2	2.5	13.7	5.2
United States	21 016	15.1	27.7	8.6	7.2	0.7	14.8	6.2

([1]) Refer to the internet metadata file (http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/en/educ_esms.htm).
Source: Eurostat (online data codes: tps00062 and educ_enrl5)

Eurostats (2014)

6th November 2015

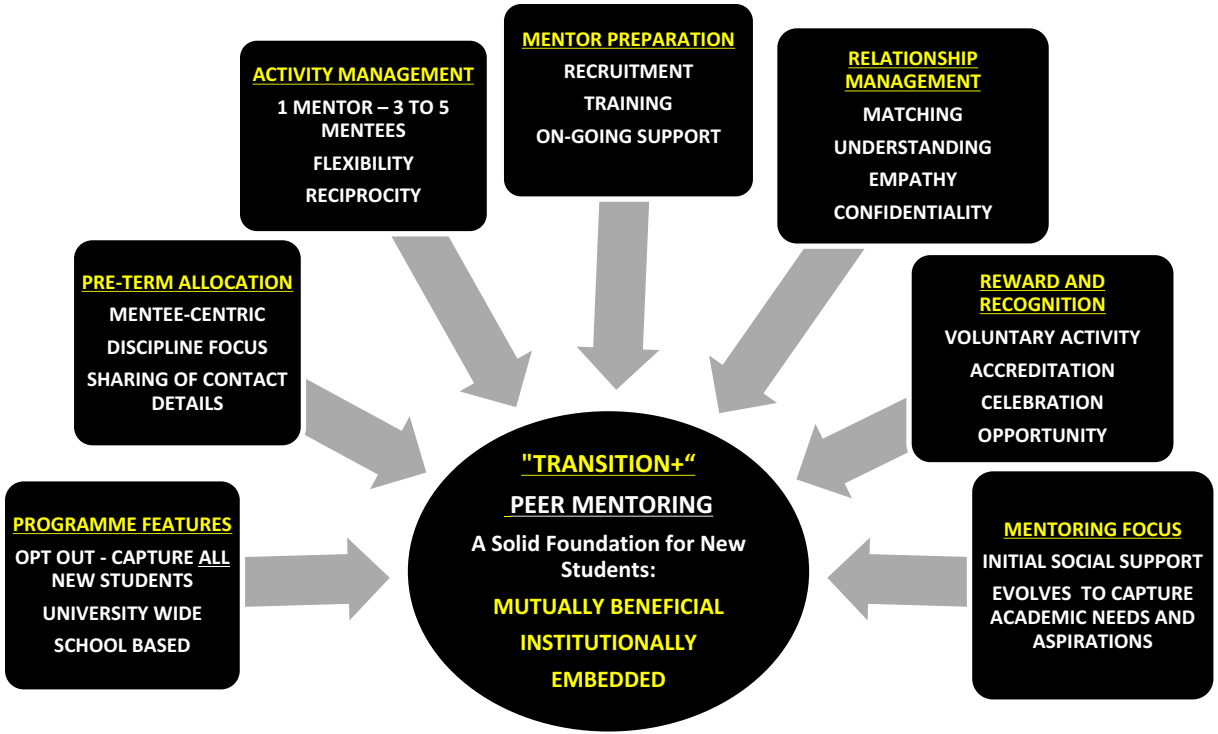


- 105 pages to digest
- Teaching Excellence Framework
- “Universities should produce well equipped students ready to contribute to society and business”
- An opportunity?

Considerations

- Reputation
- Metrics and League Tables
- Strategy and Goals
- Student Experience
- L+T Culture
- Staff Recognition
- Geography
- Student body
- Widening Participation
- Industry involvement
- Quality regime
- Accreditation
- …..

Transition – Peer Mentoring



Clark, R., Andrews, J. & Gorman, P. (2013). "Tackling Transition: The Value of Peer Mentoring". *Journal of Widening Participation and Lifelong Learning*. Vol 14, Special Issue, Winter 2012-13

Embrace your context

- Complex
- Matching your approach to your aspirations
- Promoting and realising appropriate change
- Developing an evidence base for informed decision making

Integrated Engineering Programme (IEP)

UCL Centre for Engineering Education

UCL ENGINEERING
Change the world

What is Engineering?

engineering
....the art and practice
of
changing the physical world
for
the use and benefit of all

UCL ENGINEERING
Change the world

“I think I would have done engineering if I’d known what a creative subject it was and not just about solving equations”

What is the IEP?

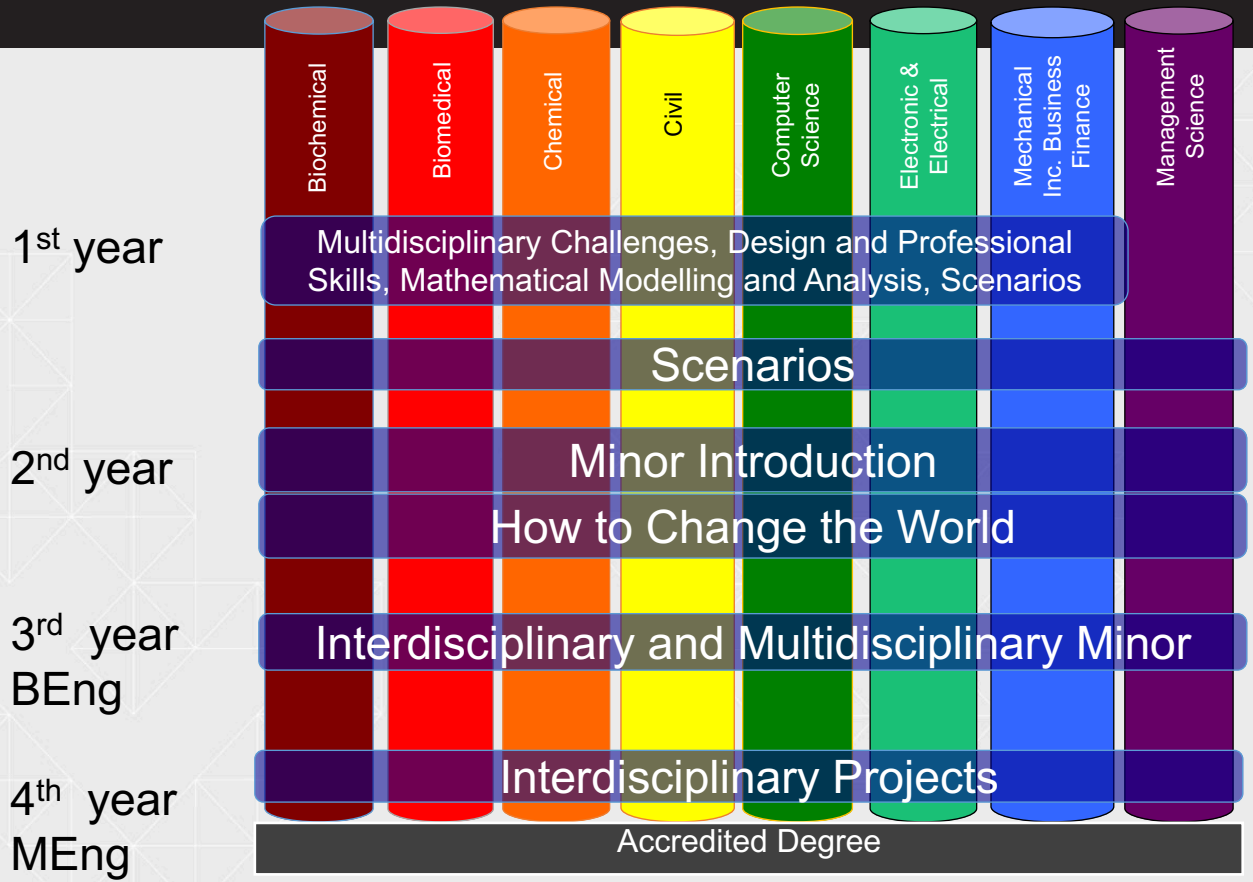
- A way of teaching that provides connecting activities between the different disciplines
- A common curriculum structure that promotes practical application and transferable skills alongside fundamental theoretical/technical knowledge
- It is embedded into the student's chosen BEng / BSci or MEng degree
- A response to change in the higher education landscape

Aims

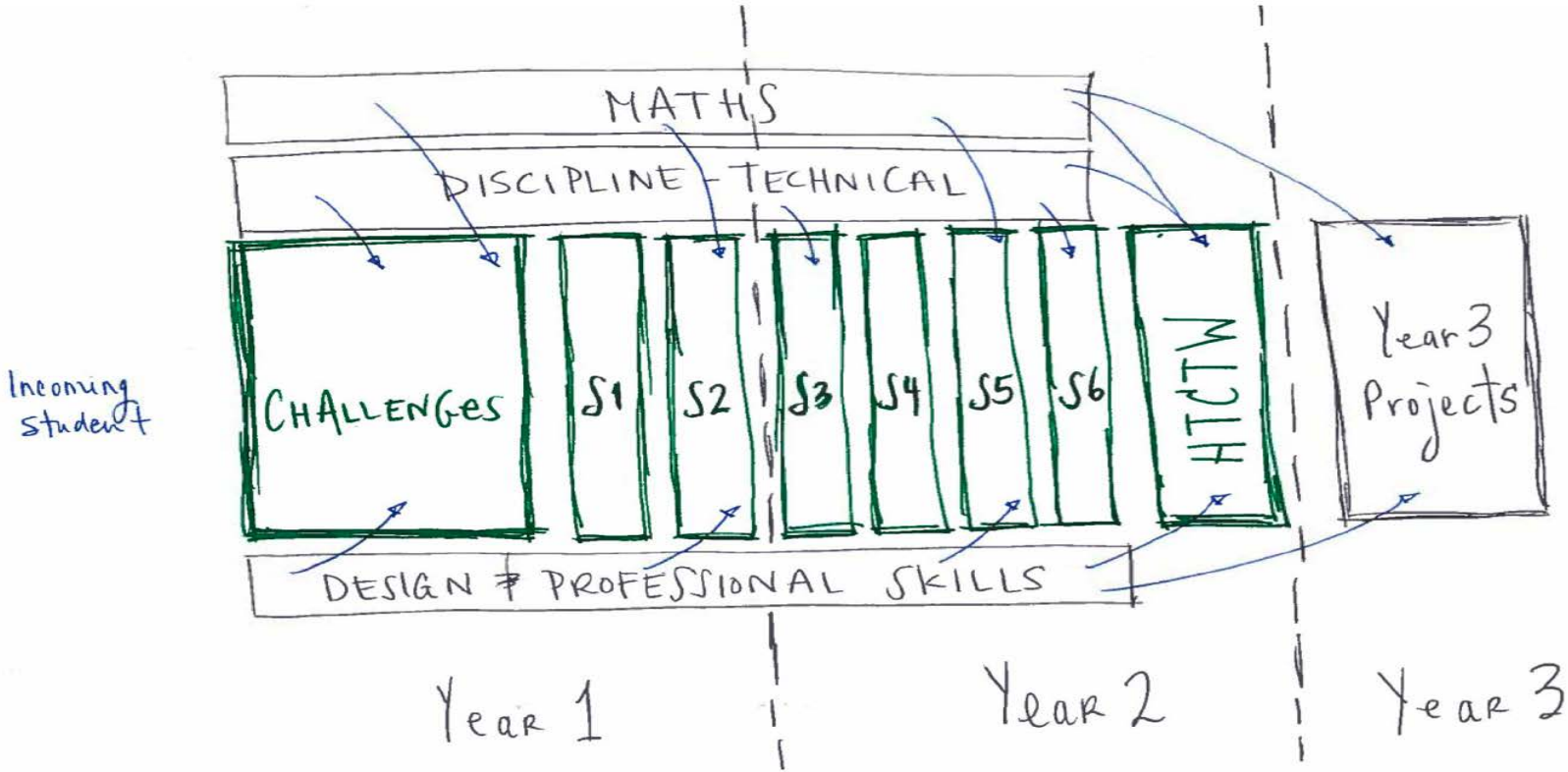
- Demonstrate the Interdisciplinary nature of Engineering
- Develop and inclusive curriculum promoting diversity
- Authentic Practical Engineering from the start
- Emphasis on Design and Professional Practice
- Maintain disciplinary strengths and alignment to research

What is different?

