The First Spring Colloquium of the United Kingdom & Ireland Engineering Education Research Network

Hosted by Northumbria University,

Newcastle upon Tyne

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Introduction.

These are the proceedings of the Spring Colloquium of the UK and Ireland Engineering Education Research Network and compliment the successful series of Annual Symposia. Following the well attended 5th Annual Symposium in November 2017 the Network's Steering Committee decided the addition of a Spring Colloquium would enhance the opportunities for the exchange of ideas, dissemination of research outcomes and most importantly the continuation of discussion and debate. Specifically it would also dedicate time to the Newer Researcher Network and give the opportunity for 'work in progress' to be presented to an audience of peers.

The Colloquium was held in Newcastle upon Tyne, hosted by the Department of Mechanical and Construction Engineering at the University of Northumbria, and drew delegates from across the geographical spread of the Network, including a strong representation from Dublin Institute of Technology.

The predominant themes of the contributions presented here is a concern with the development of expertise and the application of functional literacies, for both student engineers and engineering academics. These themes are very much a component of the Newer Researchers Network, a group whose aim it is to provide support and guidance for researchers new to the field of Engineering Education, be they PhD students or a practicing engineering academic who wishes to take-up pedagogic research. Bringing together experienced and newer researchers from across the UK and Ireland is an invigorating aspect of the Network meetings and source of vitality, bringing many fresh ideas. We can only suggest that you join a meeting and experience this for yourself.

This colloquium also happens to extend the once limited number of opportunities for those interested in the fundamental nature of engineering education to meet, share and debate. As engineering educators we do not exist in a vacuum, others define the thinking of our incoming students and contradictory voices give us targets. We must seek agility as well as influence, going beyond self-focussed 'reflective practitioners' and creating a voice for evidence informed student learning within engineering departments. It is reassuring that the Network continues to grow, in member numbers, geographical spread and in wider recognition. It may be that we are providing an additional opportunity for those described as "skilled and collegial teacher' by the Royal Academy of Engineering* to evidence activity which enhances teaching and pedagogic scholarship beyond their institution and thereby strengthening recognition as 'scholarly teacher' or 'institutional leader in teaching and learning'. Establishing such identities must be a fundamental step towards engineering departments having a sustainable future.

Dr Roger Penlington, UK & I EERN Vice Chair

* Royal Academy of Engineering (2018) The Career Framework for University Teaching; background and overview. https://www.raeng.org.uk/publications/reports/career-framework-for-university-teaching-backgroun

Contents

Engineering Capital in University Applicants: can it be measured, evaluated or spotted?

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Department of Electronic Engineering, University of York

Background

Within the context of a current shortage of engineering graduates in the UK [1],[2] a number of Higher Education engineering departments have made changes to traditional entry qualification requirements. Such changes seek to encourage wider participation in engineering programmes with some departments dropping requirements for level 3 physics, and/or maths.

Nevertheless University educators want to ensure that applicants selected to undertake engineering programmes are those with sufficient *Engineering Capital* to allow them to thrive and eventually succeed in gaining graduate-level employment as highly skilled professional engineers.

The concept of *Engineering Capital* borrows from Bourdieu's notion of *Cultural Capital*, which might be described as 'the skills and knowledge on which an individual can draw in order to give them an advantage in life' [3]. Bourdieu was concerned in particular with cultural capital which could be 'inherited' from the family setting and would lead to greater academic success at school [4] and the inequality in distribution of such cultural capital among children from different social (class) backgrounds [5].

Engineering Capital should be understood as an embodied or socialized tendency to act, think, or feel in a particular ***engineering-y*** way. Engineering capital should encompass engineering skills, knowledge of engineering, engineering norms of behaviour and engineering values. It would align to a great part with Engineering Habits of Mind: Systems thinking; Adapting; Problem-finding; Creative problem-solving; Visualising; Improving.[6]

An added complication for Higher Education engineering departments recruiting to undergraduate programmes is that many UK school students are not fully aware of the sub-disciplines within Engineering; as an example, since only very small numbers of students in UK schools have studied Electronics at A-level many potential applicants are unaware of Electronic Engineering as a University subject. An interesting question to consider is how those involved with admissions to University/HE engineering programmes can identify applicants with sufficient *Engineering Capital* to succeed. The present project seeks to further understand the context of decision making and presence of *Engineering Capital* in potential engineering students.

Methodological Approach

Emergent findings are presented here from the initial phase of an ongoing project which analyses UCAS applications to an Electronic Engineering degree programme at a research intensive Russell Group University. Research questions to be addressed are:

- Which factors influence applicants' decisions to apply to an undergraduate engineering programme?

- What awareness and perceptions of engineering do applicants describe and how are these impacted by participation in engineering outreach and education activities?
- Can the *'engineering capital*' of potential University students be evaluated through UCAS applications alone?

The first stage of the study involves data collation and trawling, and analysis of written application documentation (personal statements, references) of around 500 undergraduate home-domiciled students.

This extended abstract reports on the initial findings from a smaller sample of 28 (14 male, 14 female) UCAS applications from one application cycle. A purposive sampling technique was used to select the applications in order to achieve an equal balance male and female engineering students and a representation across the various degree programmes offered by the department. All applicants were UK-domiciled students within the age range of 18-21 years. Applications were spread over a range of BEng and MEng Electronic Engineering programmes including a number of specialism such as Nanotechnology, Computer Engineering and Music Technology Systems.

The main source of data was the applicants' personal statements: an initial descriptive analysis was undertaken in order to gain an understanding about what the applicants wrote about themselves, their own *Engineering Capital* and the context in which they were making decisions about studying engineering.

Results: Areas of Influence

Research question: What factors influence applicants' decisions to apply to an undergraduate engineering programme?

Initial coding revealed five main areas of influence which play a role in applicants' decision making

- Early exposure to engineering activities
- Family influence
- STEM outreach activities
- Work Experience
- School influence
- Tinkering

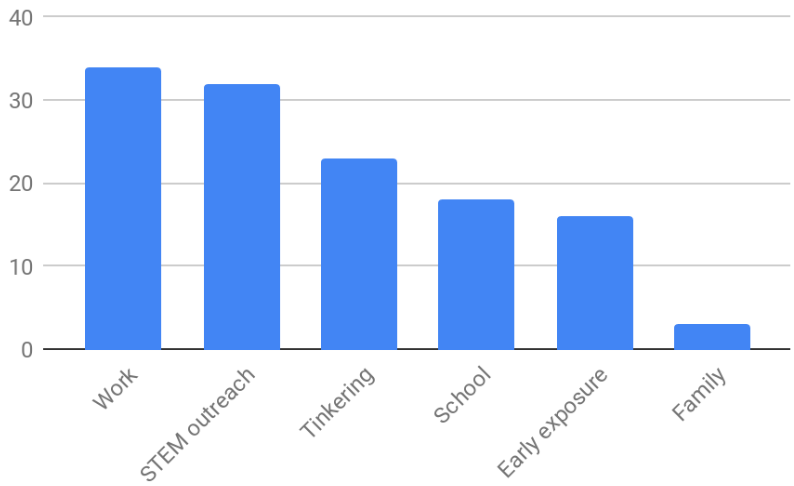

Figure 1: Bar chart of the open code frequencies of mentions of influences on applicants' engineering study choices.

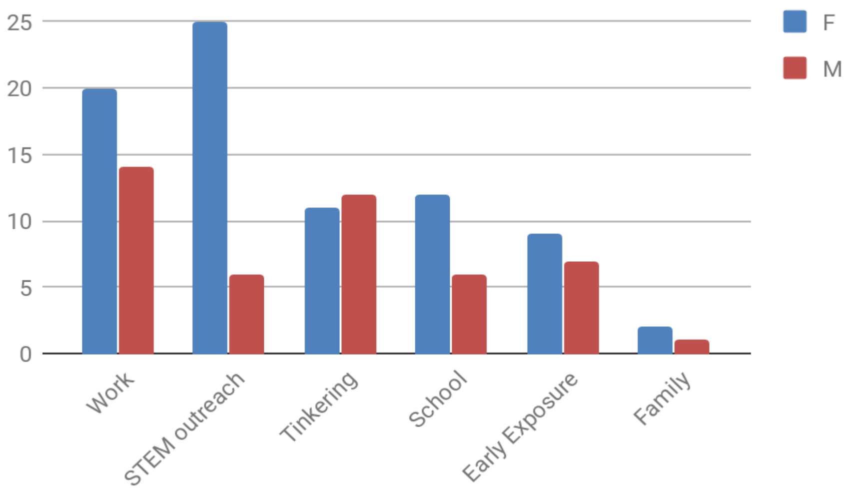

Figure 2: Bar chart of the open code frequencies of influences on applicants' engineering study choices split by gender.

All applicants mentioned recent **Work experience** either of a short 1-2 weeks duration, organised by the school, or longer work placements undertaken during summer holidays, post GCSE exams etc. *"In June ..., I undertook a week's work experience at Ultra Electronics, a local engineering company".*

Taking part in **STEM outreach activities** were referred to by most applicants. In general these were activities that had been organised through school - in particular outreach activities focussed on attracting more female engineering students were mentioned frequently by female applicants. *"I have been to several single day engineering events starting with a day trying to encourage girls into engineering, obviously successful."* STEM outreach was mentioned much less frequently by male applicants.

Although only mentioned a few times, **Family influence** was often from close relatives who worked in engineering and had passed on their skills or knowledge in an informal family context. In the current data set all of these family influencers were male (and often grandfathers). - *"my grandad, who was an RAF radio engineer in the 1950s taught me how to solder and the basics of electronics like ohms (sic) law".*

A large number of applicants mentioned that they enjoyed **Tinkering:** *"I've taken my interest in electronics into my own hands from making my own Arduino powered candy vending machine to making LED light shows for Halloween."* In particular small electronic microprocessors such as micro:bit, Arduino boards and Raspberry pi were mentioned by a number of applicants.

Early exposure included information about the applicant's first memory of being involved in engineering activities at an early age (e.g. primary school) *"From the age of 7, I picked up my first microphone - I built my first speaker system at the age of 10."* This type of early exposure to electronic engineering was mentioned slightly more often by female applicants.

Results: Perceptions of Engineering

Research Question: What awareness and perceptions of engineering do applicants describe and how are these impacted by participation in engineering outreach and education activities?

Initial coding revealed the following common perceptions of what engineering involves:

- Team work
- Real-world problem solving
- Creativity
- Application of maths/physics
- Gender inequality

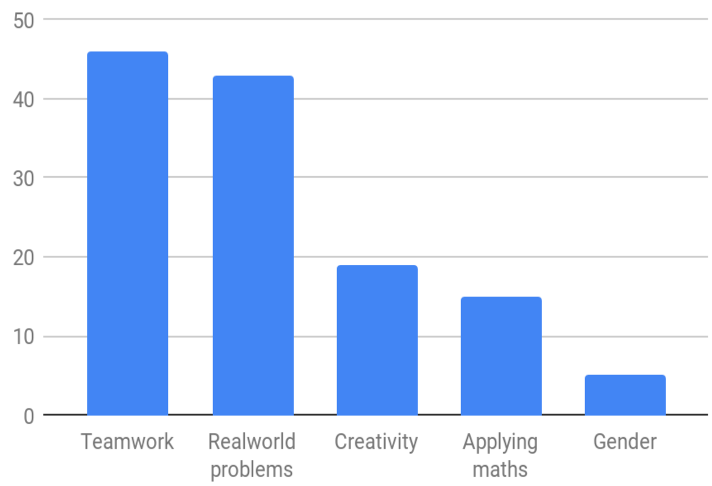

Figure 3: Bar chart of the open code frequencies of applicants' perceptions of engineering.

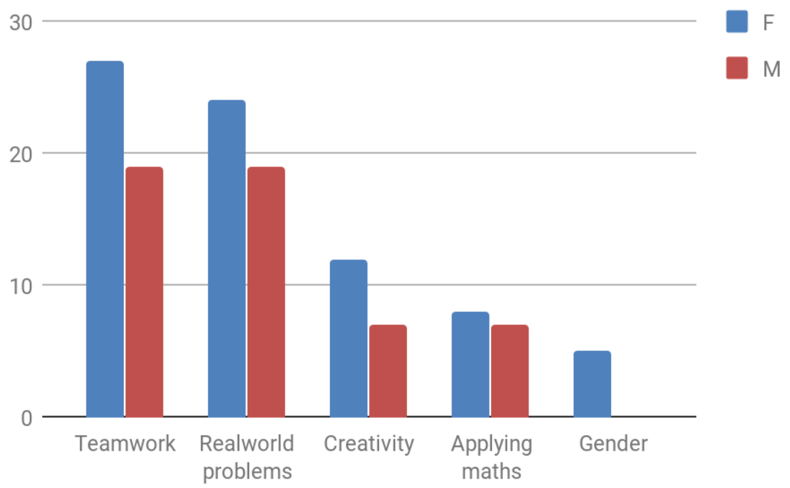

Figure 3: Bar chart of the open code frequencies of applicants' perceptions of engineering split by gender.

All applicants mentioned their experience of **Teamwork "***Here I worked in a small team to research and design a circuit that would drive a motor to be used in an aircraft's automatic door"* - sometimes in the context of an engineering activity, at other times in a more general context.

Real world problems and the role of engineering in society was mentioned by a large proportion of students **-** *"To me, it was a demonstration of how integral engineering has become to life; how it will never stop thriving until our Curiosity dies and We stop imagining."*

Creativity was mentioned by a smaller number of applicants "*electronic engineering…offers me a unique opportunity to combine problem solving with creativity*," but was mentioned more frequently than engineering being about **applying Maths** (or physics) ***"****basic principles of physics and maths underpin everything".*

Teamwork, real-world problem solving and creativity were mentioned more often by female applicants. In fact no male applicants wrote about the **gender** (inequality) aspect of engineering whereas this was mentioned five times by female applicants *"even as a child I noticed the lack of women in this sector"* - in this example even combined with evidence of early exposure to engineering as a discipline.

Discussion

While the results of this initial analysis were not wholly unexpected some aspects invite further consideration. It is interesting that all the female applicants in the data set mentioned having taken part in a STEM outreach activity, whereas only some of the male applicants mentioned outreach activities. This result might show that efforts that have been made over the last few years to attract more female student engineers have been successful and have reached their target audience.

However, it could also be argued that such activities are taken up by those who would have been interested in engineering nevertheless, and perhaps even despite any involvement in female-focussed STEM outreach. It is not possible from the current data and analysis methods to determine which of these conclusions should be drawn.

All applicants wrote about work experience and their experiences of team work; this is understandable given that most of the advice available on 'how to write your personal statement' suggests that any work experience undertaken should be included e.g. [7]

Overall, female applicants appear to make more frequent mention of the influences and reasons that they have chosen to study engineering; perhaps this points to a perception that engineering is a common choice for male students, but that female applicants feel that they need to explain their decision making and perhaps in an attempt to 'prove themselves' to University admissions staff in order to counteract any possibility of stereotype threat [8].

Future Work

The research question "*Can the engineering capital of potential University students be evaluated through UCAS applications alone?"* cannot be answered through this initial sample. In order to gain better understanding of this aspect of applying to University a number of applicants should be tracked from their entry to the programme, progression and final graduation results in a longer term study. However, the data analysis of the full sample of around 500 applications is ongoing. The second phase of the project will include qualitative interviews with current students to map their 'engineering journey' from pre-University education through to graduation.

Conclusion

Whilst only a small part of this project has been undertaken, it is hoped that emergent findings presented here can help to inform the discussion and debate around pre-university education and the capacity of University applicants to make an informed decision about studying engineering at University.

It is also hoped that the results of this initial sample will further a better understanding of how potential engineering students' perceptions of engineering are formed, and where and how they might acquire *Engineering Capital* prior to applying to and attending undergraduate engineering programmes. It should also help to inform the HE engineering community's efforts to widen participation in engineering by seeking students with the potential to gain *Engineering Capital* which would allow them to thrive as highly skilled professional engineers.

[1] 'Engineering UK 2018: The state of engineering', Engineering UK , 2018[Online]. Available https://www.engineeringuk.com/media/1576/7444_enguk18_synopsis_standalone_aw.pdf.
[2] 'Skills & Demand in Industry: 2017 IET skills survey', The IET, Dec. 2017[Online]. Available http://www.theiet.org/factfiles/education/skills2017-page.cfm[Accessed: 11December2017].
[3] P. Bourdieu et al., 'Power and ideology in education', *Cultural reproduction, social reproduction. Oxford University Press, Oxford*, 1977.
[4] P. Bourdieu, 'The forms of capital', in *Handbook of theory and research for the sociology of education*, J. G. Robinson, Ed. New York: Greenwood Press., 1986.
[5] D. Reay, 'Education and cultural capital: the implications of changing trends in education policies', *Cultural Trends*, vol. 13, no. 2, pp. 73–86, Jun. 2004.
[6] 'Thinking like an engineer - Implications for the education system', Royal Academy of Engineering , 2014[Online]. Available https://www.raeng.org.uk/publications/reports/thinking-like-an-engineer-implications-full-report.
[7] UCAS website, *Struggling with your personal statement? Help is at hand!*, UCAS. [Online]. Available: https://www.ucas.com/undergraduate/applying-university/how-write-ucas-undergraduate-personal-statement. [Accessed: 12 Jul. 2018].
[8] C. R. Logel et al., 'Unleashing Latent Ability: Implications of Stereotype Threat for College Admissions', *Educ. Psychol.*, vol. 47, no. 1, pp. 42–50, Jan. 2012.


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The UCL MSc Engineering & Education
Abel Nyamapfene
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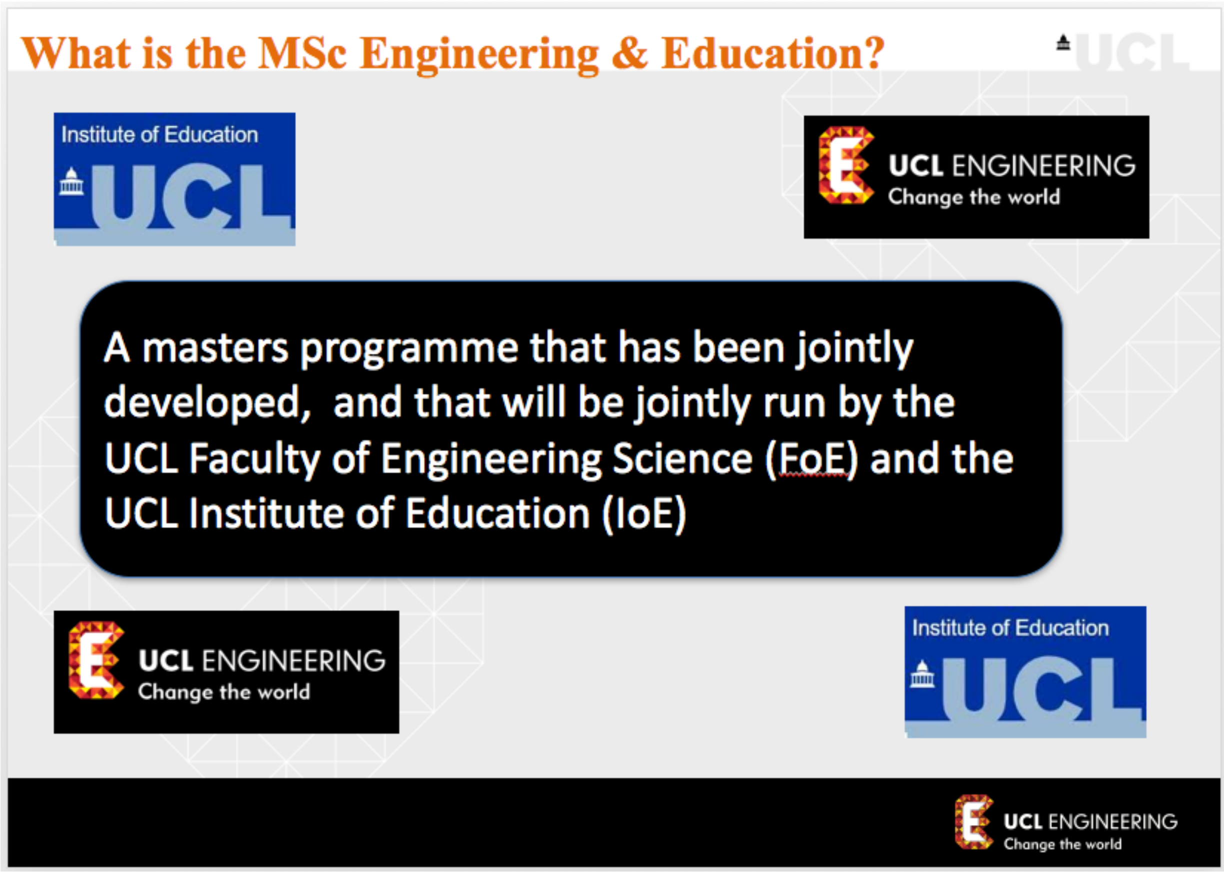
What is the MSc Engineering & Education?
UCL
Institute of Education
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A masters programme that has been jointly developed, and that will be jointly run by the UCL Faculty of Engineering Science (FoE) and the UCL Institute of Education (IoE)
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Institute of Education
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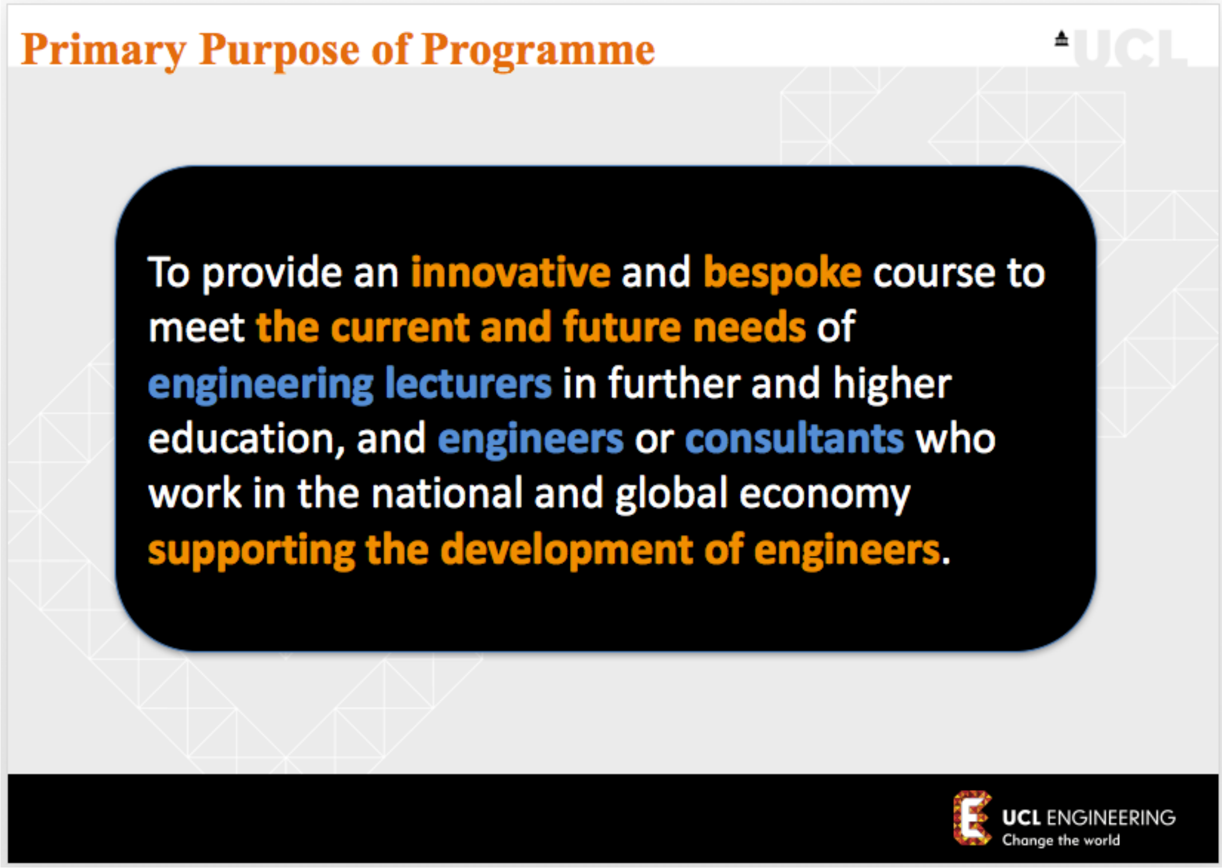
Primary Purpose of Programme
UCL
To provide an innovative and bespoke course to meet the current and future needs of engineering lecturers in further and higher education, and engineers or consultants who work in the national and global economy supporting the development of engineers.
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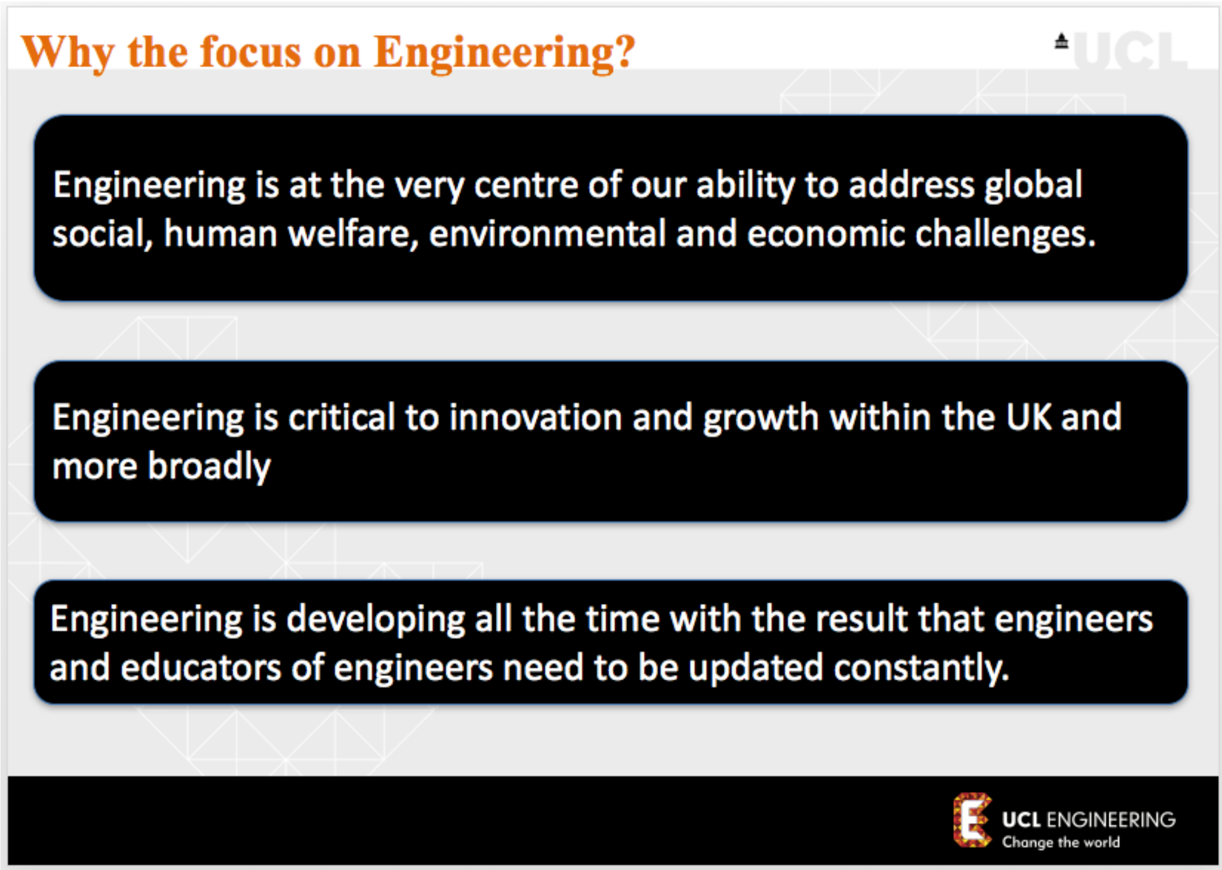
Why the focus on Engineering?
UCL
Engineering is at the very centre of our ability to address global social, human welfare, environmental and economic challenges.
Engineering is critical to innovation and growth within the UK and more broadly
Engineering is developing all the time with the result that engineers and educators of engineers need to be updated constantly.
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Why an MSc in Engineering & Education?
1. Recruitment Issues
University departments/faculties of engineering, especially those with the highest ratings, have less high quality domestic undergraduate and post-graduate students and less students from atypical backgrounds applying to them than they would like
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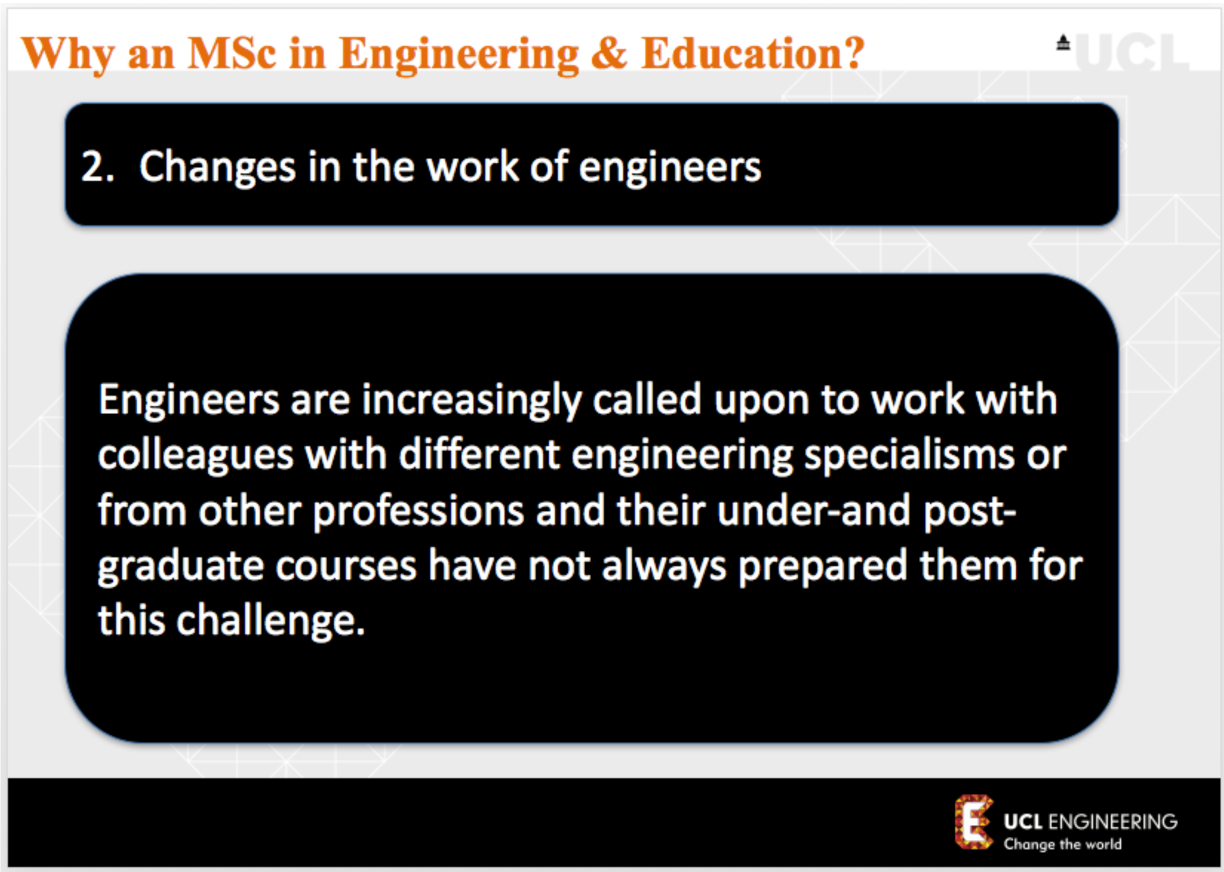
Why an MSc in Engineering & Education?
2. Changes in the work of engineers
Engineers are increasingly called upon to work with colleagues with different engineering specialisms or from other professions and their under-and post-graduate courses have not always prepared them for this challenge.
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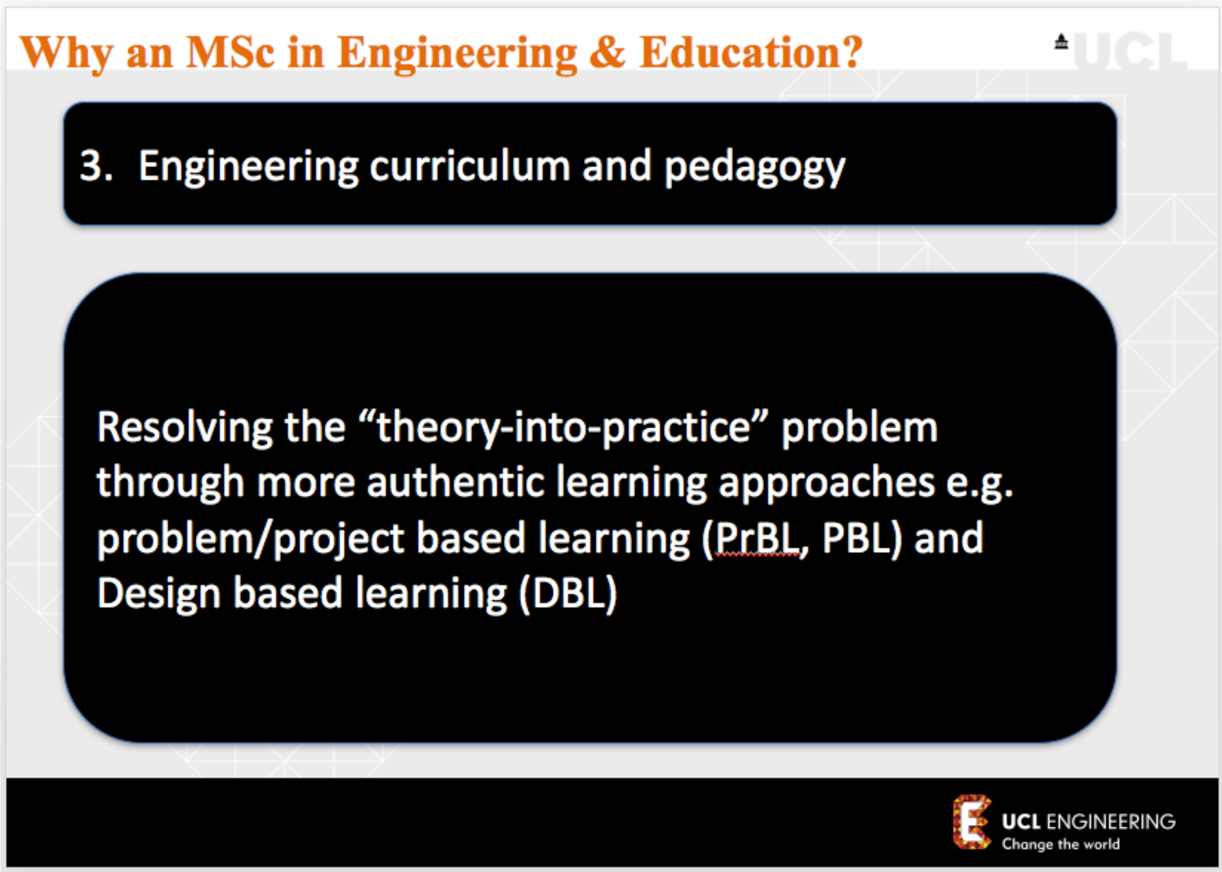
Why an MSc in Engineering & Education?
UCL
3. Engineering curriculum and pedagogy
Resolving the "theory-into-practice" problem through more authentic learning approaches e.g. problem/project based learning (PrBL, PBL) and Design based learning (DBL)
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Who is the programme aimed for?
UCL
Primarily aimed at engineering lecturers in further and higher education, policy makers, consultants and engineers working in the national and global economy who have an 'educative' or workplace development role
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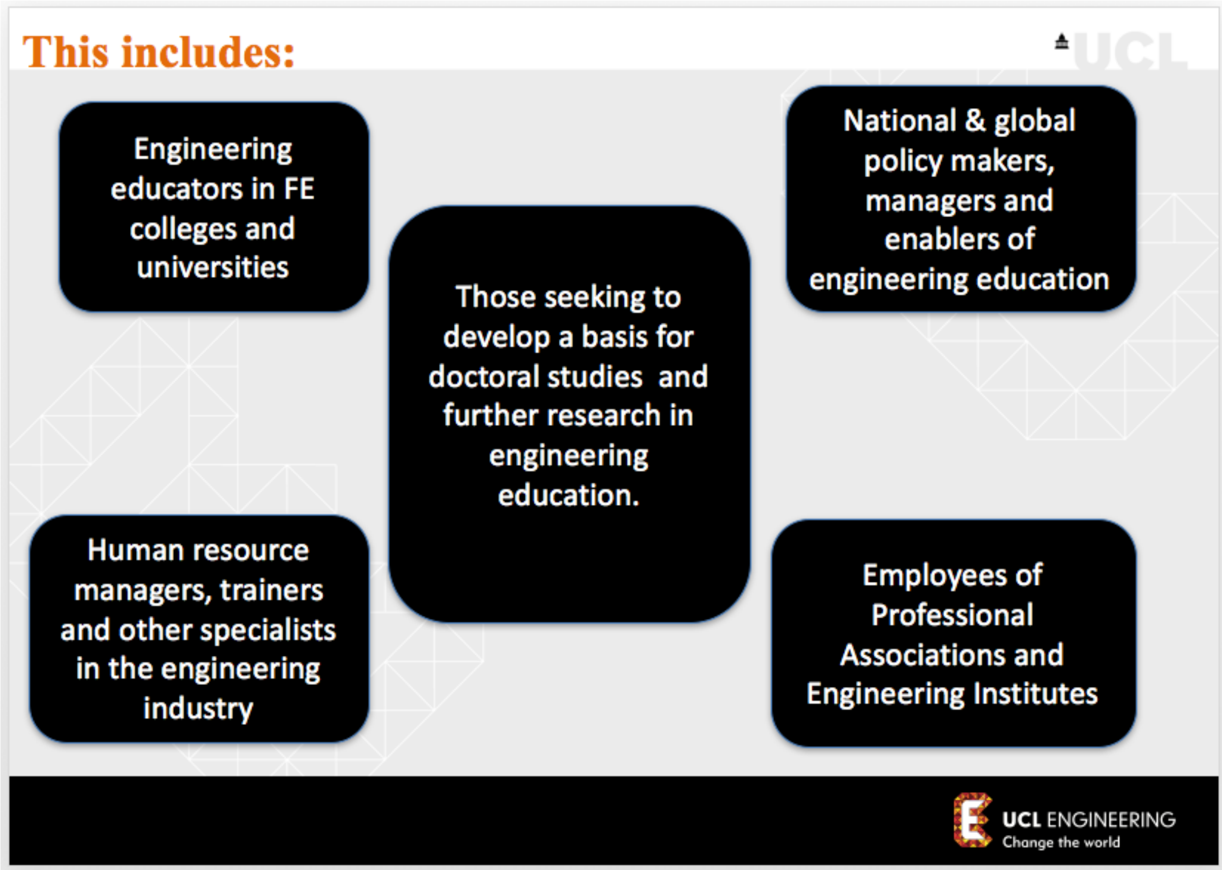
This includes:
UCL
Engineering educators in FE colleges and universities
Those seeking to develop a basis for doctoral studies and further research in engineering education.
National & global policy makers, managers and enablers of engineering education
Human resource managers, trainers and other specialists in the engineering industry
Employees of Professional Associations and Engineering Institutes
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Specific Programme Objectives
UCL
Introduce current debates about the contribution of education and work in developing engineers' expertise to assist them to design/ redesign/ contribute to engineering courses that develop 21st century skill needs
Upgrade participants' engineering knowledge by providing them with access to research in their engineering specialism or new developments in engineering
Stimulate and support research and innovative approaches in engineering education
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Programme Entry Requirements