- Authentic engineering work place practices through several project opportunities
- Learn to work with engineers from other disciplines from the start
- Develop skills that will help students turn their theoretical work into real solutions
- Assist in identifying personal values and develop transferable skills that help students reflect on the kind of Engineer they want to be and impact they want to make in their career


Biochemical
Biomedical
Chemical
Civil
Computer Science
Electronic & Electrical
Mechanical Inc. Business Finance
Management Science
1st year
Multidisciplinary Challenges, Design and Professional Skills, Mathematical Modelling and Analysis, Scenarios
Scenarios
2nd year
Minor Introduction
How to Change the World
3rd year BEng
Interdisciplinary and Multidisciplinary Minor
4th year MEng
Interdisciplinary Projects
Accredited Degree

IEP 'Spine'

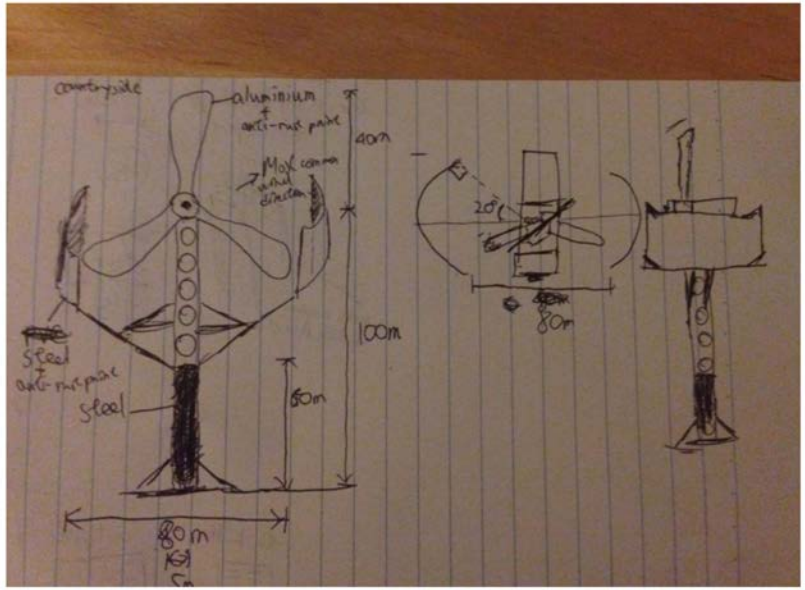

MATHS
DISCIPLINE - TECHNICAL
Incoming student
CHALLENGES
S1
S2
S3
S4
S5
S6
HTCTW
Year 3 Projects
DESIGN & PROFESSIONAL SKILLS
Year 1
Year 2
Year 3

Integrated Teaching & Learning

- A connected curriculum, punctuated with problem-based and research-based activities
- Inter-disciplinary approach (7 undergraduate departments - >700 students)
- Year 1 foundations, upper year projects and minor streams
- Minors - topical and inter-disciplinary
- Review the balance of assessment & delivery styles
- Review of discipline specific curriculum

What our Engineering students do?

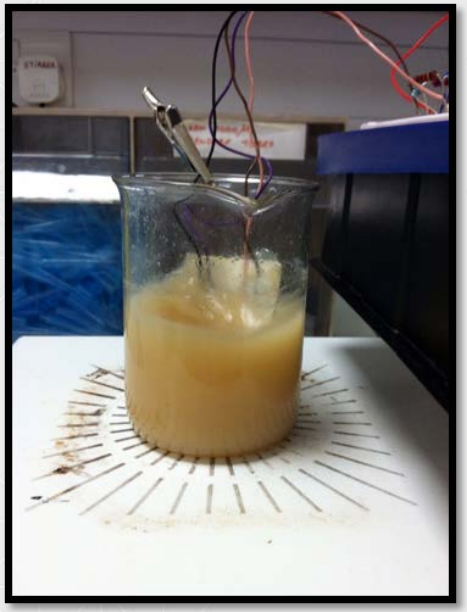
Group work



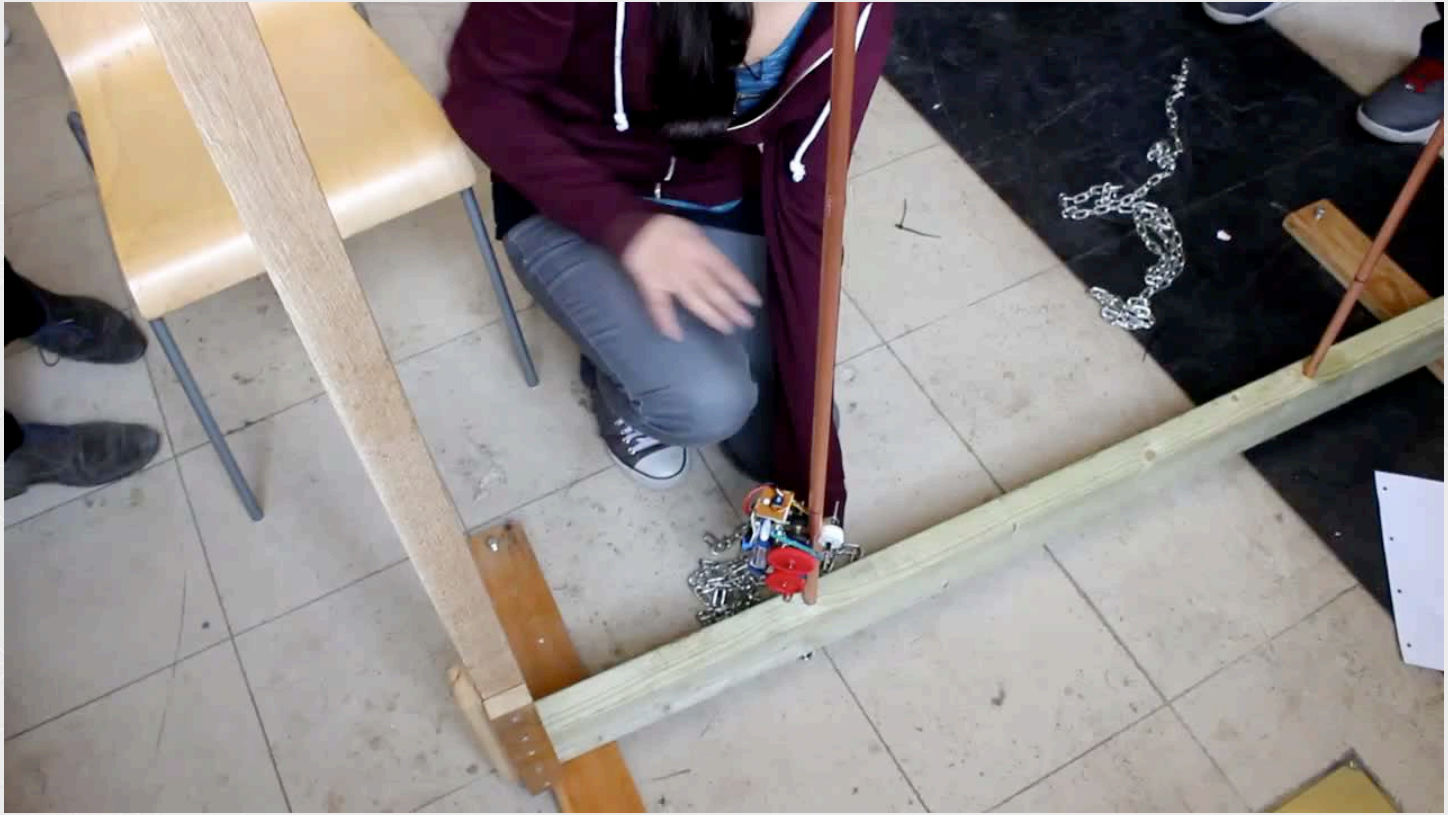
Design

Authentic Learning - Challenges

- Challenge 2: TB Vaccine Production in Sub Saharan Africa



Authentic Learning - Scenarios



How to Change the World

- 700+ Students, 65 Partners, 5 Cohorts, 50+ Teaching team
- A unique, two-week hands-on training programme that equips rising engineering talent with the skills to develop creative and technically robust solutions to 21st-century challenges to bring about positive social change.

How to Change the World

2017 partners:

Inherent to the IEP?

- Teamwork, leadership & project management
- Student-led learning / autonomy or mastery
- Self-awareness & self-efficacy
- Ethics, values & morals
- Sustainability
- Global challenges & societal impact
- Non-traditional pathways
- **… and Inclusion & Diversity**

UCL

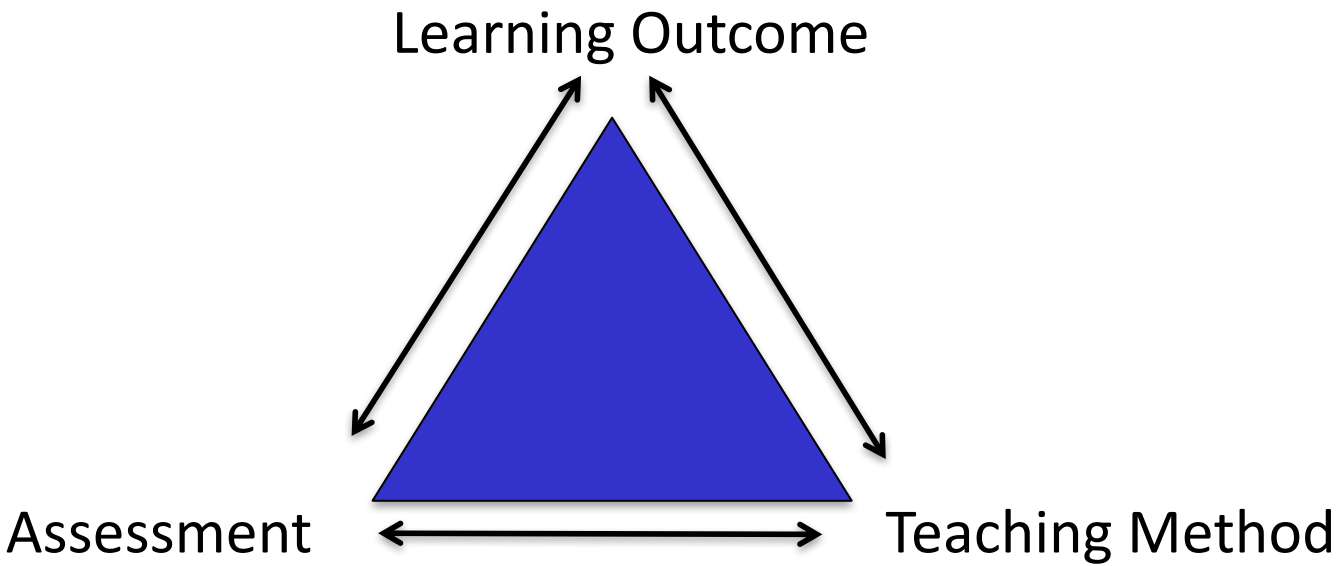
TO CHANGE THE WORLD, YOU NEED TO BE TAUGHT DIFFERENTLY.

UCL ENGINEERING
Change the world

An Approach - RVS

- What is it?
- Where did it come from?
- Why was it developed?

Starting Point



Constructive alignment (Biggs, 1999, 2003)

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

Clark, R. & Andrews, J. (2014). "Relationships, Variety & Synergy: The vital ingredients for scholarship in engineering education?" *European Journal of Engineering Education,* Volume 39, No. 6, pp 585-600

Working Together

BRUNEL'S
SS GREAT BRITAIN

Clark, R. (2011). "Using Heritage to Promote Student Learning". In Grainger, S., Kestell, C. (Eds). *Engineering Education – An Australian Perspective.* Chapter 6. pp 411-423. Multi-Science Publishing

Innovation in the University

- **Variety and Active Learning**
- **Authentic Learning Experiences**

- Discussion
- Video
- Audio
- Case study
- Role play
- Games and Puzzles
- Buzz group
- Labs
- Presentation
- Shared experiences
- Placement
- Polling
- Lecture (teacher, student, external)
- …..

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

Adding the Value

Enhancing Employability:

Making the Most of University:

A Toolkit for Engineering, Design & Applied Science Students.

Jane Andrews, Robin Clark,

Helen Higson

Aston University

Engineering Education Research Group,
School of Engineering & Applied Science.
r.p.clark@aston.ac.uk j.e.andrews@aston.ac.uk

0121 204 3363

Aston University
Birmingham

WBL – Student Comments

'An important fact is that learning is both an active and a reflective process. What really stands out from my learning experience is the lifelong learning. Up until I left university, I had always thought that university was going to be the end of my educational years. I have now learnt that going to university was not just to learn how to be an engineer, but also to learn how to learn'

Student, BP Angola

'The course is developed around workplace needs and projects… From a personal perspective, the benefits are substantial, having access to academics and peers, all working towards the same goal of developing World Class Engineers'

Student, BAE Systems

What’s happened

- Generated conversation
- Helped to weaken L+T / Research staff barriers
- Basis for strategy development

An Approach - CDIO

- Origins in Engineering Education
- Increasing reach, well established

CDIO

The CDIO™ INITIATIVE is an innovative educational framework for producing the next generation of engineers. The framework provides students with an education stressing engineering fundamentals set in the context of Conceiving — Designing — Implementing — Operating (CDIO) real-world systems and products. Throughout the world, CDIO Initiative collaborators have adopted CDIO as the **framework of their curricular planning and outcome-based assessment**. CDIO collaborators recognize that an engineering education is acquired over a long period and in a variety of institutions, and that educators in all parts of this spectrum can learn from practice elsewhere. ***The CDIO network*** *therefore welcomes members in a diverse range of institutions ranging from research-led internationally acclaimed universities to local colleges dedicated to providing students with their initial grounding in engineering.*

www.cdio.org (2017)

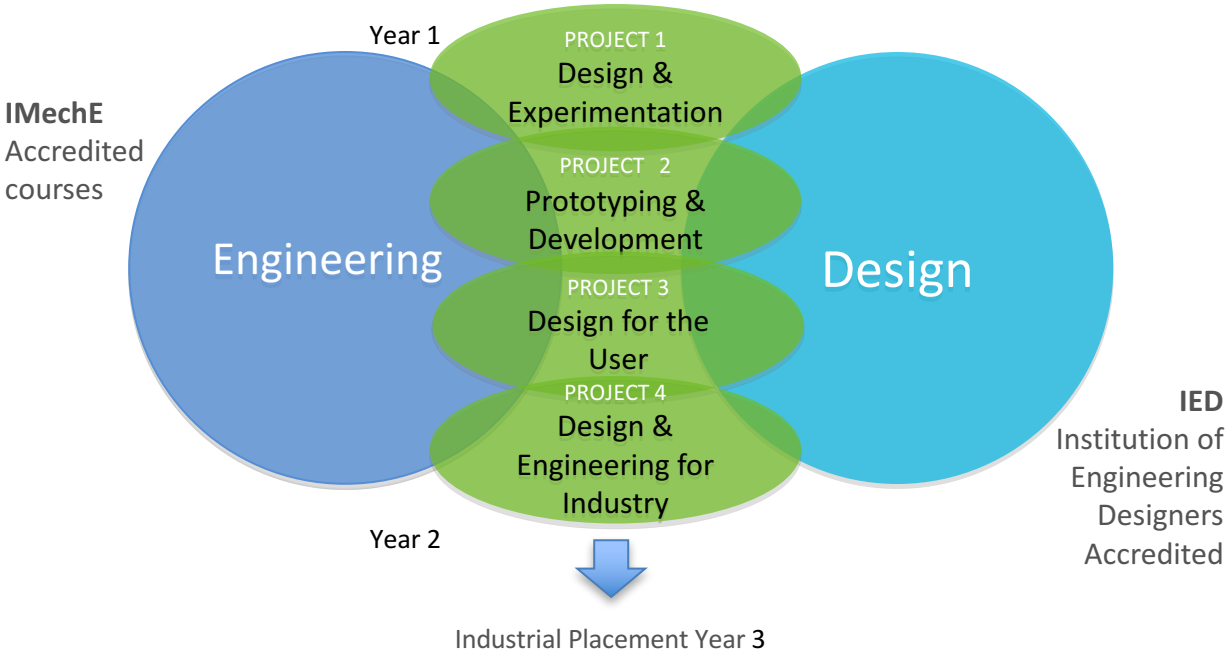
CDIO Standards

- 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

- Aston Mechanical Engineering and Product Design
- Start 2010
- Evaluation of Impact
- Students and staff
- Employers recognise the improvement

Clark, R. & Andrews, J. (2012). “Engineering the Future: CDIO as a tool for combating retention difficulties”. In Rasul, M. (Ed). *Developments in Engineering Education Standards: Advanced Curriculum Innovations.* Chapter 8. pp 143-155. IGI Global

Structure Years 1 and 2



Early days….


16.17

Staff Reflections

- Learning and teaching is very much at the front of the group and school philosophy
- Culture of innovation exists within group
- Around half of staff now actively involved in pedagogical innovation
- Programmes are now much more integrated – silo teaching much less common

Student Reflections

*"**During my placement** at Morgan Advanced Materials, I soon found that out of all the knowledge I had gained during my first two years of academic study at university**, it was the skills developed during CDIO that I was utilising most frequently -** this spanned from simple project planning exercises to costing reviews, proposals and report writing. Indeed, the very nature of work conducted in the module prepares you to work in challenging environments outside of university; **it prepares you to work effectively in teams** comprising of varying specialties and **promotes effective debating and discussion** within such a scenario. In addition, it allows the student to become familiar with the myriad of requirements within an industrial engineering project."*

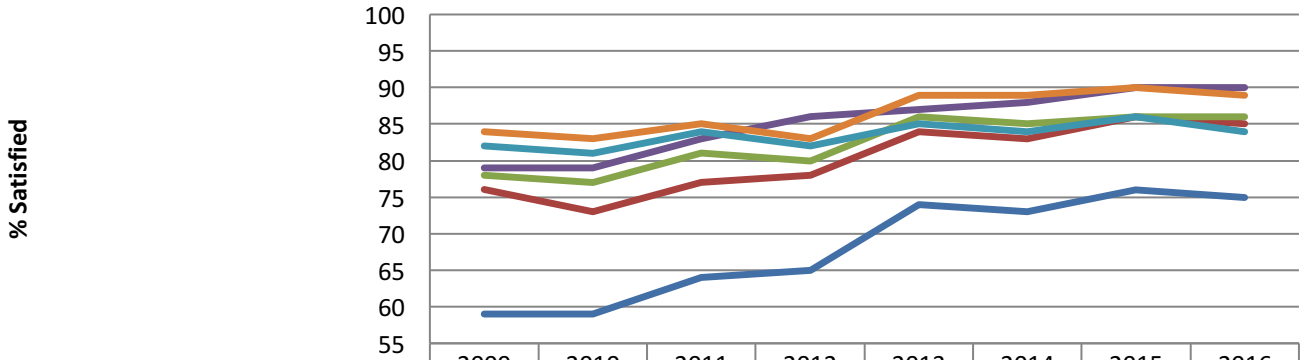
Harrison Bourne, ex-placement student

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

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

CDIO – An Activity

- Regulatory and Continuous Improvement are drivers
- Self-Evaluation tool developed as part of a European Project
- Promotes a holistic view of the curriculum

QUALITY ASSURANCE AND ENHANCEMENT MARKETPLACE FOR HIGHER EDUCATION INSTITUTIONS

TURKU AMK

Aston University

Self Evaluation and Assessment

- A set of criteria drawn from a comprehensive range of Quality Frameworks*
- Pairing process based on outcomes of the self assessment questionnaire
- Cross-sparring visits and peer learning in a supportive community of practice
- Sharing of best practice
- Structured implementation

* Clark et al (2015): Developing a Robust Self Evaluation Framework for Active Learning : The First Stage of an Erasmus + Project (QAEMarketPlace4HEI) Proceedings of the 43rd SEFI conference

Criteria

		Turku	Aston
Crit. no	Name	Value	Value
1	A holistic view of learning	4	3
2	Appropriate learning outcomes (developed from	4	3
3	An integrated curriculum	3	3
4	A sound subject foundation	4	5
5	Active learning approaches	3	3
6	Appropriate workspaces and equipment	3	3
7	Personal and interpersonal skills development	3	3
8	Faculty development (knowledge and teaching)	2	1
9	Learner assessment (type, level and amount)	3	3
10	Programme evaluation to promote continuous	3	3
11	Links to employability are made throughout	4	2
12	Collaborative learning	3	3
13	Additional support for learning	3	3
14	Technology to engage students in learning	3	3
15	Feedback is timely, appropriate and formative	3	1
16	Research is used in teaching	4	3
17	Student participation in programme review and	5	1
18	Wider stakeholder input to programme development	4	3
19	Student retention and progression is monitored	4	2
20	Work placements are promoted	5	4
21	Problem solving opportunities (links to the research	4	3 or 5
22	Design projects are integrated throughout the	5	3 or 5
23	Equality, diversity and equal opportunity considerations	2	3
24	Professional attributes and topical considerations are	3	4 -
25	Evidence of educational scholarship by faculty	4	3
26	Effective communication with students	3	3
27	Different learning styles are taken account of	2	3
28	Teaching resources	3	3

The Active Part

- Now it’s your turn
- You have 4 criteria to score
- Do this for the main programme you teach on
- Compare scores, pair up and explore the evidence questions on your handout
- Complete your handout as fully as you can
- Be ready to feedback

Homework!

Homework – identify a module / unit within one of your programmes for consideration tomorrow

Day 2

08:00	Arrival and tea/coffee
08:30	a) Questions and thoughts from Day 1
	b) What resonates and what doesn't? Why? (activity)
	c) How do we determine the success of a curriculum development process? (activity)
	d) The UK Landscape. TEF , Recognition, Accreditation, Industry engagement, institutional context.
10:30	Tea/Coffee
11:00	Considering your unit – how can you use IEP / RVS / CDIO thinking? (activity)
12:30	Lunch
13:30	a) Taking your colleagues with you
	b) Considering other stakeholders
	c) EER / Scholarship
14:15	d) Your action plan (activity)
	e) What support would be valuable?
15:15	Closure, tea/coffee and departure

Questions and Thoughts from Day 1

What resonates and what doesn't? Why?

20 minute group discussion

Activity

- Our goal is success with our curriculum development process
- What is success for you?
- Discuss in your groups – identify what success means to you (30 mins)
- You will then be asked to feedback

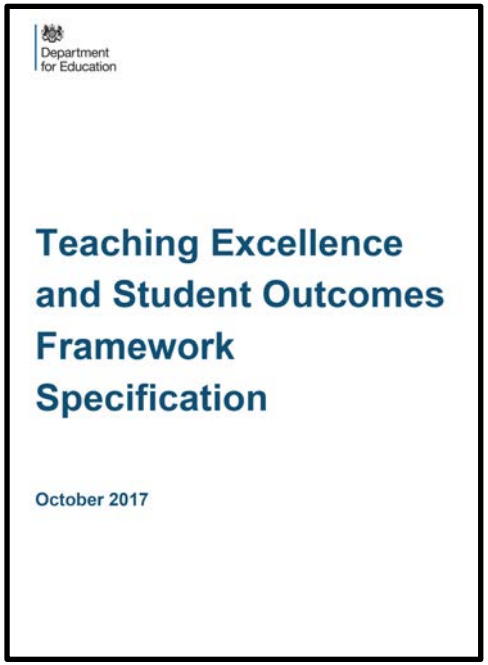
Feedback

- Curricula makes sense to everyone
- Students enjoy it.
- Staff buy in
- Industry value the education
- Increase meaningful access for diversity group of students
- Focus on students skills and attributes from now to 2050
- Fulfil the mission and vision of the university in your curriculum
- Students have found what they are inspired by

The UK Landscape

- TEF
- Recognition
- Accreditation
- Industry engagement
- Institutional context

What is the TEF?



- Student Experience (NSS)
- Employment Destinations (DLHE)
- 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.

Current Status

- Subject Level Pilots
- Learning Gain Study
- Postgraduate Provision
- 2020 onwards

- WMG approach – Steering Group and 2 Working Groups
  - Teaching Quality and Learning Environment
  - Student Outcomes and Learning Gain

TQLE

- Looking at teaching practices which provide an appropriate level of contact, stimulation and challenge, encourage student effort and engagement, and which are effective in developing the knowledge, skills, attributes and work readiness of students. Also the wider context for teaching which includes the effectiveness of resources designed to support learning, maximise completion, and aid the development of independent study and research skills. This may include learning spaces, use of technology, work experience, extra-curricular activities and opportunities for peer-to-peer interaction. The development of staff to facilitate learning underpins all of the above

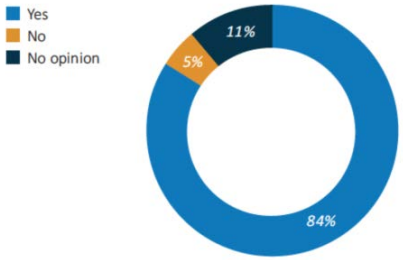
SOLG

Employment and Further Study (SO1)	Students achieve their educational and professional goals, in particular progression to further study or highly skilled employment
Employability and Transferable Skills (SO2)	Students acquire knowledge, skills and attributes that are valued by employers and that enhance their personal and/or professional lives
Positive Outcomes for All (SO3)	Positive outcomes are achieved by its students from all backgrounds, in particular those from disadvantaged backgrounds or those who are at greater risk of not achieving positive outcomes

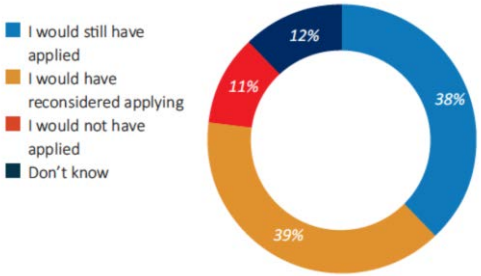
A sobering thought

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

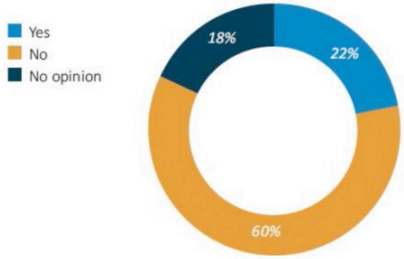
Should the government be running an exercise to encourage excellent teaching in universities?



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



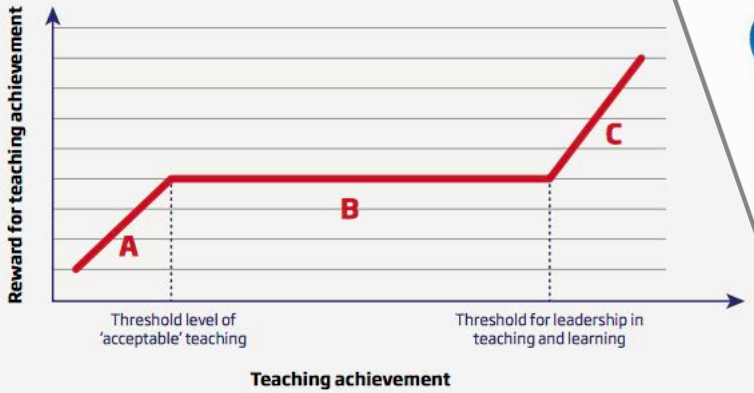
Should student fees be linked to the TEF rating of the university?