Applicants are expected to have a second class honours degree or equivalent in an Engineering or related Engineering and Education discipline.

European or international applicants are expected to have qualifications at an equivalent level.

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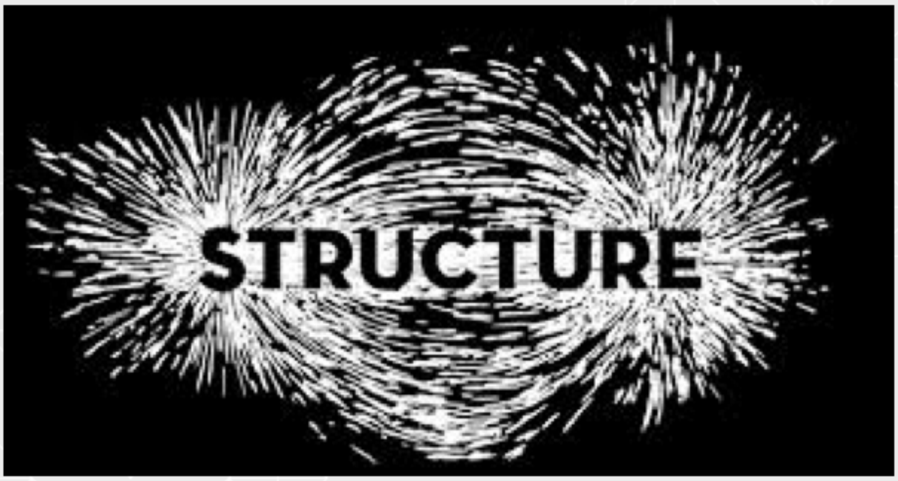
Programme Structure



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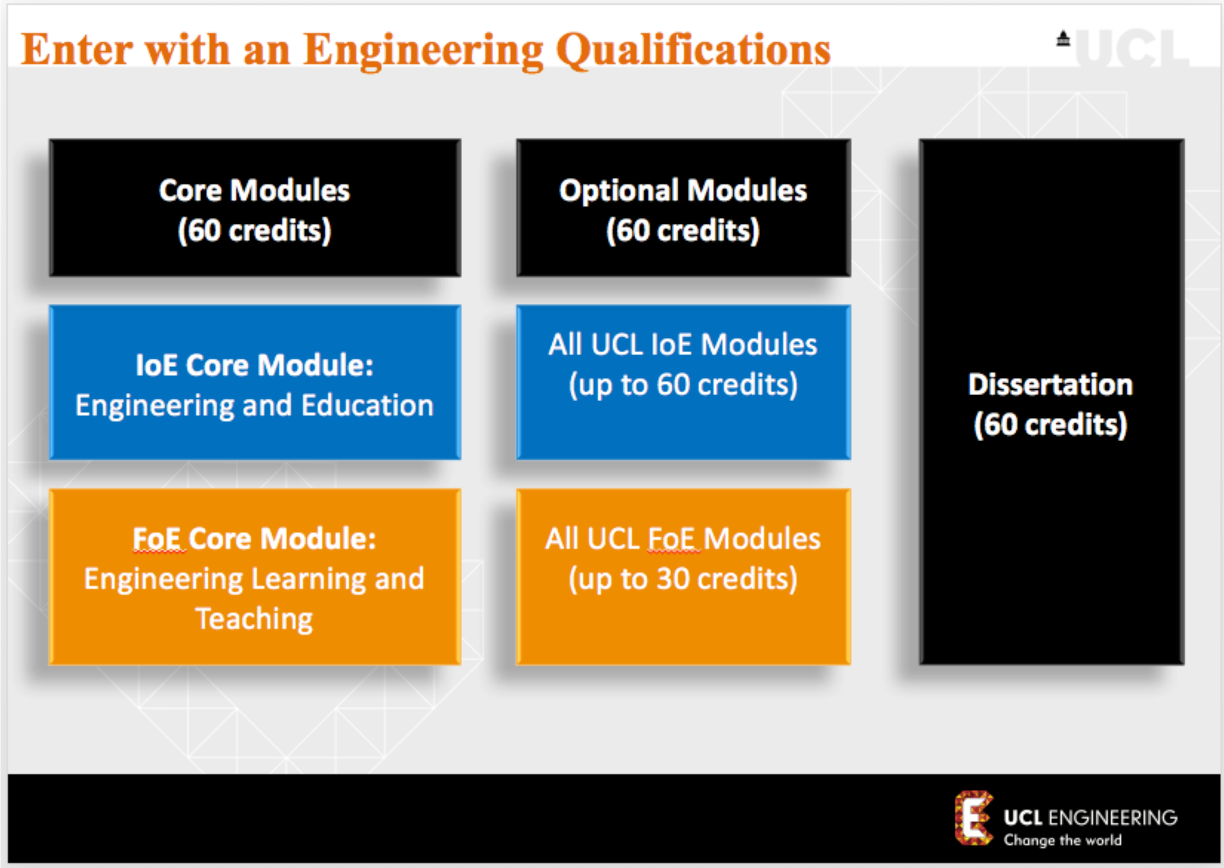
Enter with an Engineering Qualifications
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Core Modules
(60 credits)
IoE Core Module:
Engineering and Education
FoE Core Module:
Engineering Learning and Teaching
Optional Modules
(60 credits)
All UCL IoE Modules
(up to 60 credits)
All UCL FoE Modules
(up to 30 credits)
Dissertation
(60 credits)
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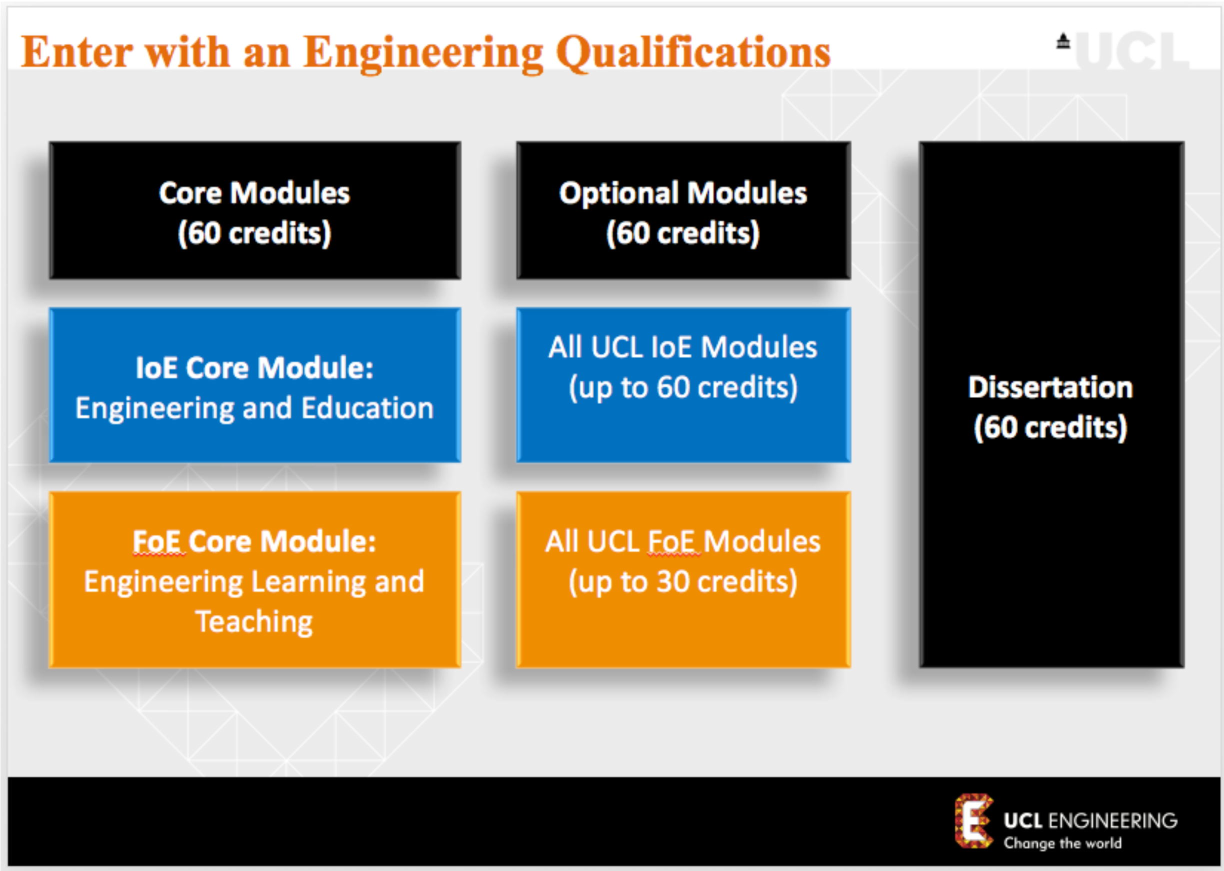
Enter with an Engineering Qualifications
UCL
Core Modules
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IoE Core Module:
Engineering and Education
FoE Core Module:
Engineering Learning and Teaching
Optional Modules
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All UCL FoE Modules
(up to 30 credits)
Dissertation
(60 credits)
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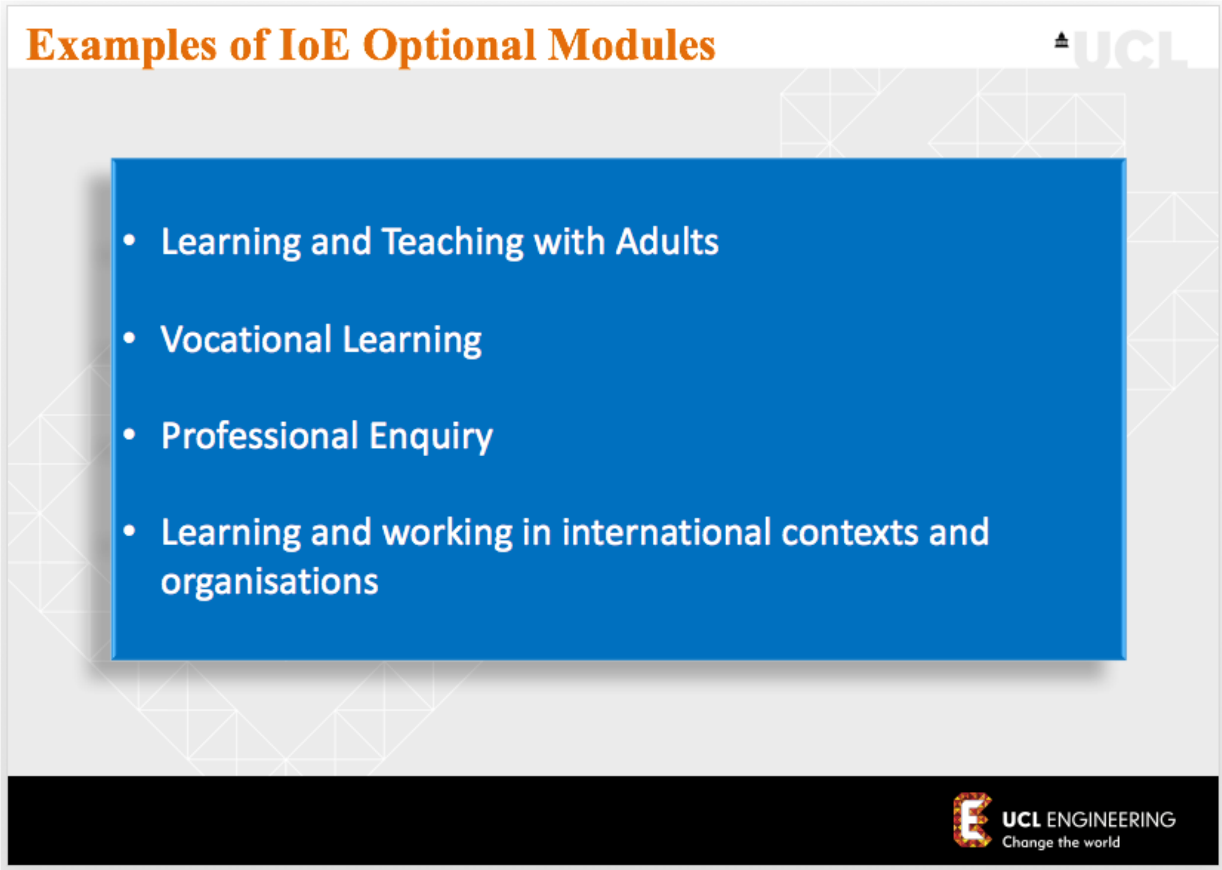
Examples of IoE Optional Modules
UCL
Learning and Teaching with Adults
Vocational Learning
Professional Enquiry
Learning and working in international contexts and organisations
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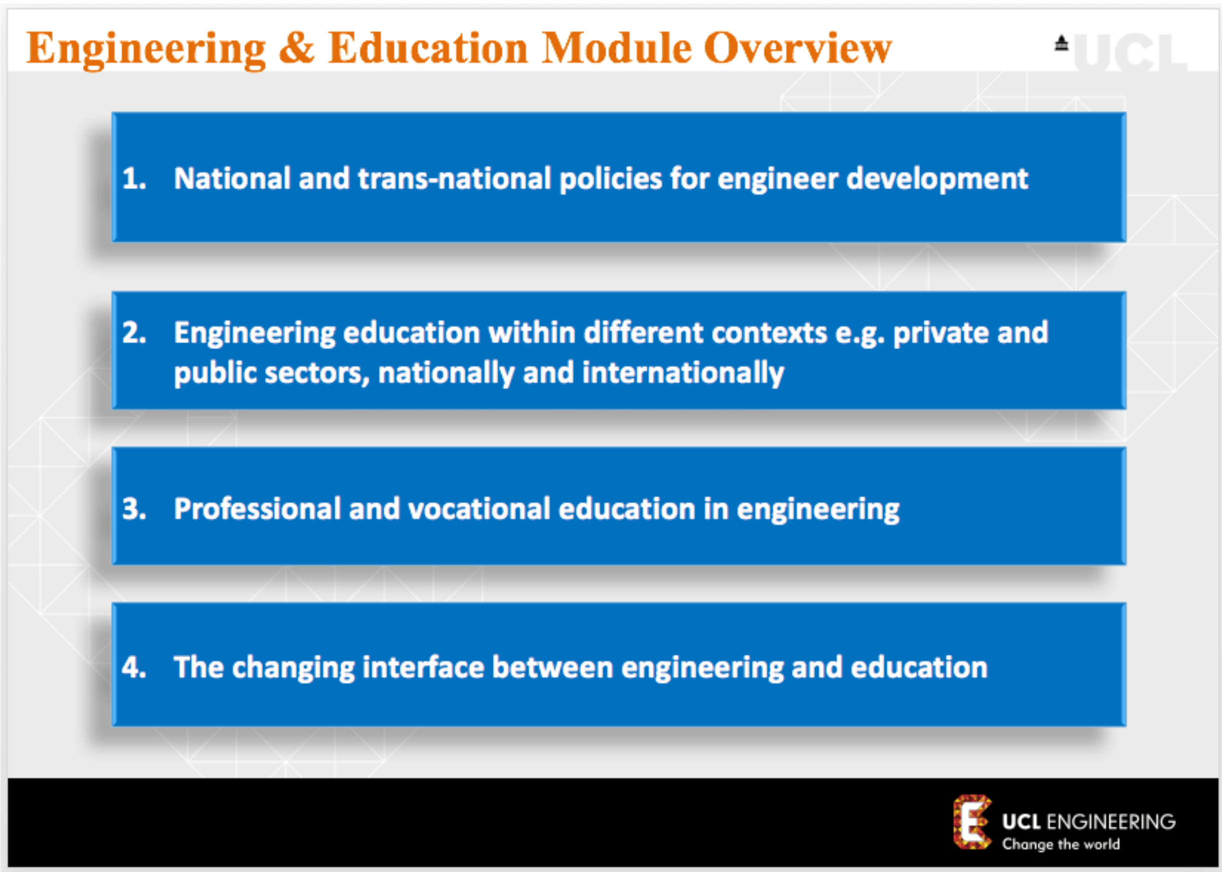
Engineering & Education Module Overview
UCL
1. National and trans-national policies for engineer development
2. Engineering education within different contexts e.g. private and public sectors, nationally and internationally
3. Professional and vocational education in engineering
4. The changing interface between engineering and education
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Learning & Teaching Module Overview