UK Trendence Research, 2017

Recognition

- http://www.evaluatingteaching.com



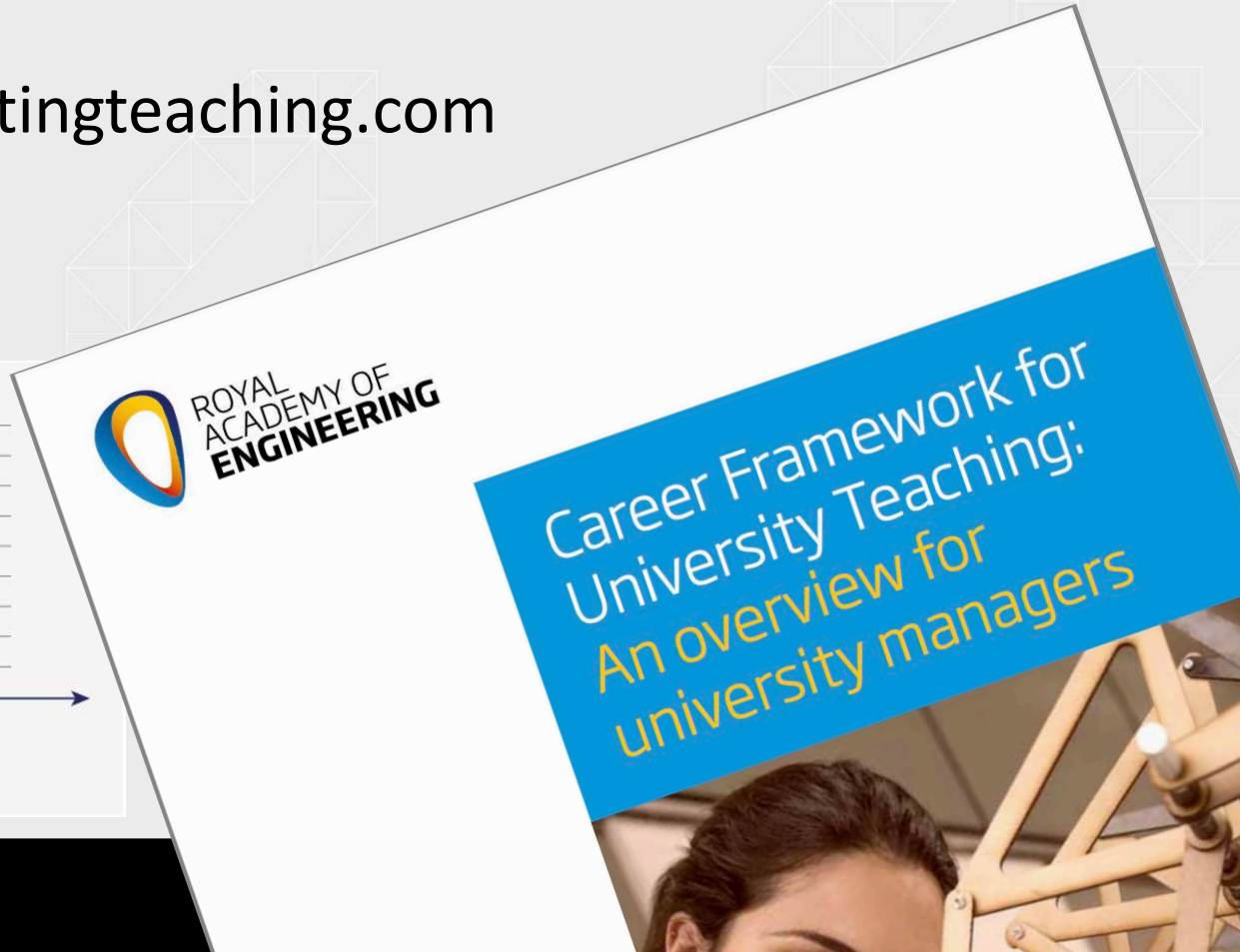
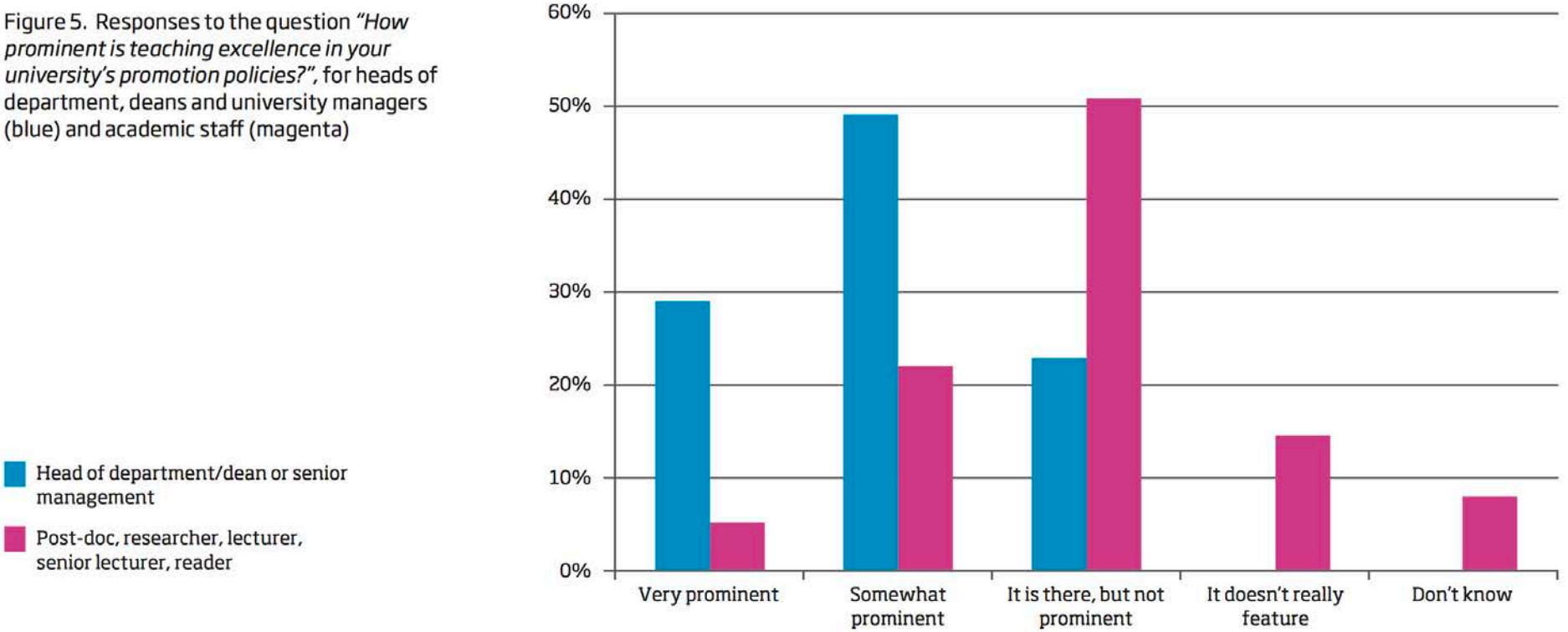
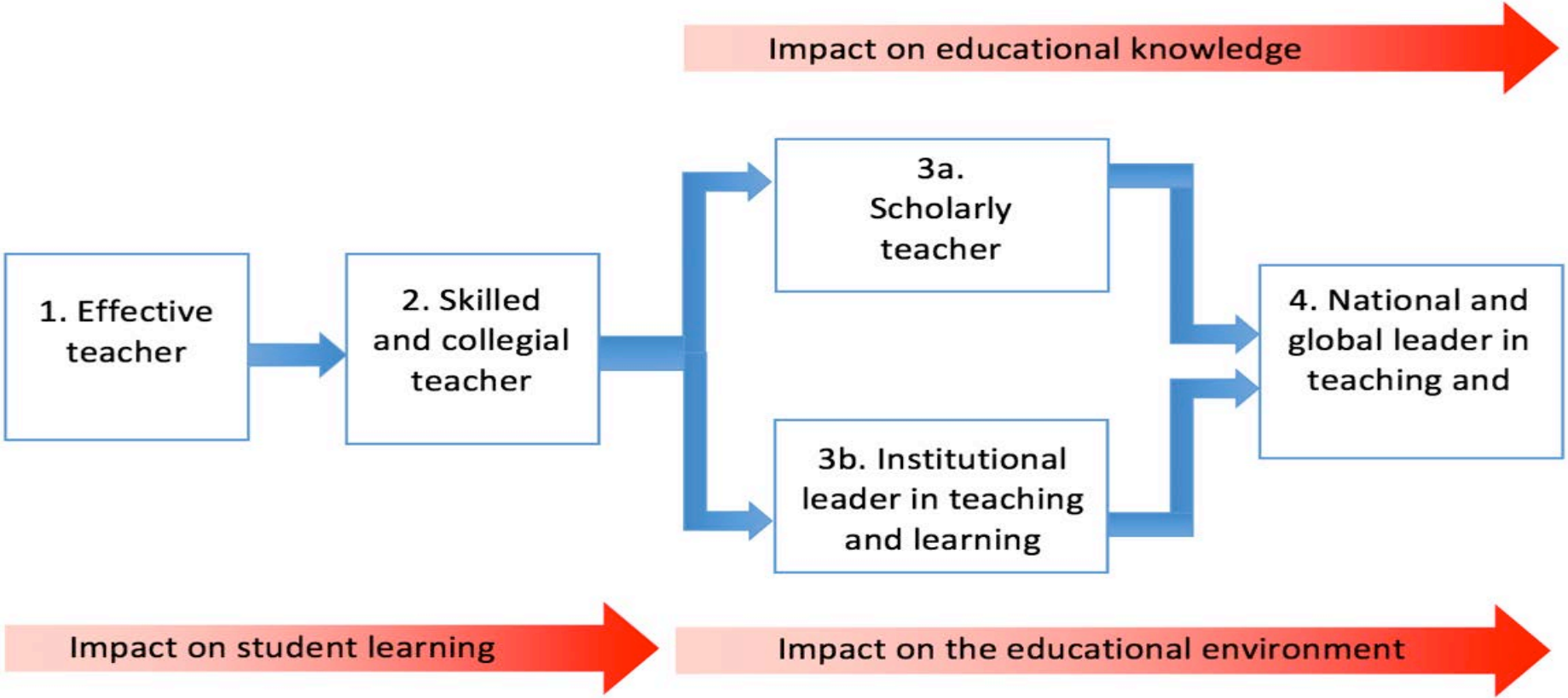


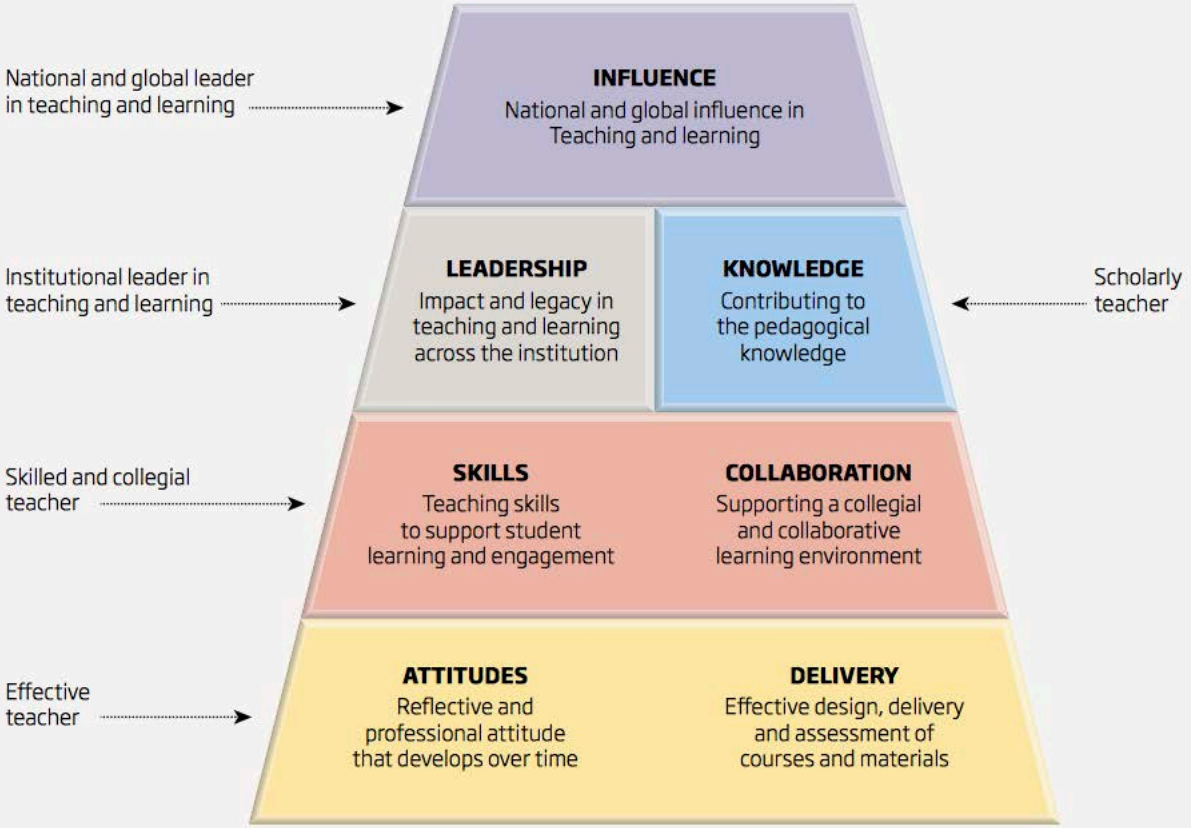
Figure 5. Responses to the question *"How prominent is teaching excellence in your university's promotion policies?"*, for heads of department, deans and university managers (blue) and academic staff (magenta)



Royal Academy of Engineering – Does Teaching Advance your Academic Career.
http://www.raeng.org.uk/publications/reports/does-teaching-advance-your-academic-career

UCL ENGINEERING
Change the world


Impact on educational knowledge
1. Effective teacher
2. Skilled and collegial teacher
3a. Scholarly teacher
3b. Institutional leader in teaching and learning
4. National and global leader in teaching and
Impact on student learning
Impact on the educational environment


National and global leader in teaching and learning
INFLUENCE
National and global influence in Teaching and learning
Institutional leader in teaching and learning
LEADERSHIP
Impact and legacy in teaching and learning across the institution
KNOWLEDGE
Contributing to the pedagogical knowledge
Scholarly teacher
Skilled and collegial teacher
SKILLS
Teaching skills to support student learning and engagement
COLLABORATION
Supporting a collegial and collaborative learning environment
Effective teacher
ATTITUDES
Reflective and professional attitude that develops over time
DELIVERY
Effective design, delivery and assessment of courses and materials

What type of chair?

Accreditation

Accreditation

- 36 different professional engineering institutions then accredit!

BCS, The Chartered Institute for IT
British Institute of Non-Destructive Testing (BINDT)
Chartered Institution of Building Services Engineers (CIBSE)
Chartered Institution of Highways & Transportation (CIHT)
Chartered Institute of Plumbing and Heating Engineering (CIPHE)
Chartered Institution of Water and Environmental Management (CIWEM)
Energy Institute (EI)
Institution of Agricultural Engineers (IAgrE)
Institution of Civil Engineers (ICE)
Institution of Chemical Engineers (IChemE)
Institute of Cast Metals Engineers (ICME)
Institution of Engineering Designers (IED)
Institution of Engineering and Technology (IET)
Institution of Fire Engineers (IFE)
Institution of Gas Engineers and Managers (IGEM)
Institute of Highway Engineers (IHE)
Institute of Healthcare Engineering and Estate Management (IHEEM)
Institution of Lighting Professionals (ILP)
Institute of Marine Engineering, Science & Technology (IMarEST)
Institution of Mechanical Engineers (IMechE)
Institute of Measurement and Control (InstMC)
Institution of Royal Engineers (InstRE)
Institute of Acoustics (IOA)
Institute of Materials, Minerals and Mining (IOM3)
Institute of Physics (IOP)
Institute of Physics and Engineering in Medicine (IPEM)
Institution of Railway Signal Engineers (IRSE)
Institution of Structural Engineers (IStructE)
Institute of Water
Nuclear Institute (NI)
Royal Aeronautical Society (RAeS)
Royal Institution of Naval Architects (RINA)
Society of Environmental Engineers (SEE)
The Society of Operations Engineers (SOE)
The Welding Institute

Accreditation

- The learning outcomes of the programme(s)
- The teaching and learning processes
- The assessment strategies employed
- The resources involved – including human, physical and material
- Its internal regulations regarding compensation for underperformance
- Quality assurance arrangements
- Entry to the programme and how cohort entry extremes will be supported
- How previous accreditation recommendations and requirements have been dealt with

Accreditation

- Underpinning science and mathematics, and associated engineering disciplines, as defined by the relevant engineering institution
- Engineering Analysis
- Design
- Economic, social and environmental context
- Engineering Practice

Student Demands

- Students increasingly drawn to engineering because they want to design creative solutions to major global challenges.
- Want to see the connection between theory and practice.
- Increased consideration of employability
- Require competencies in working across a multiplicity of boundaries and with people whose specialisation and/or cultural frameworks that differ from their own

Industry Demands

UCL ENGINEERING
Change the world

Industry engagement

- ‘It is what it says on the tin’
- Not always easy
- Increasing competition
- Relationships need effort
- Economy and Brexit present challenges
- TEF / Learning Gain / Integration

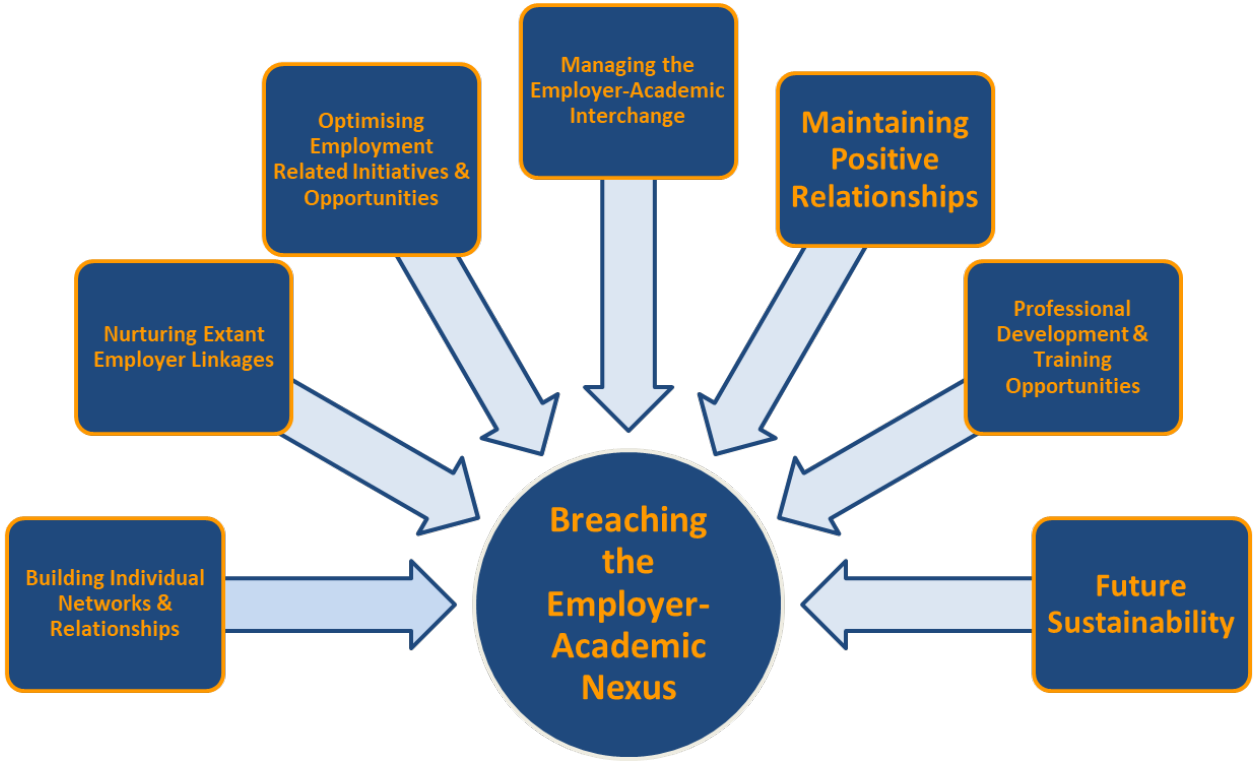
Global Partners with WMG

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

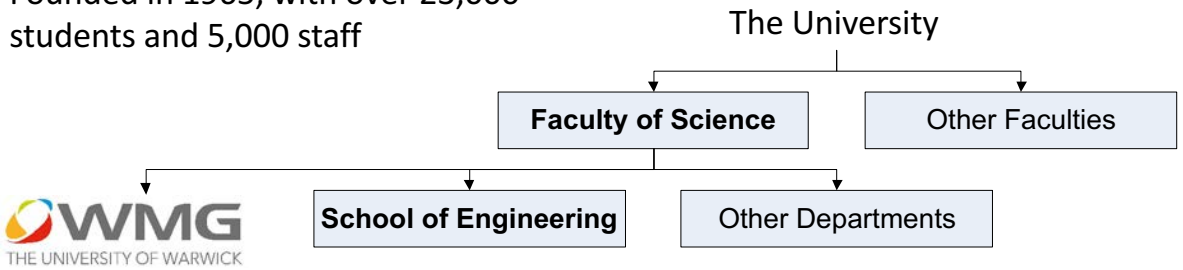
IMechE, 2011

Engagement Model



The University of Warwick

- 6th - The Times and Sunday Times 2015
- 7th - Research Excellence Framework 2014 (latest data)
- 48th - QS World Rankings 2015
- Founded in 1965, with over 23,000 students and 5,000 staff



WMG
THE UNIVERSITY OF WARWICK

WMG

- Established in 1980 by Professor Lord Bhattacharyya
- World class applied research from manufacturing to healthcare
- World’s largest Manufacturing Group: Research, Training, Implementation
- Application is key - programmes industry funded and lead to implementation
- Over 400 staff in six main buildings

Aston University

- Founded in 1895, University since 1966
- Campus in Birmingham city centre
- Student population: 9000+ (just over 1,700 International students)
- Industry-focused and accredited programmes
- USP - Employability
- Engineering and Applied Science, Life and Health Science, Business and Languages – Medical School coming
- Industrial placement year (80%)
- Graduates entering employment (92%)
- A top 30 UK University

Aston University

Institutional Context

- Aston v WMG
- Gold v Silver
- Teaching v Research
- Student body
- Student experience
- Industry relationships
- …..

UCL

Founded in 1826 as University of London

The first in England to admit students regardless of class, race or religion

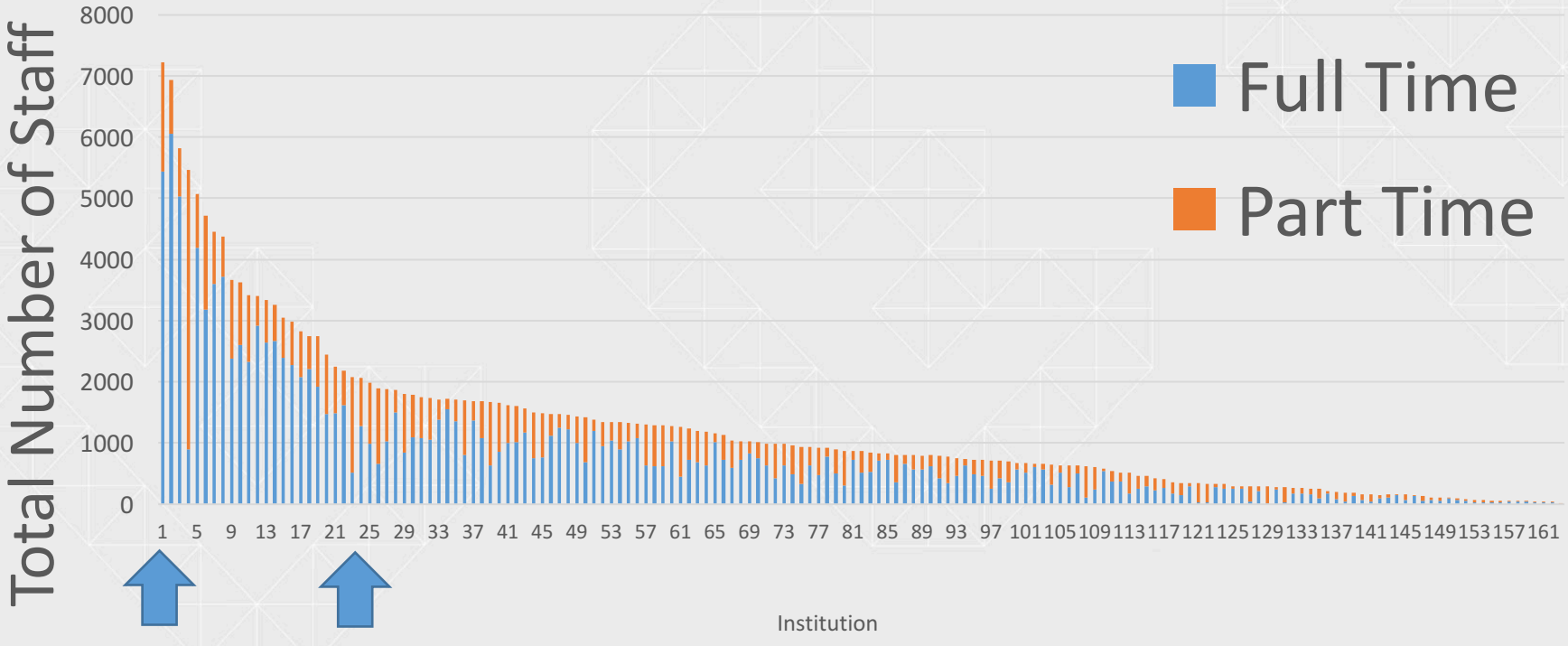
The first in England to admit women students on equal terms with men