1. Historical context for learning, teaching and assessment in engineering
2. Current learning, teaching and assessment practices in engineering education
3. Engineering curriculum design & transformation
4. Scholarship in engineering education

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Using theories of socially situated learning to understand how academics learn to teach

Dr Susan Mathieson
Northumbria University

Using theory in research into teaching

- **The research question:**
  - How do early career academics (ECAs) learn about teaching and supporting learning in the university workplace through an experiential route to HEA Fellowship?
  - How can this be used to inform the understanding and implementation of national plans to introduce the Apprenticeship for Academic Professionals?
- **Using theory in research to influence policy implementation:**
  - What light do 'social practice' theories of professional learning shed on this?

The policy shift towards academic learning as an 'apprenticeship'

- Historically academics have learnt about their teaching role through central taught programmes (PGCert/PGCAP)
- However, institutional commitment to costly and time intensive centralised teaching programmes for academics is under pressure
- The AP Apprenticeship was seen as providing a source of funding for academic professional training via the Apprentice Levy
- In practice, this has been fraught with difficulties, given the different cultures of learning in HE and apprenticeships, and resistance to perceptions of bureaucratic demands by the Institute for Apprentices
- However, the concept of an apprenticeship does surface pedagogical questions about how academics learn to teach and the role of disciplinary workplaces in this
- As a former programme leader of a PGCAP, the most significant factor influencing academic engagement was the level of support for their teaching in the disciplinary workplace
- Understanding workplace learning through a theoretical lens can bring greater rigour to discussions about the implementation of the Apprenticeship for Academic Professionals

Research design

- A single institution study where the compulsory PGCert for early career academics (ECAs) was replaced by an experiential route to HEA Fellowship supported by departmental mentoring and Peer Support, i.e. already a shift from a centralised programme towards learning through work based apprenticeship
- Perceptions that this has been ad hoc, with good results in some places, but some new academics left to flounder with insufficient departmental support
- Research project analysing Reflective Commentaries of ECAs gaining HEA Fellowship via the experiential route, from 2015-2017, initially in one faculty, to see what can be learnt about academic workplace learning. This research to be used to develop a more formal 'apprenticeship' pathway for early career academic learning
- Using a social practice theoretical framework focusing on learning through participation in 'communities of practice' to develop new identities and practices as experienced academics, identifying:
  - Instances of **practice learning**: e.g. Peer Support, mentoring, reified tools/policies
  - Understandings of the **'community'**: e.g. colleagues, mentors, students, policies
  - Developing new **identities** as teachers in HE
- Supplemented by in depth semi-structured interviews with academics, mentors and Faculty HEA Coordinators

A social practice approach to academic learning about teaching

- Focus on practices situated in particular contexts developed over time, influenced by sets of power relations, and shaping socially situated ways of knowing, identity, and ways of doing things (disciplinary departments?)
- Lave and Wenger (1991) : interested in socially situated **learning** through participation in 'communities of practice' (CoPs)
- Learning of newcomers through 'legitimate peripheral participation' – early career academics need access to meaning-making in (departmental) communities to enable an inbound trajectory to central participation in the (departmental) community
- Gherardi, Nicolini and Odella (1998): workgroup communities create 'pedagogic pathways of participation' by organising newcomers tasks to create a 'situated curriculum' (early career academic learning plan?)

Who do academics learn from about teaching?

- Problems in situated learning theory in the concept of coherent communities
- **Situated learning in departmental workgroups**: 'Teaching and Learning Regimes' (Trowler 2008); not voluntaristic CoPs but partly structural, with issues of power and difference
- **Or informal 'significant networks' below the departmental TLR** (Roxa and Martensson 2009): more voluntaristic, agentic, learning happening through 'sincere and honest discussions about teaching with chosen peers', 'backstage' learning – academic developers need to engage with these networks (more like a 'community of practice?')
- Warhurst (2008): incidental participatory learning - noting paucity of directed pedagogical interactions to support learning of ECAs about teaching in disciplinary workgroups, compared to extensive support for developing research

How does learning by ECAs enrich programme practices?

- Boud and Brew (2013): focus less on individual learning than practice learning – measuring how practice improved, rather than how individual learning improved (e.g. NSS, student achievement)
- Learning through:
  - collaborative engagement in policy change
  - engagement with practice issues, e.g. Peer Support
  - scholarly discussions about teaching that go beyond the immediate classroom situation
- Less interested in academic agency and identity as individual trajectory than in the benefits for the institution

Academic identity construction and agency

- A weak area in situated learning theory - does not distinguish between individual identity and social identities as part of a community

- Need to draw on other theories of academic identity development
  - Bernstein identifies core elements of academic and professional identity as "a particular kind of humane relationship to knowledge …centred on what he termed 'inwardness' and 'inner dedication", which he saw as threatened by marketization, external regulation and an 'audit culture' (Beck and Young 2005)
  - Henkel (2000) argues academic identities located in disciplines still strong, particularly in research-intensive universities, advocating a new relationship between corporate and collegial academic cultures (Henkel 2016)
  - Importance of **academic narratives** in creating coherent identities and practices across contradictory HE discourses – research/teaching (Mathieson 2011) "having a voice means being empowered to express oneself within …the fragmented power space of the current higher education system" (Barnett and Di Napoli 2008: 6)

Analysing the findings

- Analyse HEA Reflective Commentaries to identify learning of early career academics through the following:
  - **Practice Learning**
  - **Community**
  - **Identity**

Practice learning through Peer Support

Advice on using technology to achieve conceptual learning:

“(x) observed my teaching a cohort of ~20 engineering students and was able to provide constructive feedback on my performance. His suggestions for making use of different teaching formats, such as both whiteboard and visualizer, to communicate complex mathematical problems was very useful. This encouraged students who had difficulty keeping track of the logical arguments to recap on the core principle, which remained on the whiteboard, whilst working out was conducted for numerous example problems on the visualizer.” (ECA 13)

Longer term **practice learning** through shadowing and professional conversations

After observing and mastering the 'basics', early career academics identified the need to work with colleagues to facilitate more complex student learning through the framework of lectures and workshops:

"After a few weeks, I started to handle the class by myself. I applied the lessons learned to my own teaching. As the contents got more difficult at the later stage, we proceeded to the concepts of class, objects, and even more complicated concepts such as inheritance, polymorphism. It became more challenging to deliver the knowledge effectively. **I asked advices from (the module tutor) and thought about the teaching strategy from the students' point of view. I decided to spend more time in explaining basic concepts in the lectures and instruct students to learn the syntax practically in the workshops. The students reflected that this change provided the right support they needed and improved their learning efficiency (A1, A2, A4, K2, K3). Besides, I found that:**

- **Repetitive instructions can enhance students' conceptual understanding.**
- **Regular recap of prior knowledge is helpful for students to understand new knowledge" (ECA 8)**

Becoming an active member of module and programme teams (**community**)

Programme teams creating opportunities for research oriented early career academics to teach their research – benefits for the academic and for students – and the quality of programmes:

"There was an opportunity to incorporate research driven approaches to the development of an undergraduate final year coursework assessment, using mathematical modelling in solar physics. In collaboration with (x) we designed a project that could adequately test the students mathematical and solar physics knowledge and ability to research into the problem proposed to demonstrate independent thinking throughout semester 1 of 2016. I managed to guide students to specific published papers in quartile-one science journals and showed them how to extract information relevant to their subject by asking specific questions. We discussed the allocation of marks throughout the assignment as a reflection of the true attention and effort on each question ". (ECA 13)

Understanding **students** as part of the **community** of learning

Induction into faculty student engagement practices influencing early career academics learning about their teaching, and communicating student feedback to module teams:

"Students' feedback is vital to me, as it helps me to improve my teaching …Examples include: 1) I used TurningPoint to improve students' engagement for larger classrooms, it turned out that everyone concentrated on the teaching session (A1, K4). Many students told me that they wanted to do this again, because this improved their learning experience (A3, K5). 2) After a lab session, many students expressed that this is more interesting and they can learn more in the lab than in the lectures, I have explained the importance of both activities and reflected students' feedback to the module leader. Although the time for hands-on session is limited, we have rearranged the teaching and added more engaging lab activities for the next year (K5)." (ECA 18)

What happens when departmental communities are poor learning communities?

- Excessive demands on some ECAs with limited support:

  "Delivering multiple modules to three different levels via different modes whilst being a Module Tutor (for 3 modules) immediately after commencing work was challenging." (also Level 4 year tutor) (ECA 3)

- PL advice on responding to student concerns leading to procedural damage control, rather than reflecting pedagogically on group work learning, leading to changes in teaching:

  "Preparation, management and assessment of group work, particularly dealing with situations where there were inadequate contribution/engagement from some students were the most challenging for me in assessments. However, with peer support, I managed such situations. Once, I received an email from a student with a complaint about two group members only two days before (module) assessment presentations. The student was hesitant to declare the fellow members' lack of commitment openly but wanted an alternative solution. **After discussing with the programme leader, I gave the option of splitting the group and presenting with what the two contributing members had prepared but reminded that it will be communicated to the others exposing that a complaint has been raised** " (ECA 3)

- Need for support for workbased learning beyond the immediate programme team

Learning as **changes in identity**

- Developing an identity as a teacher, by building on existing researcher identity:

"Besides, I'm a research active staff member and have been conducting research in the field of wireless networks, network coding, resource allocation and optimisation, which can be reflected by high quality journal (Q1) publications [20-23]. I tried to incorporate my research outputs into the module teaching and project supervision. For instance, in (module) I used my research achievements in (x) layer modelling to help students with their assignment; in (x module) I used my research experience in network simulations to help students understand the framework of a network simulator written by C++ in their assignment" (ECA 8)

"Incorporating the multi-disciplinary approach to research has greatly shaped my approach to teaching and my enthusiasm for providing a broader context in student learning at all levels of education."(ECA 13)

- Emotional aspects: developing self efficacy through access to rich variety of supported tasks, being valued by colleagues for contributions, recognition of particular strengths

What can we learn from situated learning theory about creating rich workplace learning environments

Learning through **engaging in practice**

- Importance of actively structuring rich learning opportunities for ECAs: Peer support; shadowing; collaborative programme redesign
- Importance of quality of learning environments in programme teams for academics to learn about teaching: team teaching; flexibility of programmes to enable ECAs to contribute their expertise
- Investing in the learning of ECAs benefits programmes

Becoming part of a **community**

- Informal learning with trusted colleagues often more important than a formal mentor – consider room shares, module tutors, etc.
- Importance of institutional policies in strengthening teaching communities e.g. student engagement policy, programme redesign principles, research informed learning policy

Developing new **identities**

- Recognise opportunities for building on existing discipline identities as researchers and professionals
- Importance of affirming contribution of ECAs to strengthening practice of programme teams, opportunities to share innovations
- Importance of formal reflection on practice in developing new identities
- Resilience of academic identities, and capacity to learn about teaching based on existing disciplinary identities, even where limited support in programme teams (Bernstein's 'inner dedication'?)

How can this inform development of the Apprenticeship for Academic Professionals?

- Shift focus from centralized programmes to building rich learning environments for academics in departments
- Identify policies that support rich learning communities: Institutional CPD schemes, Peer Support, mentor roles
- Formalise informal practices through requirement to complete a **Learning Plan** with departmental mentors specifying learning opportunities that will be provided in relation to the academic teaching role (UKPSF), including practice learning, opportunities to become part of a community, recognizing and building on existing strengths, e.g. as an early career researcher

Bibliography

- Barnett, R. and Di Napoli, R. (2008) *Changing identities in higher education: Voicing perspectives.* London Routledge.
- Beck, J. and Young, M. (2005) The assault on the professions and the restructuring of academic and professional identities: a Bernsteinian analysis, *British Journal of Sociology of Education 26 (2)* 183-197.
- Bernstein, B. (2000) *Pedagogy, symbolic control and identity: theory, research and critique* (rev edn). Rowman and Littlefield.
- Boud, D. and Brew, A. (2013) "Reconceptualising academic work as professional practice: implications for academic development." *International Journal for Academic Development*, 18 (3) 208-221.
- Delanty, G. (2008) Academic identities and institutional change. In R. Barnett and R. Di Napoli (Eds.), *Changing identities in higher education: Voicing perspectives (pp. 124-133).* Routledge, London.
- Gherardi, S., D. Nicolini and F. Odella (1998) "Towards a social understanding of how people learn in organisations: The notion of situated curriculum." *Management Learning* 29 (3) 273-297.
- Henkel, M. (2000) *Academic identities and policy change in higher education.* Jessica Kingsley, London.
- Henkel, M. (2016) "Multiversities and academic identities: change, continuities and complexities". In L. Leisyte and U Wilkesmann (Eds.) *Organizing academic work: Teaching, learning and identities (pp. 205-223).* Routledge, London.
- Lave, J. and E. Wenger. 1991. *Situated Learning: Legitimate Peripheral Participation.* Cambridge University Press.
- Mathieson, S. (2011) "Developing academic agency through critical reflection: a sociocultural approach to academic induction programmes". International Journal for Academic Development 16 (3) 243-256
- Mathieson, S. (forthcoming) "Recreating academic narratives of research-informed teaching in the context of changes to the research-teaching-practice nexus"
- Roxa, T. and Martensson, K. (2009) Significant conversations and significant networks – exploring the backstage of the teaching arena" *Studies in Higher Education 34 (5)* 547-559.
- Strathearn, M. (Ed.) (2000) Audit Cultures: Anthropological studies in accountability, ethics and the academy (London, Routledge)
- Trowler, P. 2008. *Cultures and Change in Higher Education: Theories and Practice*. Palgrave Macmillan.
- Warhurst, R. (2008) "'Cigars on the flight-deck': new lecturers participatory learning within workplace communities of practice", *Studies in Higher Education* 33 (4) 453-467.