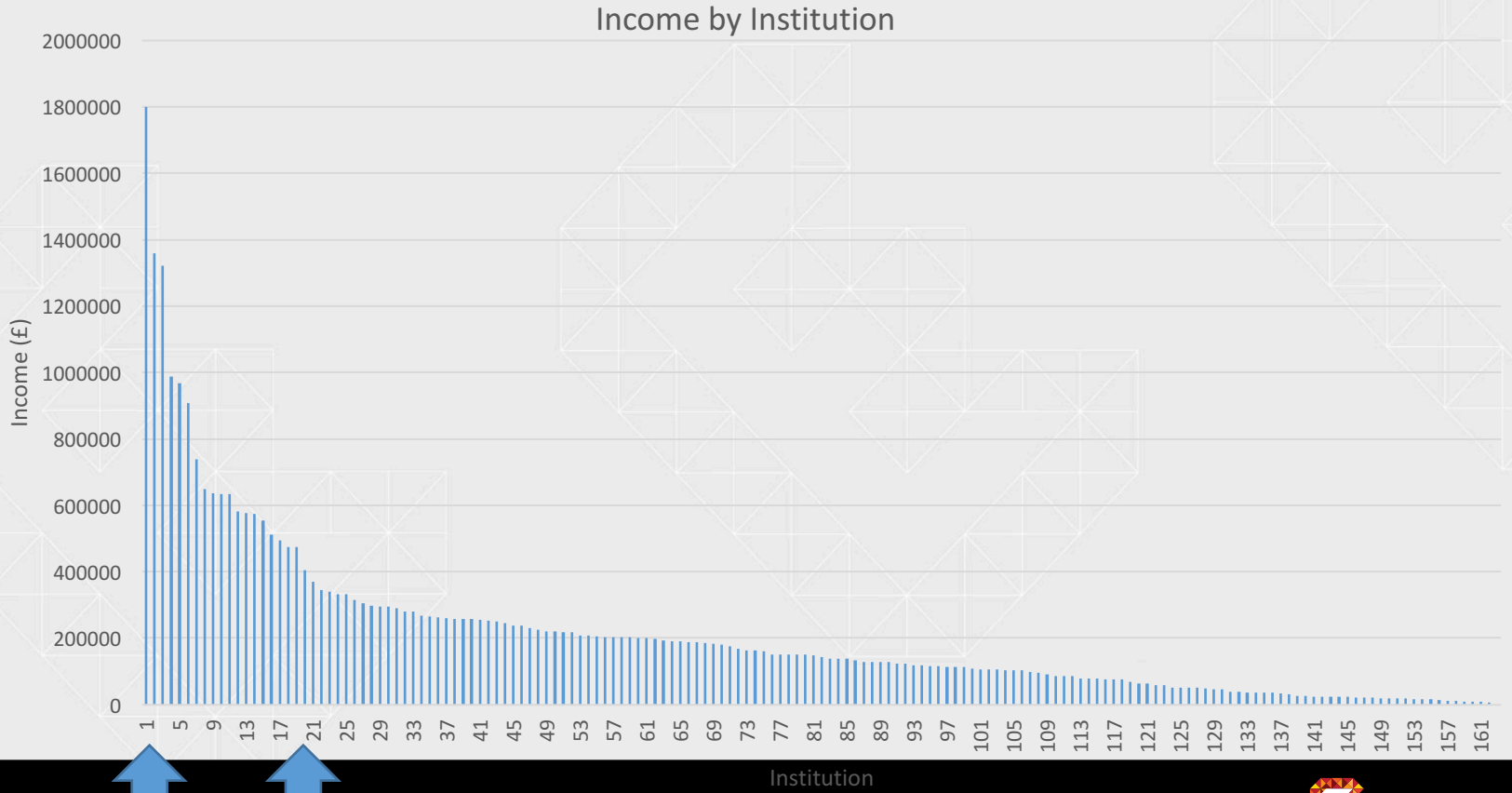
> 6,000 academic and research staff

> 40,000 Students, 52% at Graduate Level

> 28 Nobel Prize winners who are or were students or staff

Total Number of Staff - UK

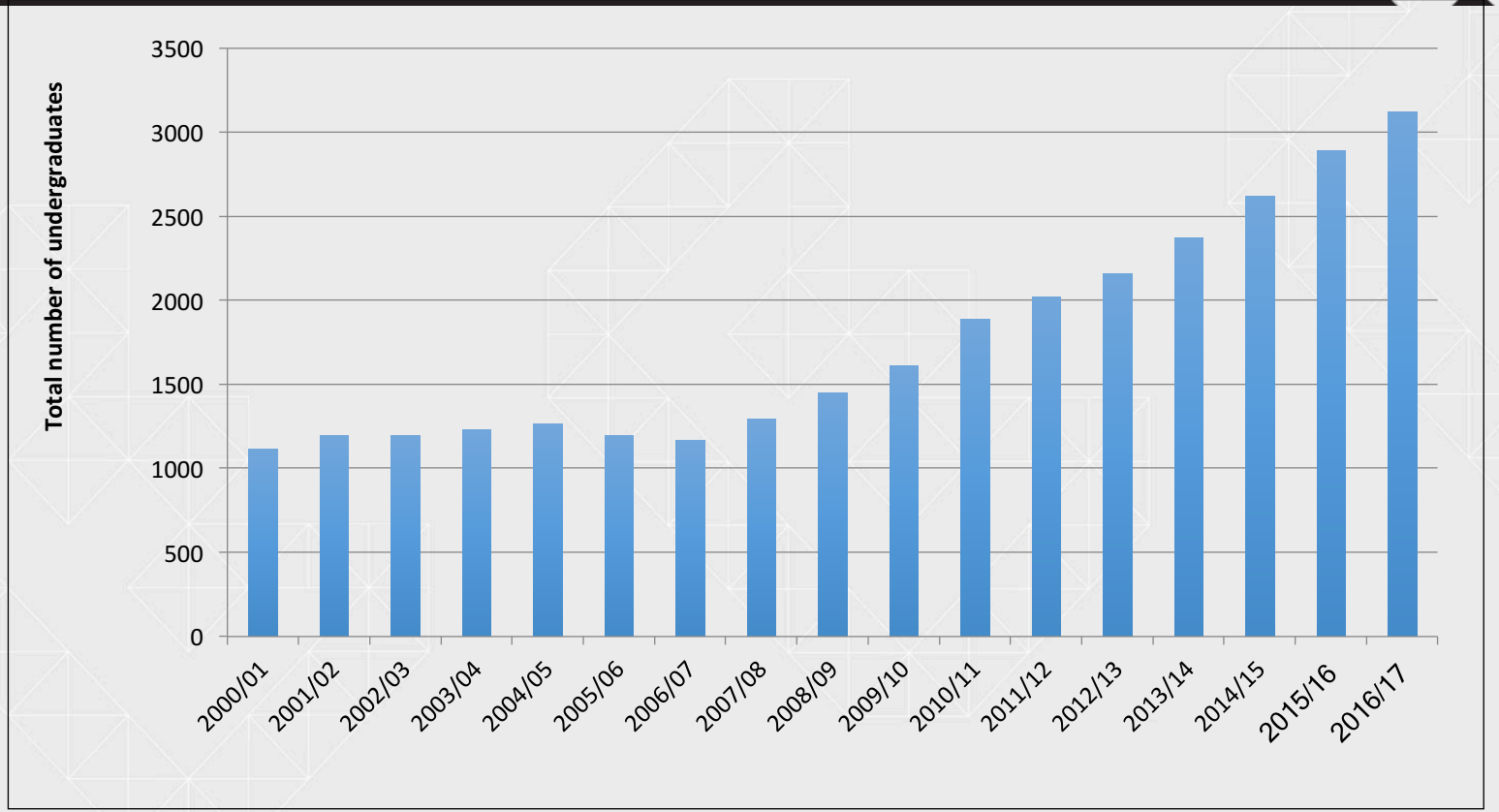



Income by Institution
Income (£)
2000000
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
1
5
9
13
17
21
25
29
33
37
41
45
49
53
57
61
65
69
73
77
81
85
89
93
97
101
105
109
113
117
121
125
129
133
137
141
145
149
153
157
161
Institution

UCL Engineering

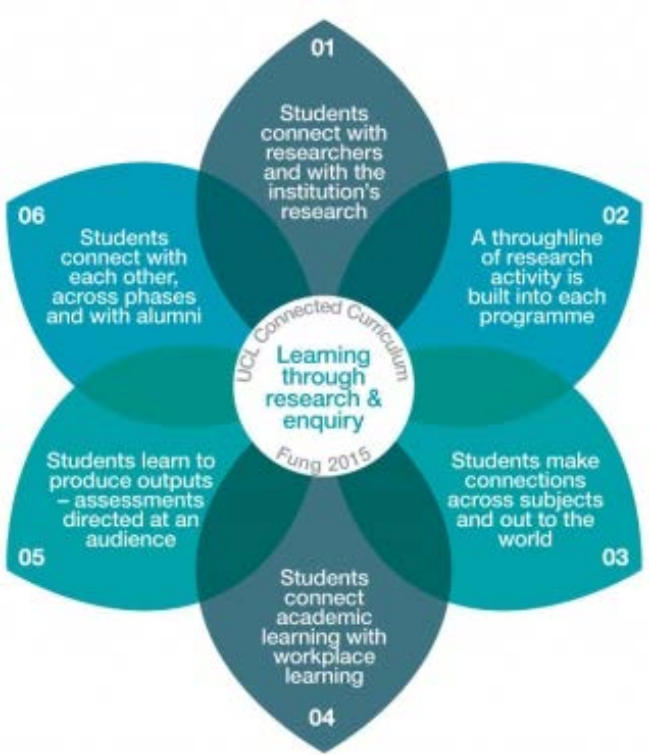
- 10 Departments
- 3122 UG
- 2534 PG
- 305 Academics,
- 410 Researchers,
- 77 Teaching Fellows

Undergraduate Numbers



UCL Context

- Innovate to create a learning culture and curriculum structures that develop and foster critical independent thinking that is radical and disruptive and contributes to problem solving.
- - UCL 2034:Theme 2



UCL Connected Curriculum

http://www.ucl.ac.uk/2034
https://www.ucl.ac.uk/teaching-learning/education-initiatives/connected-curriculum