Purpose: Advancing women in engineering

- 30-35% needed to shift a profession's culture from being male-dominated (Fingleton et al, 2014)
- Countries achieving 1/3 women in engineering, manufacturing & construction: Argentina, Estonia, Iceland, Italy, Poland, & Slovenia (OECD, 2013)

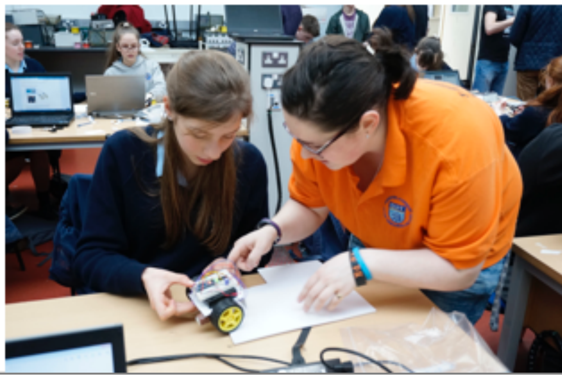
Why: UK & Ireland are far behind

In the UK

- Women =**7% of professional engineers** and <4% of engineering technologists (IET, 2013)
- By age 12, most girls in Britain have started on paths that, by the time they reach 16, will prevent them from studying engineering as undergraduates (Silim & Crosse, 2014)

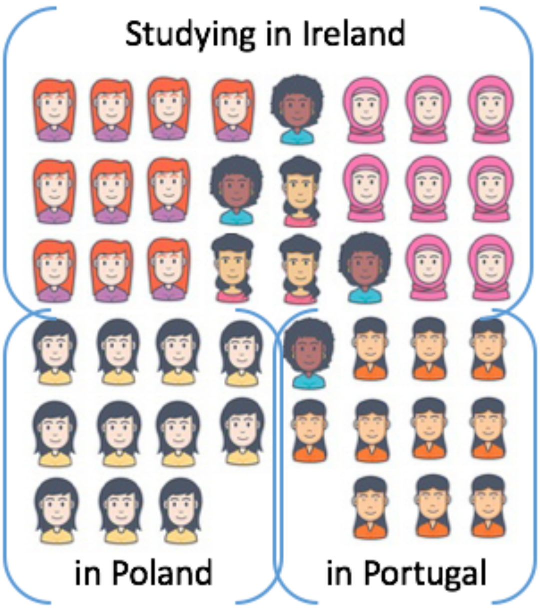
In Ireland

- Women =**9% of professional engineers** (Fingleton et al, 2014)
- A female engineer is half as likely as a male engineer to work in senior management (HRM Recruit, 2013)



What: student experiences

studying engineering in three countries



IRELAND

Studying at Dublin Institute of Technology
Entire cohort entering 4-year B.Eng. in 2014

POLAND

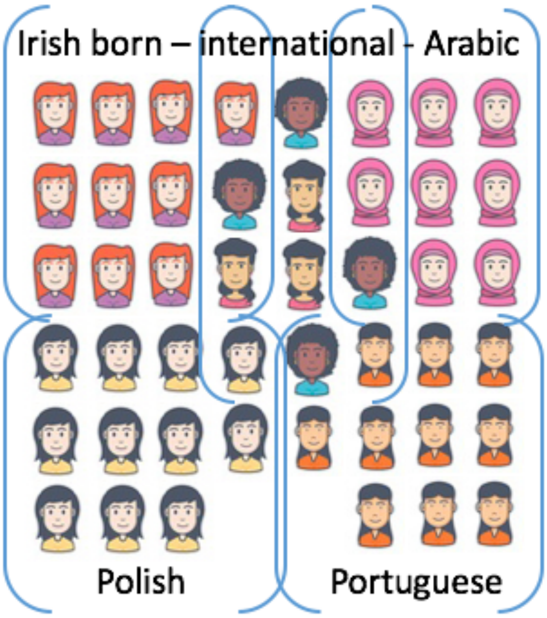
Studying at Polish Universities of Technology
Diverse experience (second year to postgrad)
All successful/volunteers/English speakers

PORTUGAL

Studying at Polytechnic Institute of Setúbal
Volunteers in technical programs at 2nd year

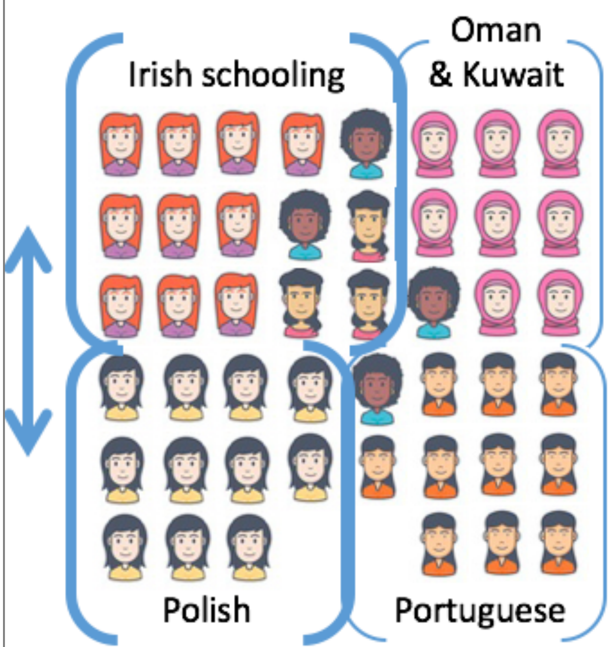
What: student experiences

differences initially detected



What: student experiences

maximum contrast



IRISH SCHOOLING studying at DIT
- 15 schooled in Ireland
- 01 born and schooled elsewhere
- *Entire cohort entering 4-year B.Eng. in 2014*

MIDDLE EAST studying at DIT
- 08 schooled in Oman and Kuwait
- *Entire cohort entering 4-year B.Eng. in 2014*

POLAND most studying at Warsaw Univ. of Tech.
- 12 born and schooled in Poland
- *Diverse experience (second year to postgrad)*
- *All successful/volunteers/English speakers*

PORTUGAL at Polytechnic Institute of Setúbal
- 10 born and schooled in Portugal
- 01 born and schooled elsewhere
- *Volunteers in technical programs at 2nd year*

In Ireland (DIT)

- A majority of participants described going to all-girl schools or very small schools
- No one from an all-girl school mentioned taking physics or engineering at primary level
- Several described taking a stand to get physics for Leaving Cert

In Poland (WUT)

- Most women had attended co-ed schools & selected their high school for its method or content
- Many mentioned encountering physics content in primary AND secondary school
- All had ready access to physics and technology courses in school
- **Today women comprise 37% of students at universities of technology in Poland** (Ślusarczyk & Broniszewska, 2015)

7

Poland, Portugal, Oman & Kuwait reflect

Well-understood paths into undergraduate engineering

- Engineering = all subjects at WUT (in PL)
- Many high schools excel in STEM (in PL)
- Professional tracks appeal to girls (in PT)
- Govt. scholarships & coordination (in ME)

'Physics' in early education helps build interest and confidence among girls

Shared public conceptions of what engineers do

- Unified suite of terms & pathways (in PL)
- Lab internships before HE (in PT at IPS)

Schools & families recommend engineering as a good option (in PL & ME)

Clear, explicit & financial forms of government assistance identified by women in PL, PT & ME to aid the transition into undergraduate STEM

in contrast, Ireland reflects

Less clear pathways from Level 1 to 2 to 3 in engineering & technology

- Definition of engineering is nebulous
- About 1/3 of schools are single-sex (McGuire, 2015)
- Some good STEM activities in Transition Year
- Girls' advisors often lack STEM knowledge

Restricted access to 'physics' & 'engineering' at 1st & 2nd levels

No framework guiding social concepts of

- Life as an engineer
- Threads of STEM across levels 1&2
- Alternative paths into engineering

Peers & schools frequently suggest engineering is unsuitable for females

No dedicated governmental assistance identified by women schooled in Ireland to aid the transition into undergraduate STEM

Initial Findings & Recommendations

In 2008, Poland's Minister for Science & Higher Education implemented an "ordered" suite of majors to streamline the transition into 3rd-level engineering (Ślusarczyk & Broniszewska, 2015)

Today, the public conceptualizes a wide array of subjects as "engineering" and has a broad concept of "physics"

A similar policy stance in Ireland could help open the pipeline for women into engineering programs, providing:

- **Clearer branding of school activities** as engineering & physics (and depictions of careers in engineering & physics)
- **Increased access** to engineering & physics coursework in high school (Leaving Cert)
- **Clearer pathways into 3rd level STEM** courses, including increased visibility of alternative routes that don't require physics

Polish Women Described

- Schooling
  - Physics activities in middle & high school
  - Open access to diverse high schools
  - A clear path into technical university
- Good experiences in university
  - Most enrolled in male-dominated majors/courses
  - Few group projects & no instruction on how to work in teams
  - Females often providing organizational & leadership skills
  - Earned the confidence of teachers & peers (few doubters)
  - Balanced gender bias (isolated problems, ample opportunities)
- Difficulty entering industry
  - Getting in the door
  - Getting assigned challenging tasks
- Emerging success in industry
  - Start-ups, institutes, service technician
- Lack of 'go-to' people & mentors
  - Plans to address this were evident in Perspektywy Education Foundation

Thanks!

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I thank the European Union's FP7 and H2020 programs for supporting this project with a Marie Skłodowska-Curie Actions. I am also indebted to: Brian Bowe, Mike Murphy, Pamela Eddy, & Frank Daly for reviewing content; Bill Williams & Bianka Siwinska for assistance setting up interviews in Portugal & Poland; & Raquel Barreira, Michael Carr, Tais Carvalho, & Ivan Garcia for assistance with translation.

References

- Fingleton, A., Loughanme, M., McGuinness, L., & McKenna, K. (Oct. 2014). Towards Gender Balance in Engineering - UCD. Dublin, Ireland: University College Dublin.
- HRM Recruit. (2013). Engineering perspectives: A report on the careers of and challenges facing engineers in Ireland in 2013. Dublin, Ireland: Engineers Ireland.
- Institute of Engineering and Technology [IET]. (2013). *Skills and Demand in Industry: Annual Survey 2013*. Stevenage. http://www.theiet.org/factfiles/education/skills2013-page.cfm?type=pdf
- McGuire, P. (2015). Gender imbalances in the classroom – and all the way up. The Irish Times. Retrieved 5 May 2016 from http://www.irishtimes.com/news/education/gender-imbalances-in-the-classroom-and-all-the-way-up-1.2067438
- OECD (2013), Education at a Glance 2013: OECD Indicators, OECD Publishing. http://dx.doi.org/10.1787/eag-2013-en
- Silim, A., & Crosse, C. (Sept. 2014). *Women in engineering: Fixing the talent pipeline*. London: Institute for Public Policy Research.
- Ślusarczyk, B., & Broniszewska, A. (2015). Evidence from Poland on women in engineering education. *Global Journal of Engineering Education, 17*(1).

Experience in a Co-Ed School

We tried [Technical Graphics] in 1st year for 2 or 3 weeks, and I loved it. I was very young then. I was 11. ... It was... very basic, but I was like, "Okay, I'm good at this. **I can do this**. I'm going to take this."

So... for the next 2 years... I just took [Technical Graphics] and then it went very well. ...**it was a subject I enjoyed** and I was really comfortable with. So I would look forward to going to school, just because of this class.

Experience in an All-Girls School

TAKING A STAND

[I don’t have] a full idea [about what engineers do], because I went to an all-girls school. So I wanted to do subjects like engineering, metal work, tech craft, and all that stuff. But it **just wasn't offered**...

Physics wasn't actually going to be offered. There were only two girls doing Physics in my year... and **we had to do our own hours**. Like, extra hours, because **the school just wouldn't provide**. They were like, "There's not enough people doing it.” ...

The subjects... offered in the Leaving Cert [were]: history, music, home ec., geography, accounting, business. ...

And so, **our Physics teacher**... he **offered to do it out of his own hours**, as well. So, that was it. That's how the problem was solved.

...and **I was really into Physics. I loved it. I thought it was really fun. It... really made me do engineering.**

SOCIAL PERCEPTIONS

in secondary school... **when we were asked, "What are you going to do?”... I was like, "I'm going to do engineering." And they were like "Are you serious?"** And then I’m like, "Yeah, why?"

And they said, "Because, you've gone to an all-girls school." ... **"Being at an all-girls school, practically all through your life, do you think it's not going to be a big change?"**

BIGGEST CHANGE

I think it's just, the whole experience of moving to a course [where] there's mostly guys. Because that's… **probably the biggest change for me…transitioning from secondary school to college.** Because **I was surrounded by girls -- so many girls! And then moving here,** and **it's all guys.**

DEVELOPING CONFIDENCE

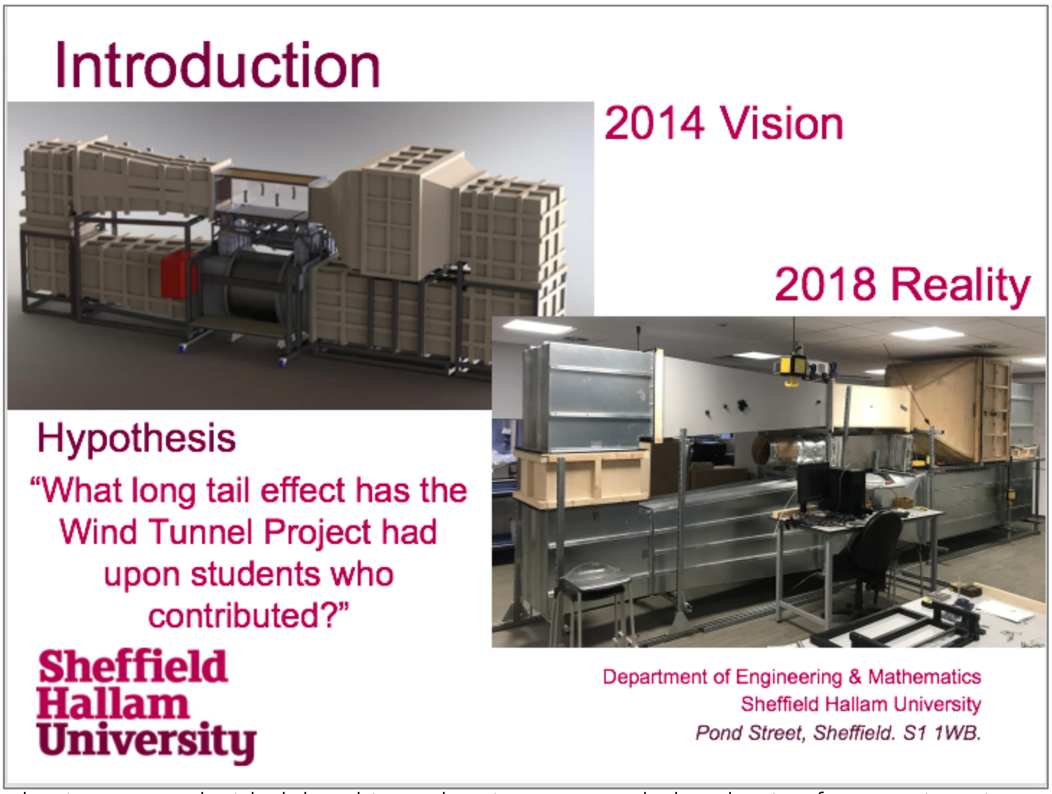
I think when we're doing group work and you can see that people are really taking into account your opinions…. They're not just brushing you off or saying, "Yeah, she's saying that." But they're actually taking into account what you're saying, **and you can see them applying it. It kind of makes you feel prideful…. And even it's seen in my labs -- like I'm the only girl there, everyone else is guys.** I guess when we're doing stuff and they ask for help. And then I ask for help, and then **everyone kind of helps each other,** I think that's like -- and I've never actually in lab -- **I've never felt like I was pushed to the side, or by myself.**

I think it was the first or **second week of RoboSumo. I was in charge of the programming and the coding and I was one of the first people to get the robot to move. So, when I got that done everyone was like, "How did you do that? Can you show us? Can you explain to us?"** So, obviously I felt kind of accepted.