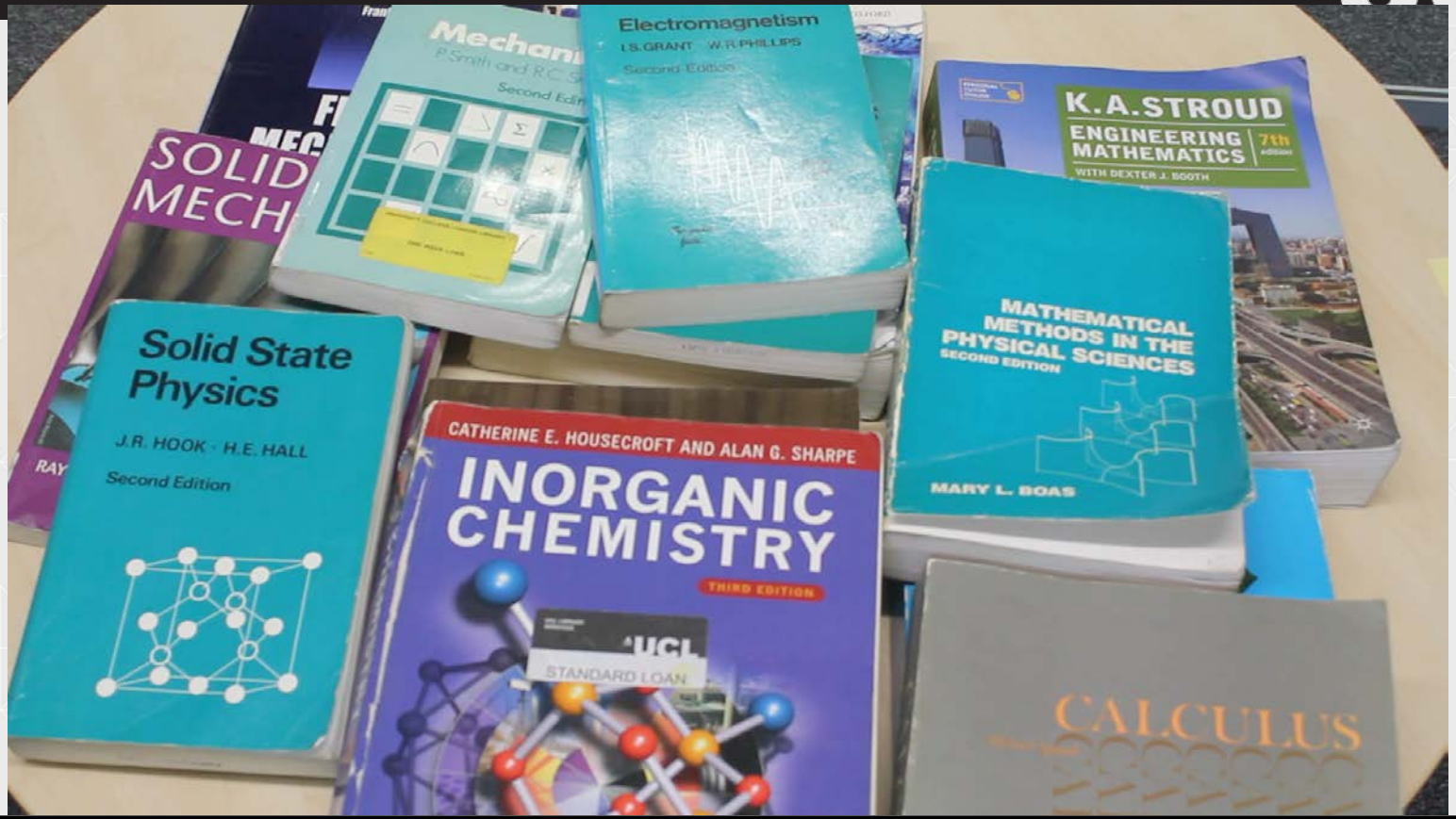
UCL ENGINEERING
Change the world

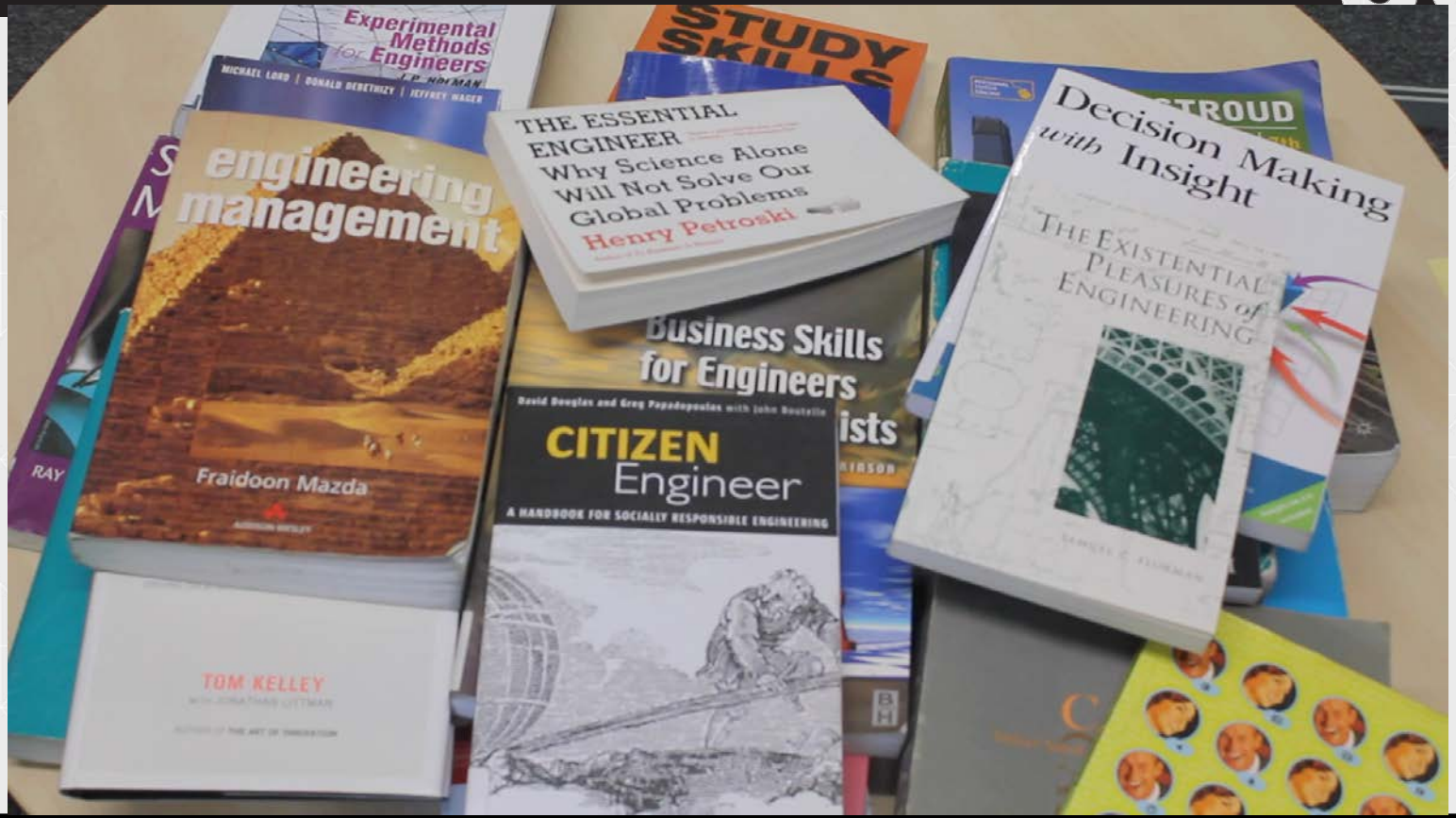
Activity

- This is the big one!
- Considering your ‘unit’ – how can you use IEP / RVS / CDIO or other thinking to realise a more integrated approach to curriculum development?
- This is your chance to create something of value

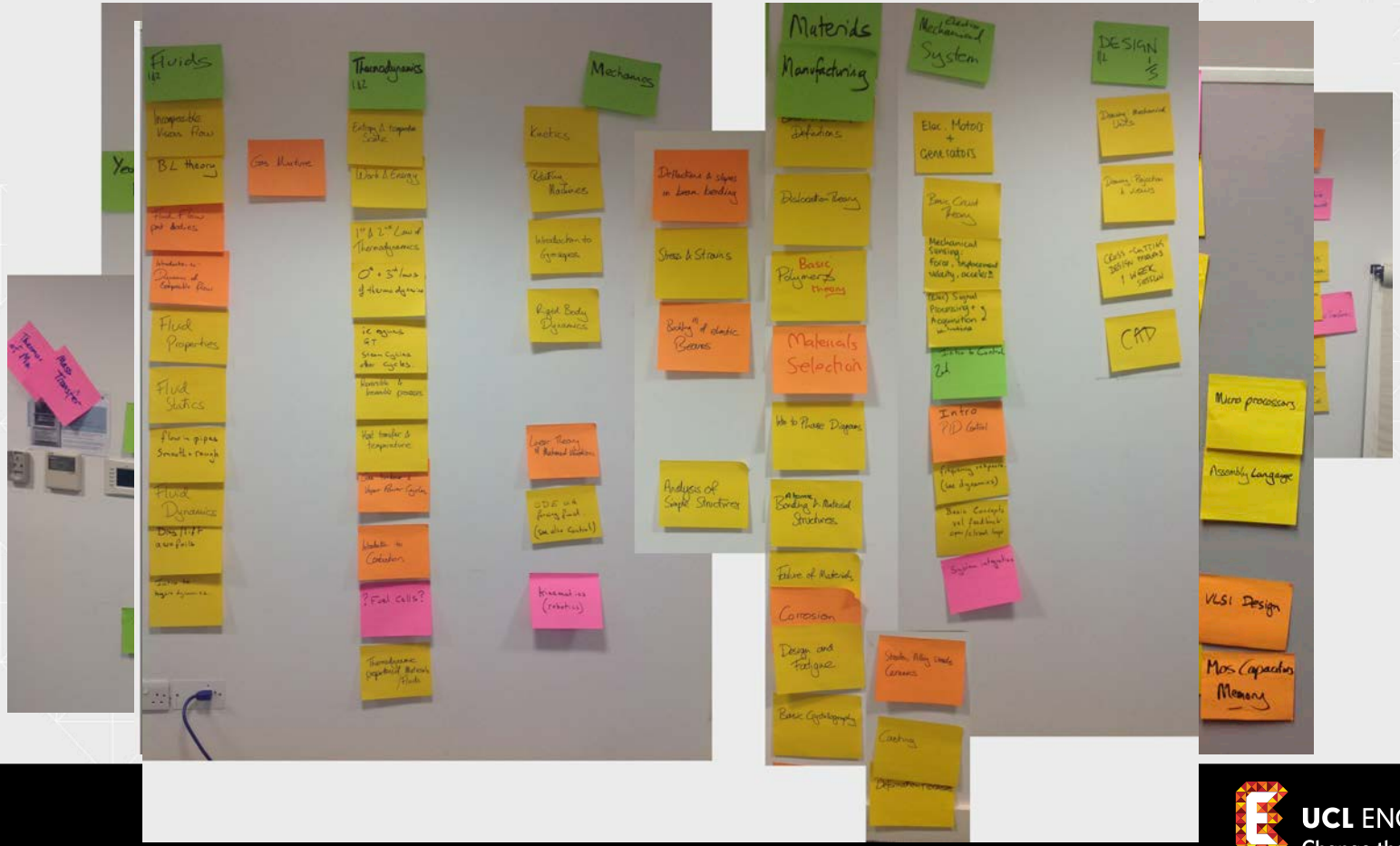
Taking your colleagues with you

What gives?


Electromagnetism
I.S.GRANT W.R.PHILLIPS
Second Edition
K.A.STROUD
ENGINEERING MATHEMATICS
7th edition
WITH DEXTER J. BOOTH
SOLID MECH
Solid State Physics
J.R. HOOK · H.E. HALL
Second Edition
MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES
SECOND EDITION
MARY L. BOAS
CATHERINE E. HOUSECROFT AND ALAN G. SHARPE
INORGANIC CHEMISTRY
THIRD EDITION
UCL
STANDARD LOAN
CALCULUS

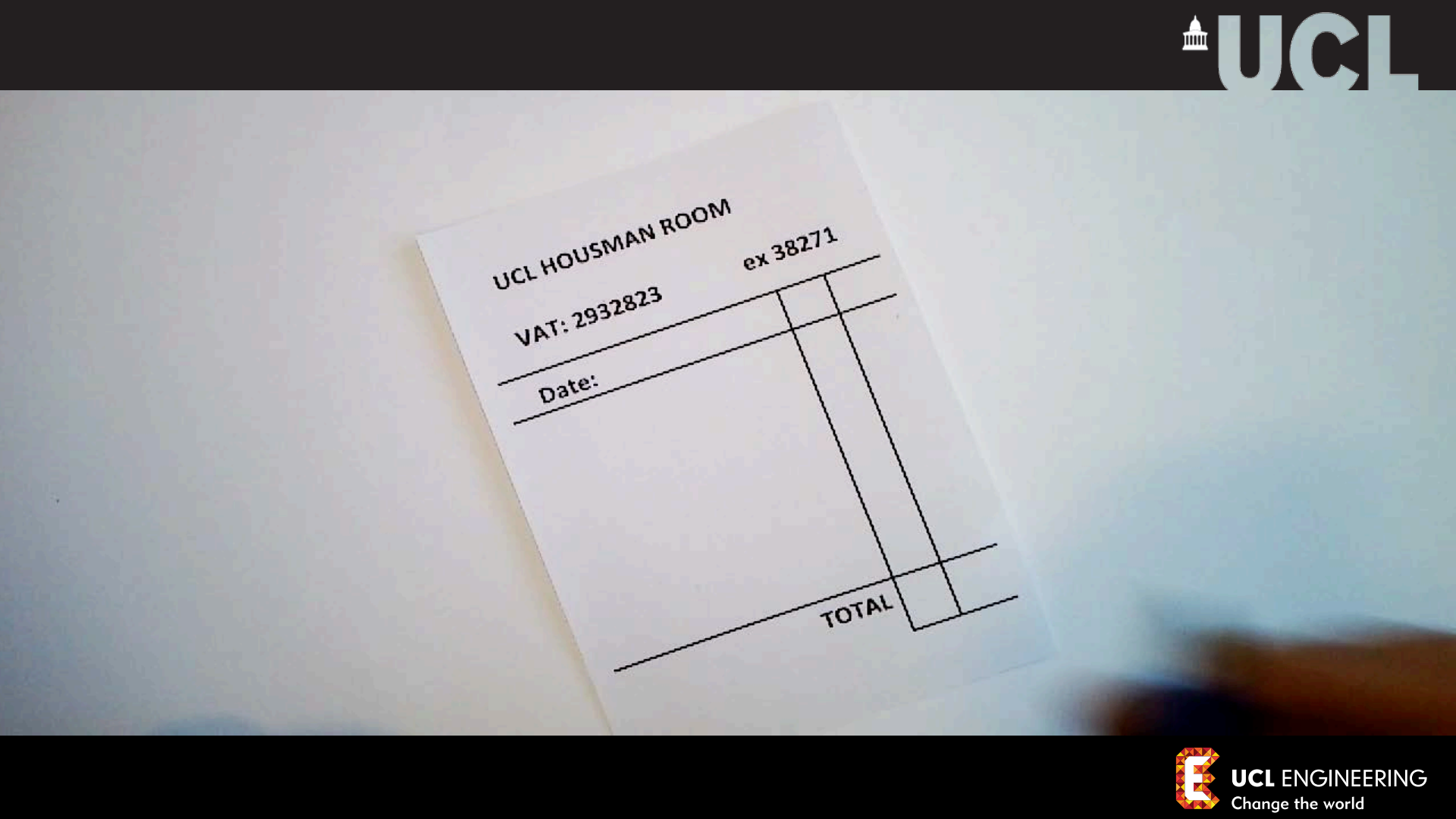

Experimental Methods for Engineers
MICHAEL LORD | DONALD DEBETHIZY | JEFFREY WAGER
STUDY SKILLS
THE ESSENTIAL ENGINEER
Why Science Alone Will Not Solve Our Global Problems
Henry Petroski
engineering management
Fraidoon Mazda
Business Skills for Engineers
CITIZEN Engineer
A HANDBOOK FOR SOCIALLY RESPONSIBLE ENGINEERING
Decision Making with Insight
THE EXISTENTIAL PLEASURES of ENGINEERING
TOM KELLEY