I realized that many of the female participants in Ireland had taken a stand to overcome barriers. Then I wondered:

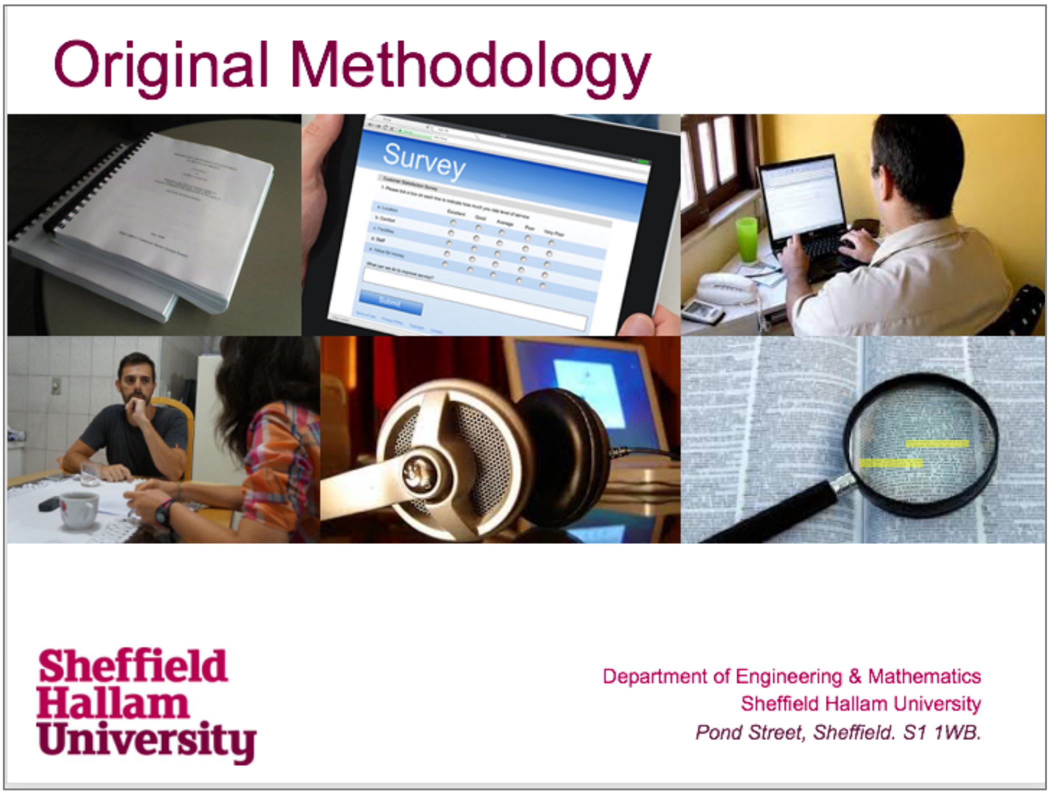
What about all the others who faced resistance & didn't take a stand?

How many had interest & ability, but we lost them because they didn't challenge the prevailing sentiment, or didn't succeed with their pleas for relevant Leaving Cert courses?



This academic year we decided that this student journey needed evaluating from engineering education perspective. The project has drawn from Mechanical, Aerospace and Electronic and Electrical Engineering, therefore presented theory opportunity for students to work in interdisciplinary teams each academic year in developing this project further, each academic year progressing from theoretical design, to procurement, to prototype builds, to actual part fabrication, to complete assembly to implementation and testing. Each group only participating in snap shot in time on long and large project.

To evaluate the impact the project has had on the students:
learning and engineering application, technical skills development, employability skills development, graduate employment (DLHE) and future employment prospects, contribution to current employers, personal perspective of project value.



Quantitative Methods: Likert and Short Answer Survey,
Qualitative Methods: Email open questions, Semi-structured interviews (Cohen & Crabtree, 2006)
Employed researcher to minimise research bias,
Codified for common themes to research questions

Preliminary results

a) Initial consultation with current students

b) Interview oriented to evaluate:

Role
Reason to join
Learnings and skills
Remarkable experiences
"Would you recommend the project?"

c) Face to face interviews

d) Highlights

Skills to develop
Experiences related to time and team management
Correlation of simulation to real context
Individual goals are group goals

e) Next steps

Modify interviews

Sheffield Hallam University

Department of Engineering & Mathematics
Sheffield Hallam University
Pond Street, Sheffield. S1 1WB.

Conclusions

Opportunities

- Pilot study advantages
- Contact with alumni
- Identify employment prospects
- Involvement of student researcher
- Test and redesign research methodology
- Inform curriculum design

Challenges

- Ethics regulations regarding experimental documentation surveys
- Data protection act
- Contact with alumni
- Number of student responses

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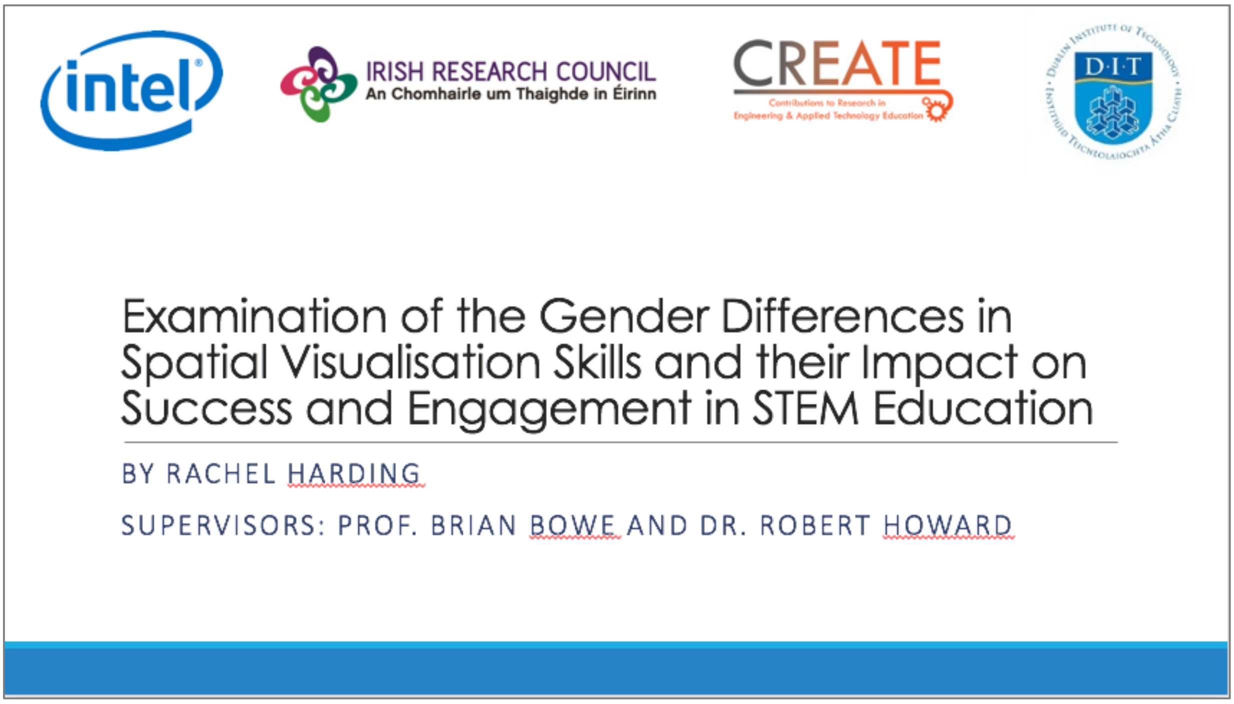
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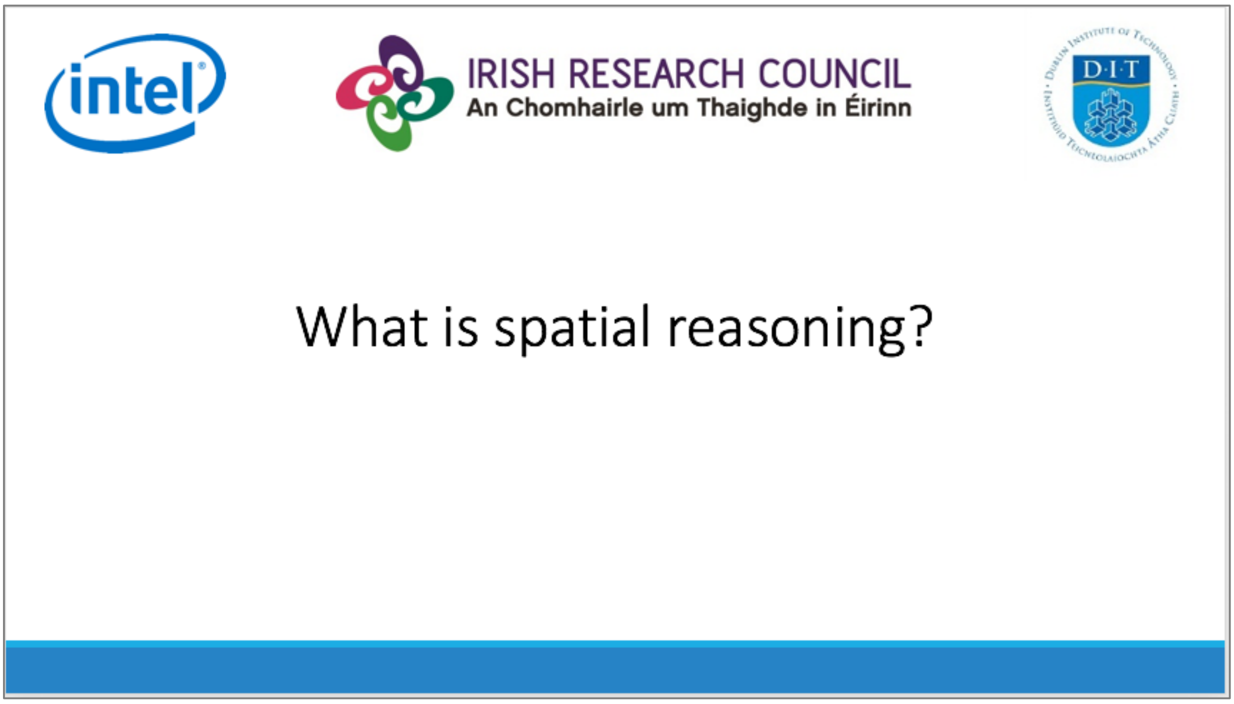
An Chomhairle um Thaighde in Éirinn
CREATE
D·I·T
Examination of the Gender Differences in Spatial Visualisation Skills and their Impact on Success and Engagement in STEM Education
BY RACHEL HARDING
SUPERVISORS: PROF. BRIAN BOWE AND DR. ROBERT HOWARD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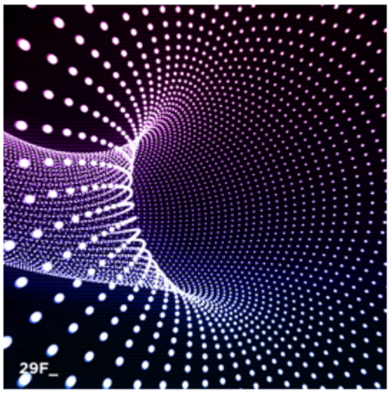
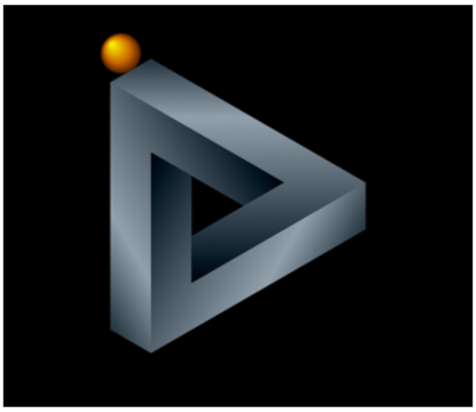
D·I·T
What is spatial reasoning?

Spatial reasoning



- Spatial Skills
- Spatial Visualisation Skills
- Spatial Abilities

Spatial reasoning



- Understand and remember the spatial relations between objects.
- Mentally manipulate 2-D and 3-D objects.
- Recognise the identity of an object when it is seen from different angles.
- Imagine the movement or internal displacement among parts of a configuration.
- It is necessary to understand the visualisation of complex phenomena.
- Unique type of intelligence that can be developed.

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Why is it important?

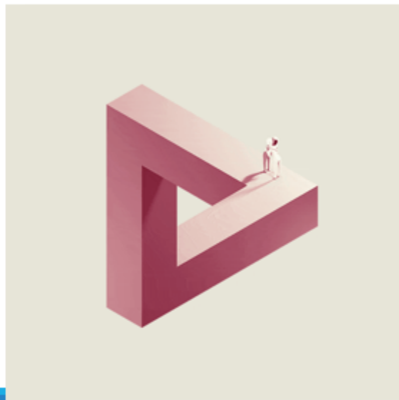
Spatial skills have been linked with abilities in STEM education and to creativity and innovation.

In 2010, the National Science Board (NSB) in the USA stated that STEM talent has always been sought among those who have high verbal and math skills, but that this should be expanded to include those with high spatial ability.

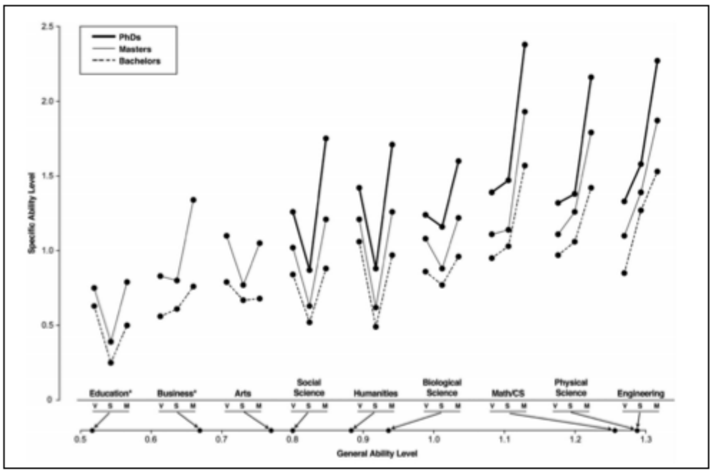
A landmark study in the US tracked 400,000 students over a 30 year period.

The study found that "A child's spatial skills level is a better predictor of STEM attainment than their math skill level in 7th grade."

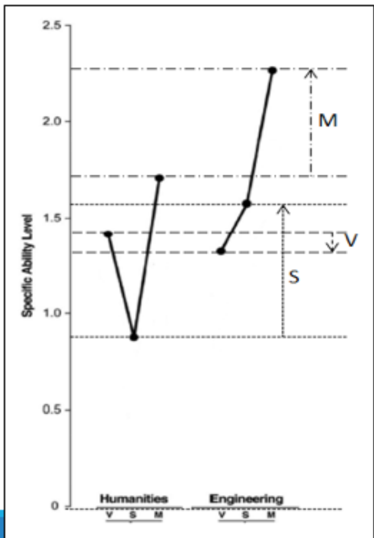
Wai, Lubinski, & Benbow, 2009



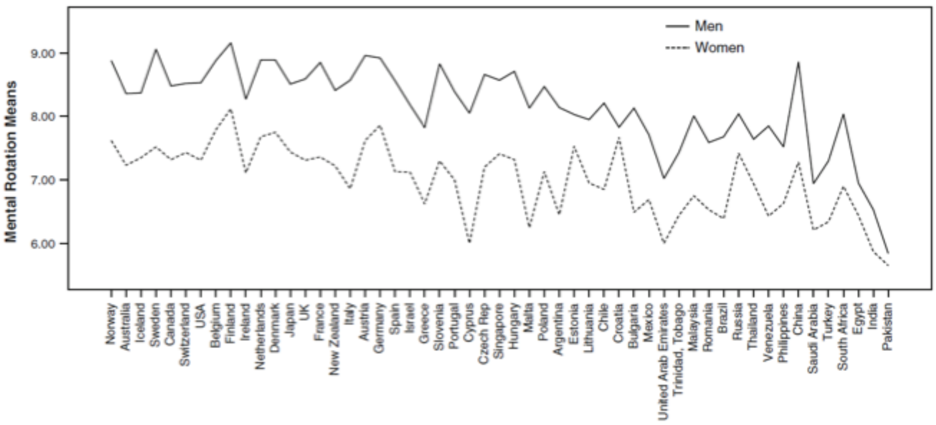
Spatial ability correlates with success in STEM education



HSS Vs. STEM aptitude profile



Gender differences is spatial ability



Research Objectives

Overall Aim

To investigate the role spatial skills play in determining secondary school students' perceptions of STEM subjects and determine their impact on academic success in STEM education, with a focus on the link with mathematics

Objectives:

- Measure the spatial skills of approx. 30,000 second level students (first to sixth year);
- Collect demographic and profile data through surveys;
- Collect perception, attitudes and approaches to learning data through surveys and interviews;
- Identify relationships between spatial skills and data pertaining to demographics, profile, subject choice, subject level, higher education discipline choice and assessment results;
- Identify the impact different STEM subjects have on the development of spatial skills, and subsequently on abilities in other subjects;
- Introduce spatial skills courses into transition year and evaluate the impact on the students' spatial skills, perceptions, approaches to learning and attitudes;
- Development of tests and learning resources for primary school.

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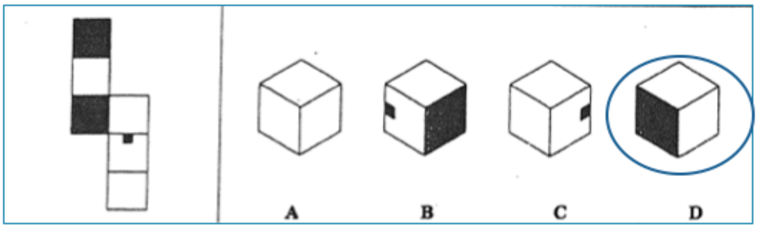
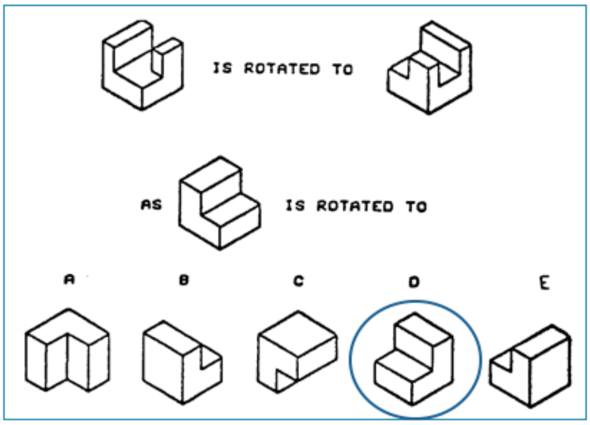
How do we test spatial ability?

Spatial Skills Tests:

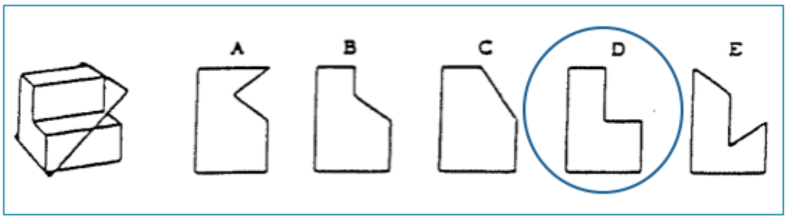
Differential Aptitude Test: Space Relations (DAT:SR)



Purdue Spatial Visualization Test: Rotations (PSVT:R)



Mental Cutting Test (MCT)



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Results to Date

- Tested 1st year students in second level.
- Approximately 2500 students participated in the research across 28 schools.
- Same test given to students of the same age in USA and Australia.
- Piloted a Spatial Skills Course in 7 selected secondary schools.

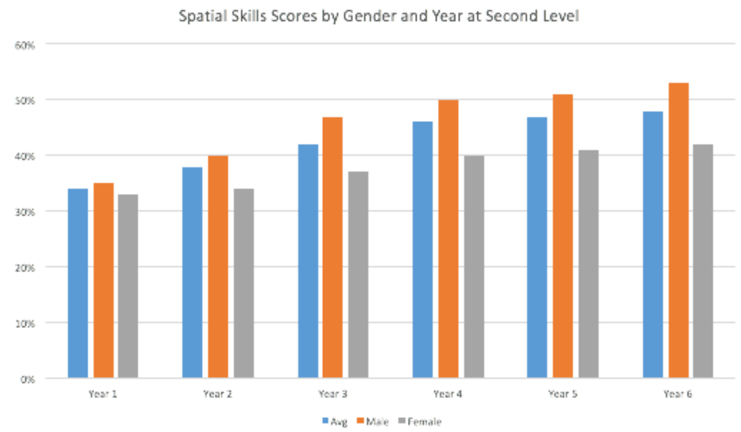

National Spatial Skills Project - Preliminary Findings of Phase One

SPACE
Spatial Ability in Education

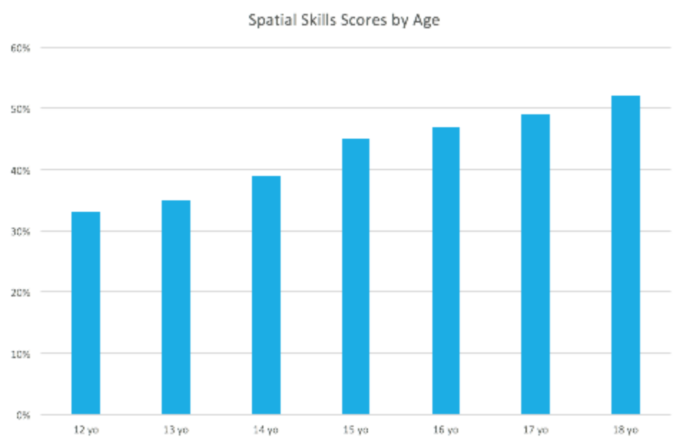
Professor Brian Bowe
Edmund Nevin
Darren Carthy
Dr Niall Seery
Professor Sheryl Sorby

June 2016

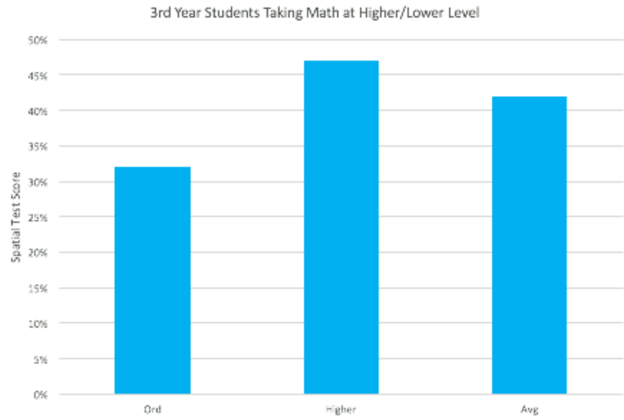
Preliminary Data for spatial skills score of 4509 students from first to sixth year by gender and year



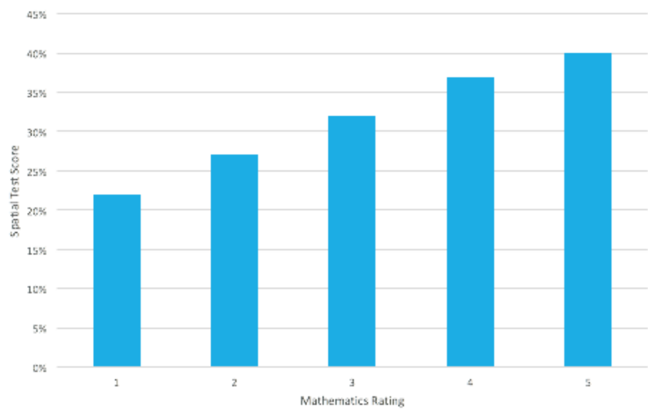
Preliminary Data for spatial skills score of 4509 students from first to sixth year by age



Preliminary Data for spatial skills score of third year students by level of mathematics taken



Preliminary Data for spatial skills score of 4509 students by mathematics rating

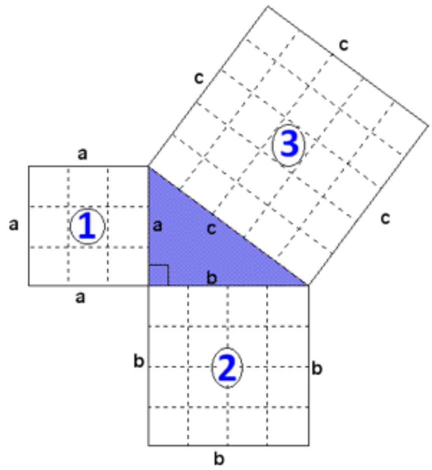


A Particular Focus on the link between Spatial Ability and Mathematics

Research Questions:

- How could a spatially oriented mathematics curriculum be designed for Secondary/Primary level?
- What effect would this new mathematics course have on Secondary/Primary students' spatial ability?

Pythagoras' Theorem as an Example



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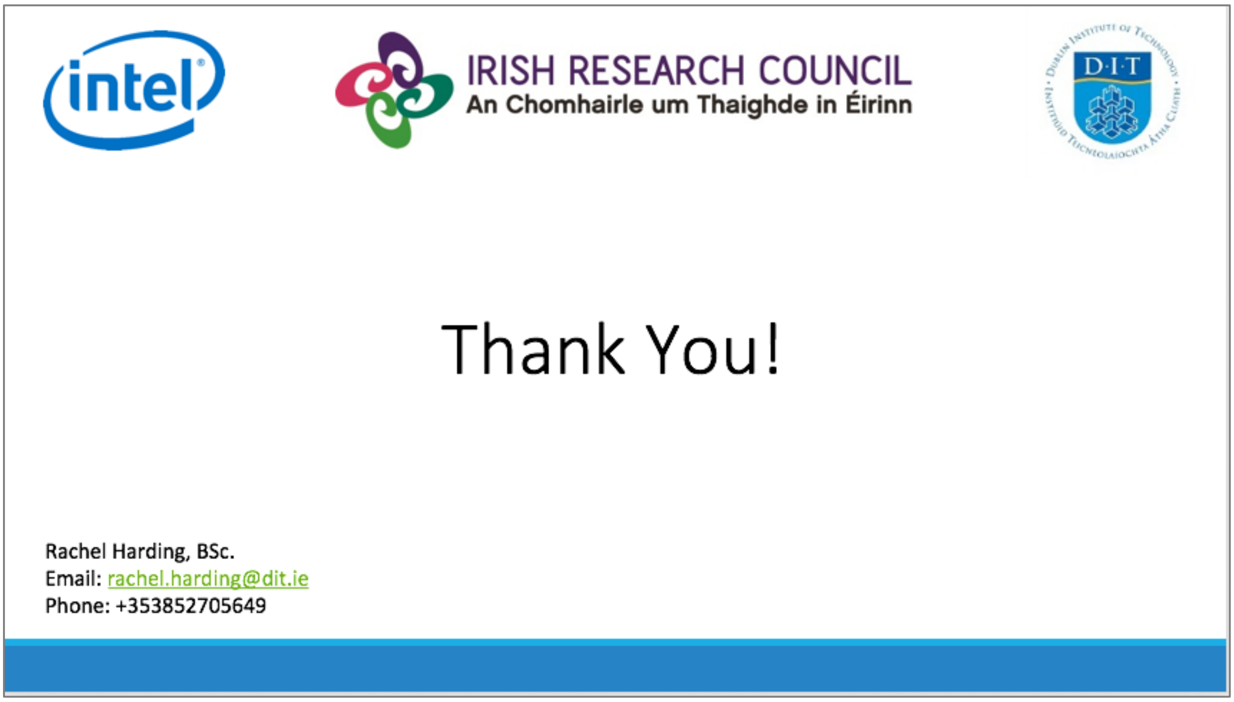
An Chomhairle um Thaighde in Éirinn

Enterprise PhD Project Funded by the Irish Research Council and Intel Ireland Under the EPS Scheme

The project is also supported by:

- PDST – Professional Development Service for Teachers
- NSSRN – National Spatial Skills Research Network, funded by the IRC
- Prof. Sheryl Sorby (Ohio State University)


IRISH RESEARCH COUNCIL
An Chomhairle um Thaighde in Éirinn
Thank You!
Rachel Harding, BSc.
Email: rachel.harding@dit.ie
Phone: +353852705649

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Blending Theory, Software and Practice: An Elemental Shift in Engineering Education

Matthew Blacklock

Senior Lecturer, Mechanical & Construction Engineering
Northumbria University

Motivation & Key Outcomes

Student Learning

Traditional/Previous		Blended
54%	Average Module Result	64%
4%	HD Students (≥80%)	22%
32%	Fail Students (<50%)	13%

Observations

Traditional/Previous	Blended
Basic lack of understanding	Improved deeper understanding
Rote learn questions & answers	Learn theory to solve range of problems

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Motivation & Key Outcomes

Student Satisfaction

Traditional/Previous		Blended
72%	Good Teaching Scale	86%
64%	Overall Satisfaction Index	87%
~25%	Attendance	~90%

Observations

Traditional/Previous	Blended
Students not engaged in class	Much improved engagement
Poor feedback mechanisms	Increased timely feedback

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Motivation & Key Outcomes

Student Satisfaction

"Lectures are a bit daunting with large equations....more examples and practice question. Smaller practice questions that eventually lead up to the full thing."

"Most of the time, the lecturers read off the lecture slides without explaining key concepts in detail."

"More problem solving during lecture."

"I like the way it is in the tutorial time. I really learn something.

"The tutorial session is good."

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Motivation & Key Outcomes

Life-long Learning

Self-regulated Learning

Communication

Key Skills for Employability

Problem Solving

Critical Thinking

Observations

Inability to solve unseen problem

Inability to work through problems

Ability to tackle a range of seen and unseen problems and communicate ideas with others

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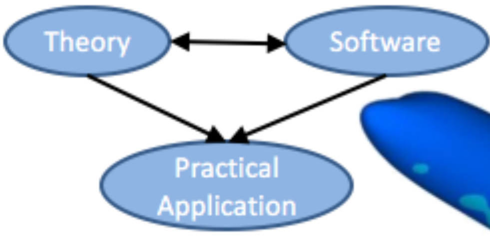
Module Taught

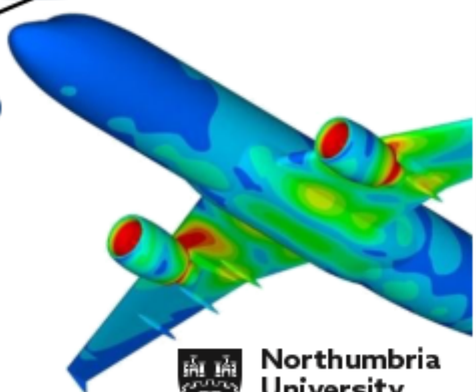
Aerospace Finite Element Methods

- Third year Aerospace Engineering students at RMIT
- Class size: 100-130 students

$$K = \begin{bmatrix} EA/L & 0 & 0 & -EA/L & 0 & 0 \\ 0 & 12EI/L^3 & 6EI/L^2 & 0 & -12EI/L^3 & 6EI/L^2 \\ 0 & 6EI/L^2 & 4EI/L & 0 & -6EI/L^2 & 2EI/L \\ -EA/L & 0 & 0 & EA/L & 0 & 0 \\ 0 & -12EI/L^3 & -6EI/L^2 & 0 & 12EI/L^3 & -6EI/L^2 \\ 0 & 6EI/L^2 & 2EI/L & 0 & -6EI/L^2 & 4EI/L \end{bmatrix}$$