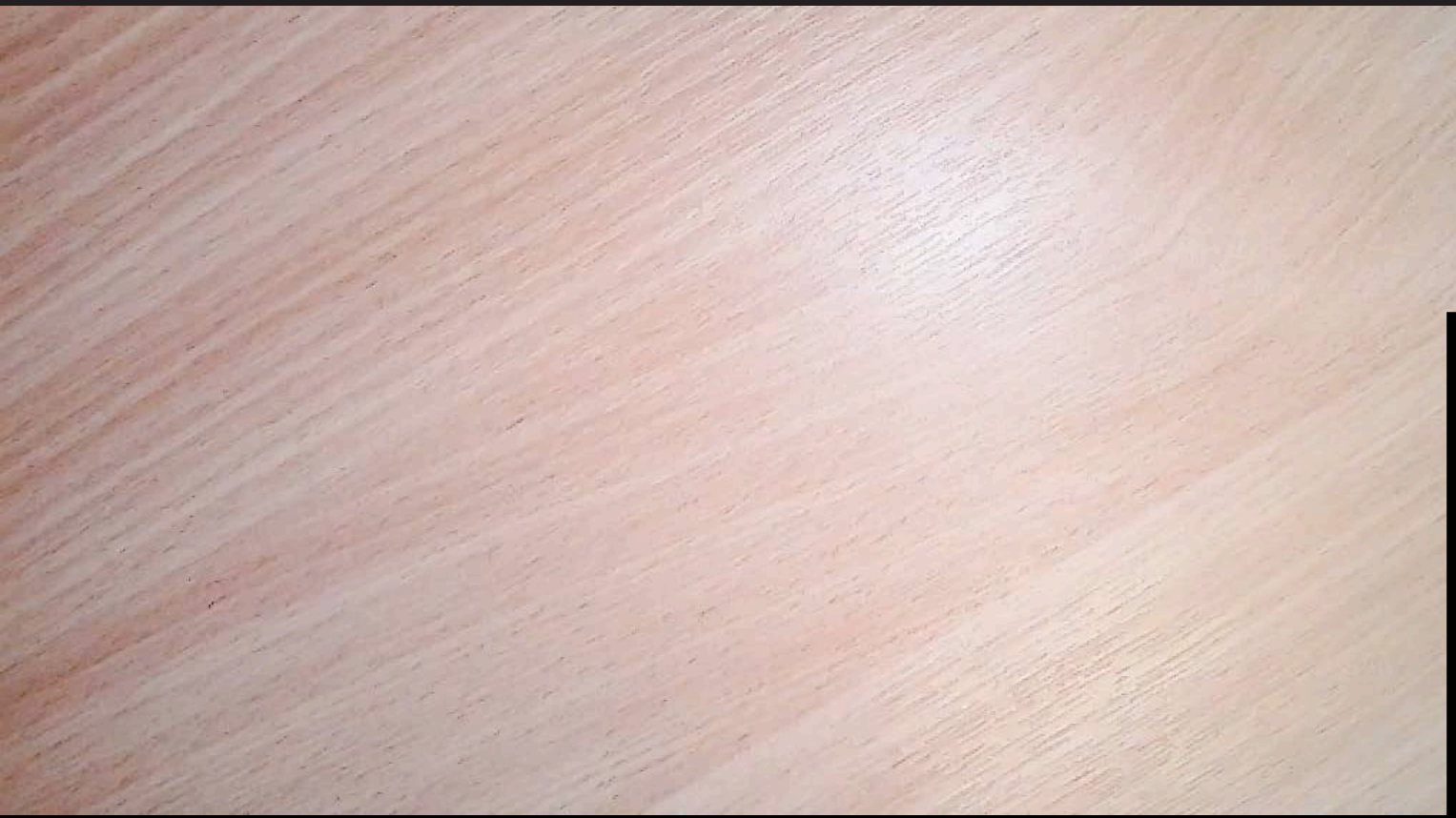
Curriculum Design



UCL ENGINEERING
Change the world

Talk to lots of people





Censored

Be careful who you listen to…

Accreditation won't allow that!

You won't get staff do that!

UCL Regulations won't allow that!

That will take years!

You won't get the space to do that!

IEP – Scaling of Existing Innovations

- Rely on and benefit from ***Precedence***

…. is our secret shared amongst the IEP Team

- Meaning… everything implemented within the IEP had existed somewhere, and in many cases at UCL

What do you need to make change happen?

Our chief weapon is

Fear

“…they are a massively research-intensive university, one of the top ten in the world, that could have really laughed this off. But they didn't. They are taking the undergraduate education seriously”.

MIT: The global state-of-the-art in engineering education: Outcomes of Phase 1 benchmarking study – unpublished.

Our two weapons are

Surprise and Fear

Our three weapons are

Fear, Surprise
and an almost fanatical
devotion to the Dean

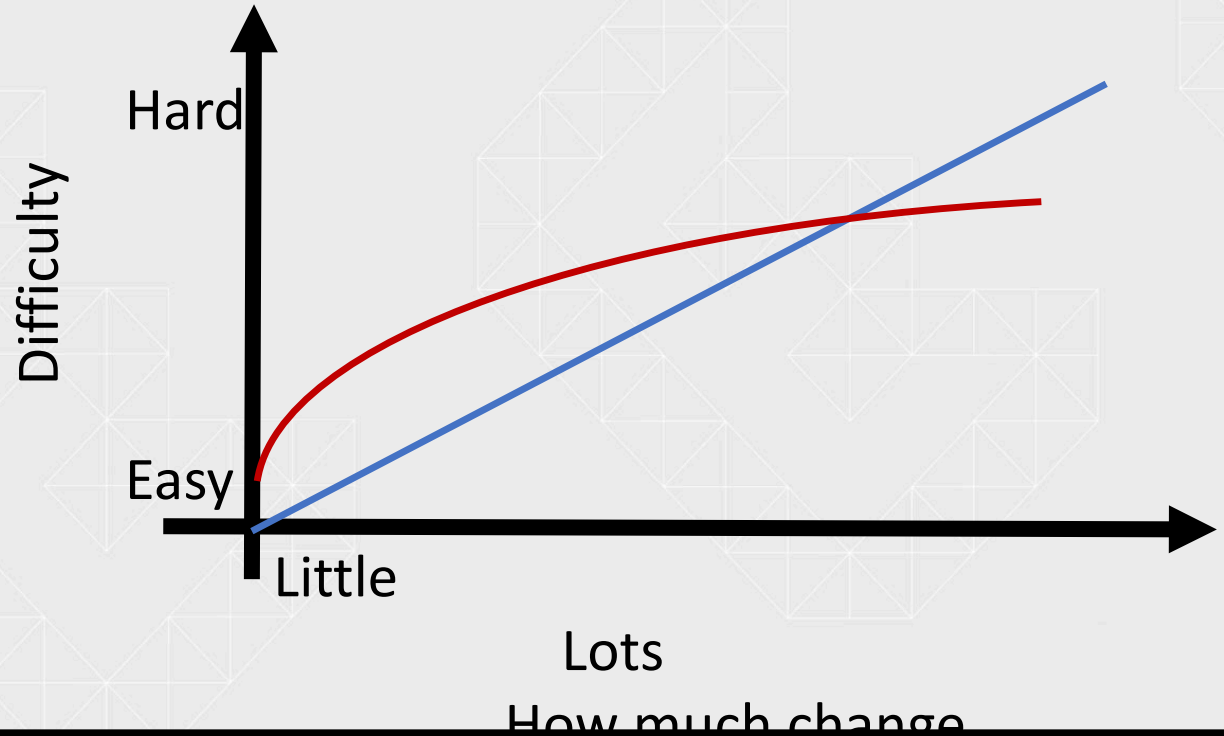
Amongst our weaponry are such diverse elements as

Fear, Surprise,

an almost fanatical devotion to the Dean,

and nice orange and grey branding…..

Change is hard!



It's not a popularity contest

"When I joined the department a couple of colleagues told me you were a waste of space whose only job was to annoy them"

Anonymous member of Professional Services

Remember the students

- Students can be conservative too
- To be exposed to research and problem solving is not what they were expecting.

but *most* enjoyed it

"Engineering should be Science and hard sums"

"We're doing team work and writing – useless skills for an Engineer"

What the students think?

I liked the fact that I was able to interact and collaborate with people; this improved my social skills, and it has made me a more co-operative person. Also, it has gotten me into the habit of asking questions when I do not understand something.

I liked the opportunity to work with people from different disciplines, on a real world problem.

I liked that it was very hands on and that I could work with other engineering disciplines. It is a good alternative to just studying books

What the students think?

IEP for me is one of the best parts of studying Computer Science at UCL and the subject that is best preparing me to work in a professional environment.

To me, the IEP is a platform where one can learn, understand and appreciate the various content from other engineering fields.

I remember how confused I was when I sat in that theatre for the IEP kick off…..But in the second term when we took on week-long scenarios, it hit me. That IEP teaches us team working and communication skills; ….. was all to make us think like engineers to unlock our creativity and for us to communicate that so we can work together.

What we've learned

- Constraints and context are important
- Sometimes you have to 'feel' it to really understand it
- UCL is a great place to do this – if you work out how

What we've learned

- Constraints and context are important
- Sometimes you have to 'feel' it to really understand it
- Universities are designed to control change.
- Being reactive at scale is challenging.
  - Technology can help but watch out for bugs
  - Remember it is staff contact that students value most.
- To get an engaged cohort, they need to be engaged with.

Considering other stakeholders

- Who are they?
- Why is it important?
- Consider your context

- Students
- Wider university
- Professional bodies
- Other accreditation bodies
- Industry
- Teachers / Parents
- Be inclusive

EER and Scholarship

- Where does it start?
- How can we nurture?
- Where is there support?

The Value

- Proactive approach to L+T
- Evidence
- Informed decision making
- Sharing
- Network
- Professional recognition
- Promotion
- Scholarship / Research

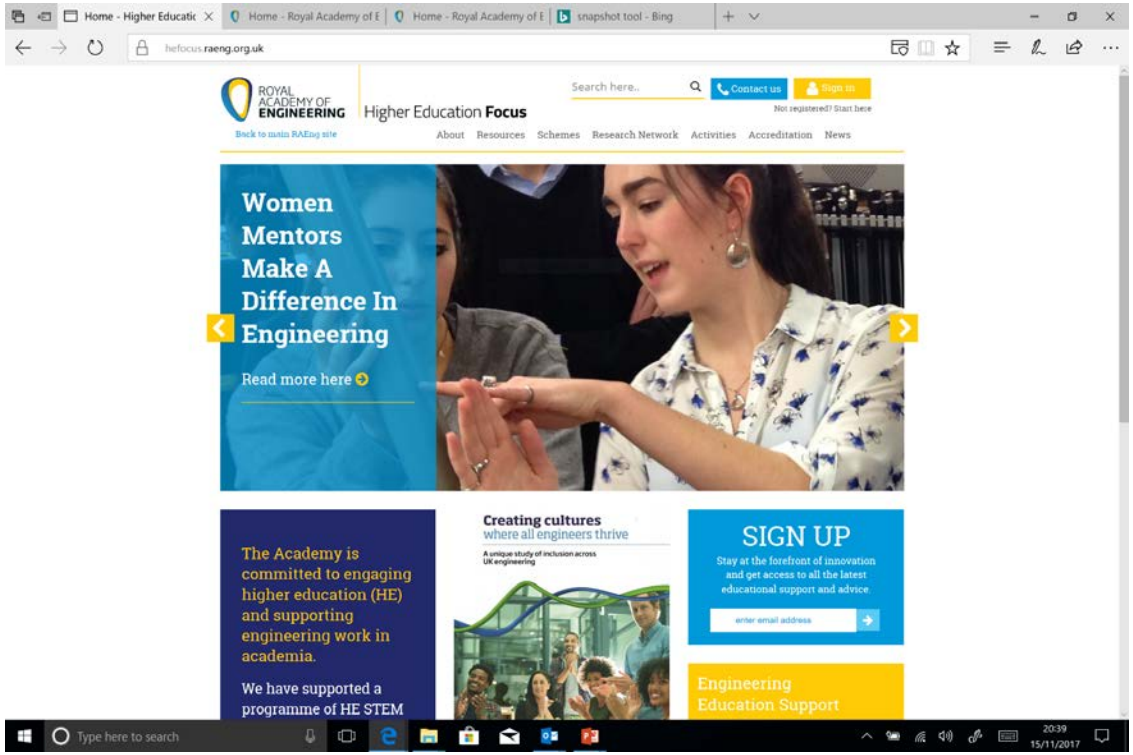
UK Network

- 2009 – Special Interest Group
- 2013 – First Annual Symposium
- 2014 – Network and welcome Ireland
- Independent
- 5th Annual Symposium – November 2017 in London

Our community

PIG?

Visibility


Home - Higher Educatic
Home - Royal Academy of E
Home - Royal Academy of E
snapshot tool - Bing
hefocus.raeng.org.uk
ROYAL ACADEMY OF ENGINEERING
Back to main RAEng site
Higher Education Focus
Search here..
Contact us
Sign in
Not registered? Start here
About
Resources
Schemes
Research Network
Activities
Accreditation
News
Women Mentors Make A Difference In Engineering
Read more here
The Academy is committed to engaging higher education (HE) and supporting engineering work in academia.
We have supported a programme of HE STEM
Creating cultures where all engineers thrive
A unique study of inclusion across UK engineering
SIGN UP
Stay at the forefront of innovation and get access to all the latest educational support and advice.
enter email address
Engineering Education Support
Type here to search
20:39
15/11/2017

Beyond the UK

- SEFI
- REEN
- ASEE, AAEE, SASEE, CDIO
- Centres and National Societies
- EU Projects – QAEMP

QUALITY ASSURANCE AND ENHANCEMENT
MARKETPLACE FOR HIGHER EDUCATION INSTITUTIONS

Research in Engineering Education Network
REEN

CEE CENTRE FOR ENGINEERING EDUCATION
UNIVERSITI TEKNOLOGI MALAYSIA

SEFI
European Society for Engineering Education
Europäische Gesellschaft für Ingenieur-Ausbildung
Société Européenne pour la Formation des Ingénieurs

SEFI 2016

- University-Business cooperation 41
- Engineering Skills 57
- Sustainability and Engineering Education 17
- Quality Assurance and Accreditation 8
- Continuing Engineering Education and Lifelong Learning 12
- Open and Online Engineering Education 17
- Ethics in Engineering Education 2
- Curriculum Development 61
- Attractiveness of Engineering Education 21
- Physics and Engineering Education 9
- Mathematics and Engineering Education 15
- Students Cooperation 12
- **Engineering Education Research 79**
- Gender and Diversity 10


collaboration
is everything

Activity – Your Action Plan

- Create it
- Share it
- Use it

Jick's 10 Commandments

- Analyze the organization and its need for change
- Create vision and common direction
- Separate from the past
- Create a sense of urgency
- Support a strong leader
- Line up political sponsorship
- Craft an implementation plan
- Develop enabling structures
- Communicate, involve people, and be honest
- Reinforce and institutionalize the change

Your Action Plan

Area	Action Point (Identify Output)	Responsibility	Completion	Priority	Status