- Accuracy
- Efficiency
- Real-world applications



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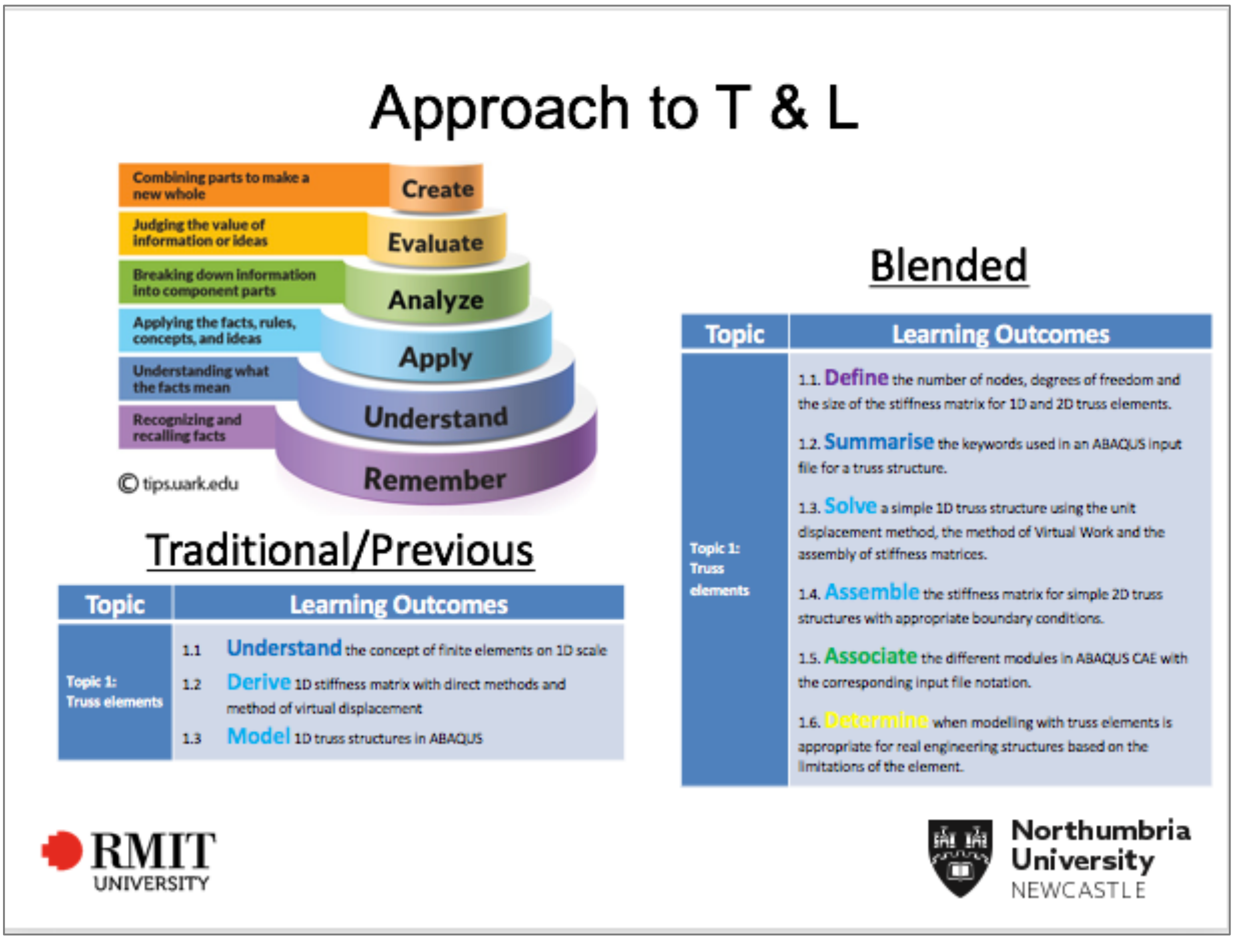
Approach to T & L
Combining parts to make a new whole
Create
Judging the value of information or ideas
Evaluate
Breaking down information into component parts
Analyze
Applying the facts, rules, concepts, and ideas
Apply
Understanding what the facts mean
Understand
Recognizing and recalling facts
Remember
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Traditional/Previous
Topic
Learning Outcomes
Topic 1: Truss elements
1.1 Understand the concept of finite elements on 1D scale
1.2 Derive 1D stiffness matrix with direct methods and method of virtual displacement
1.3 Model 1D truss structures in ABAQUS
Blended
Topic
Learning Outcomes
Topic 1: Truss elements
1.1. Define the number of nodes, degrees of freedom and the size of the stiffness matrix for 1D and 2D truss elements.
1.2. Summarise the keywords used in an ABAQUS input file for a truss structure.
1.3. Solve a simple 1D truss structure using the unit displacement method, the method of Virtual Work and the assembly of stiffness matrices.
1.4. Assemble the stiffness matrix for simple 2D truss structures with appropriate boundary conditions.
1.5. Associate the different modules in ABAQUS CAE with the corresponding input file notation.
1.6. Determine when modelling with truss elements is appropriate for real engineering structures based on the limitations of the element.
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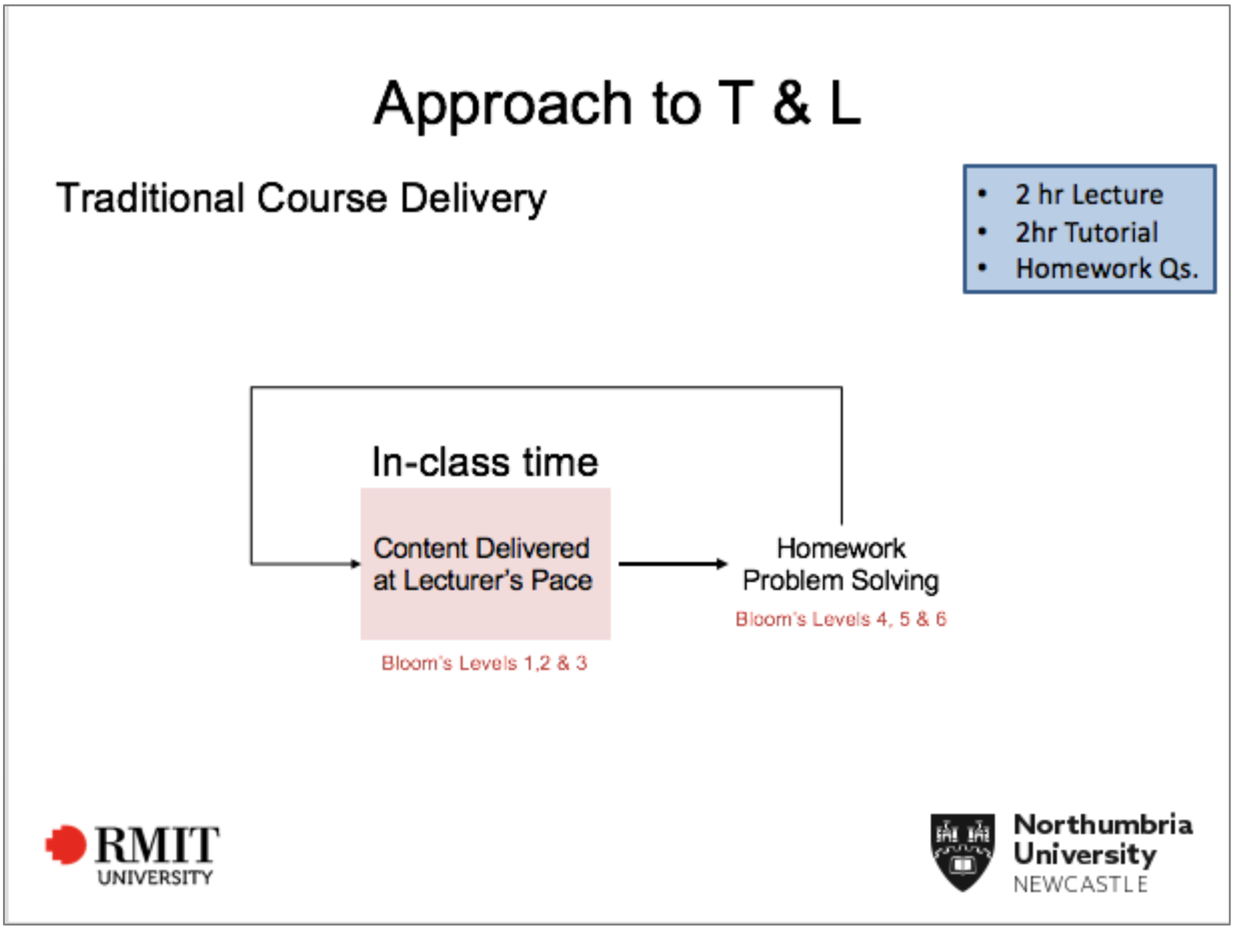
Approach to T & L
Traditional Course Delivery
• 2 hr Lecture
• 2hr Tutorial
• Homework Qs.
In-class time
Content Delivered at Lecturer's Pace
Bloom's Levels 1,2 & 3
Homework Problem Solving
Bloom's Levels 4, 5 & 6
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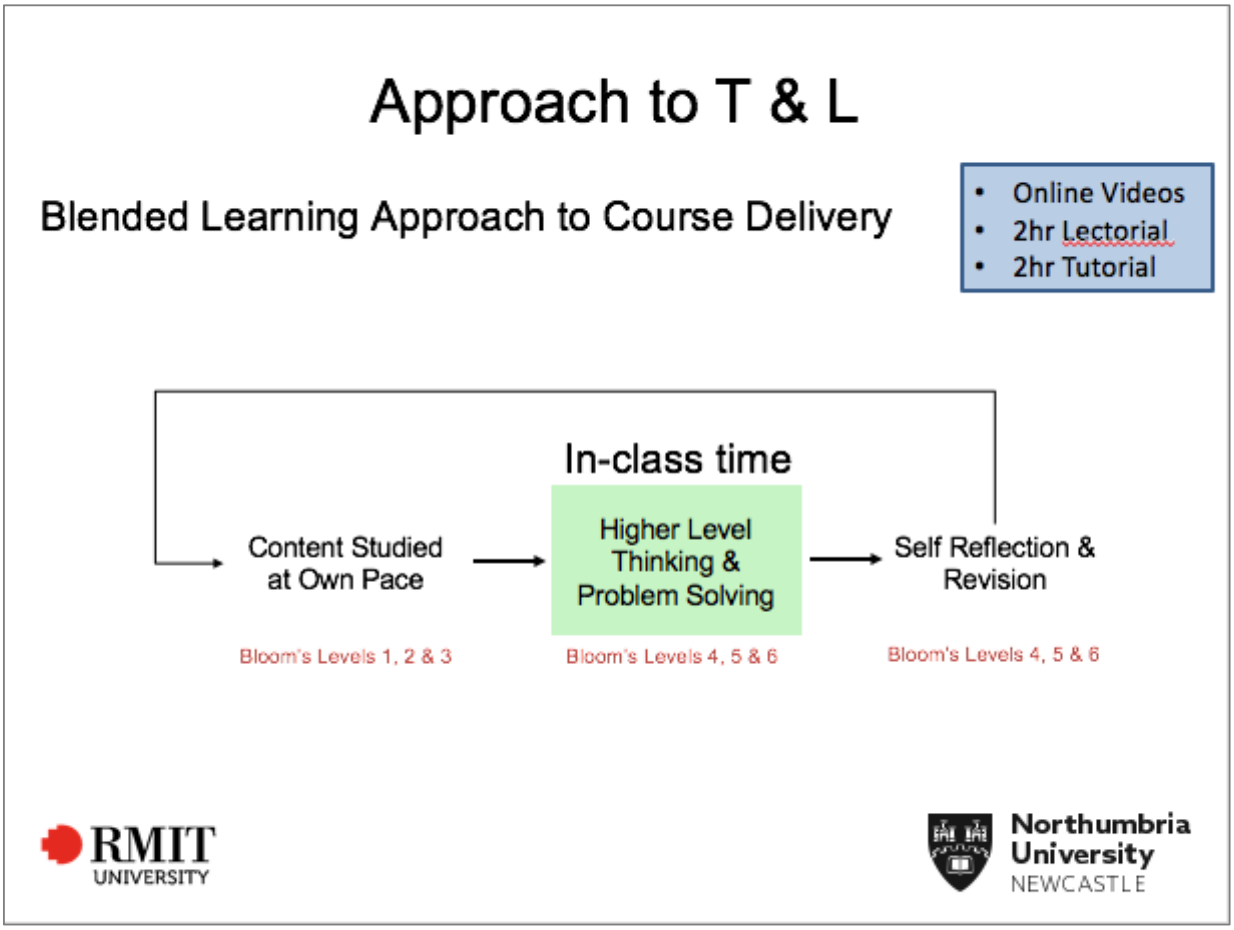
Approach to T & L
Blended Learning Approach to Course Delivery
Online Videos
2hr Lectorial
2hr Tutorial
In-class time
Content Studied at Own Pace
Higher Level Thinking & Problem Solving
Self Reflection & Revision
Bloom's Levels 1, 2 & 3
Bloom's Levels 4, 5 & 6
Bloom's Levels 4, 5 & 6
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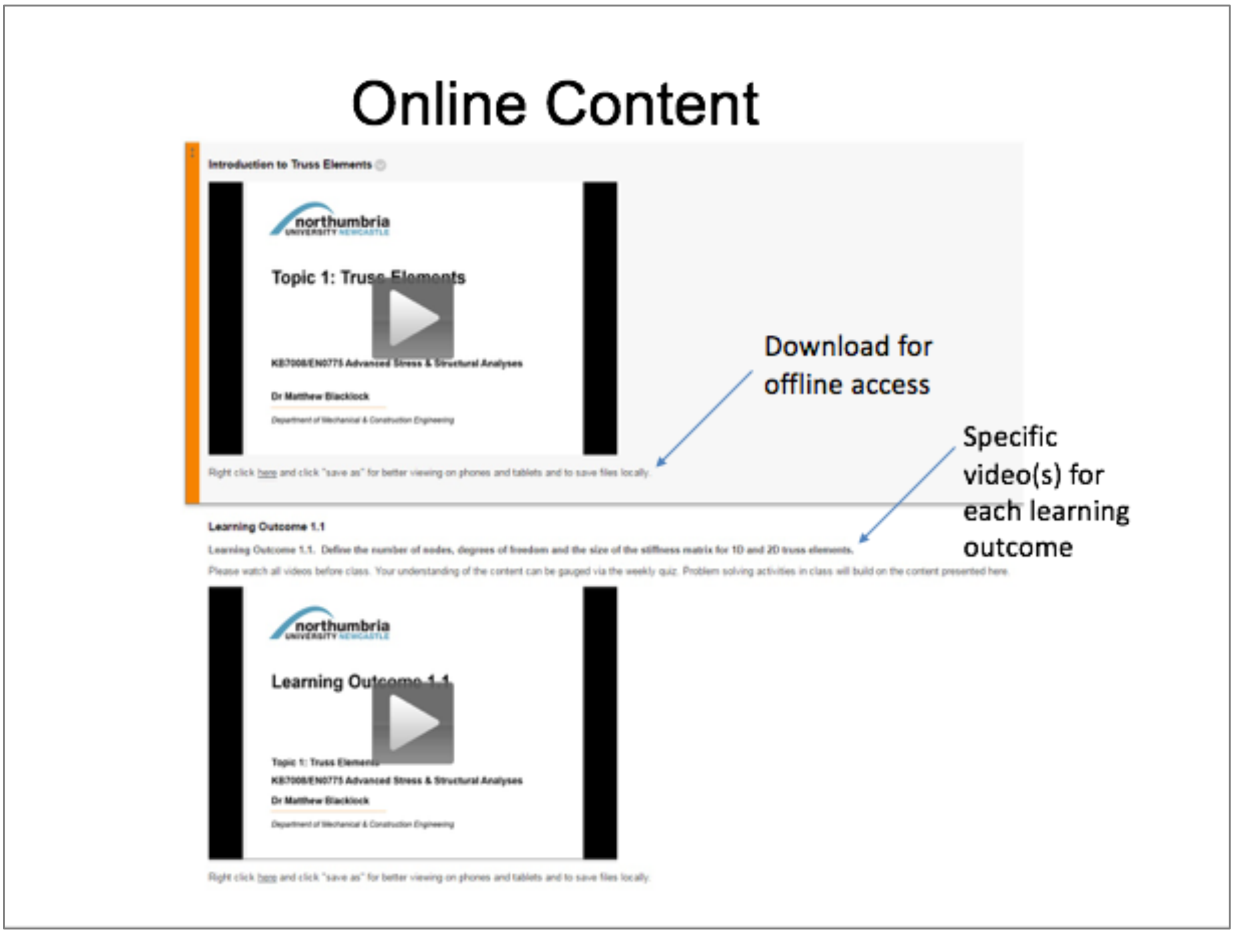
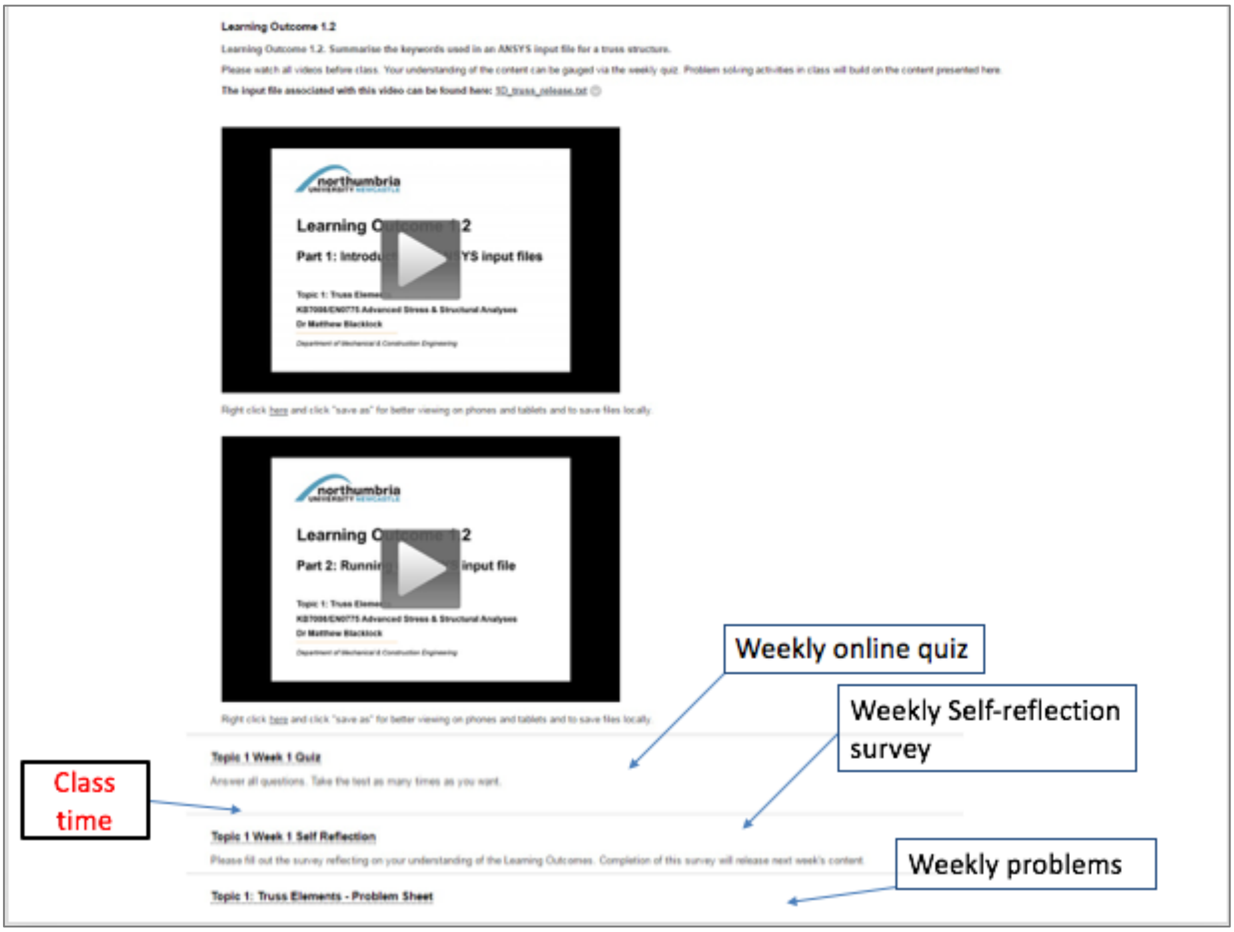

Online Content
Introduction to Truss Elements
northumbria UNIVERSITY NEWCASTLE
Topic 1: Truss Elements
Dr Matthew Blacklock
Download for offline access
Right click here and click "save as" for better viewing on phones and tablets and to save files locally.
Specific video(s) for each learning outcome
Learning Outcome 1.1
Learning Outcome 1.1. Define the number of nodes, degrees of freedom and the size of the stiffness matrix for 1D and 2D truss elements.
Please watch all videos before class. Your understanding of the content can be gauged via the weekly quiz. Problem solving activities in class will build on the content presented here.
northumbria UNIVERSITY NEWCASTLE
Learning Outcome 1.1
Dr Matthew Blacklock
Right click here and click "save as" for better viewing on phones and tablets and to save files locally.



Approach to T & L

Feedback

Traditional/Previous

- Limited In-class
- Assessment grades
- Assignment comments

Blended

- Extensive In-class
- Assessment grades
- Assignment comments
- Weekly quiz
- Self Reflection Survey
- Personalised relative to LOs

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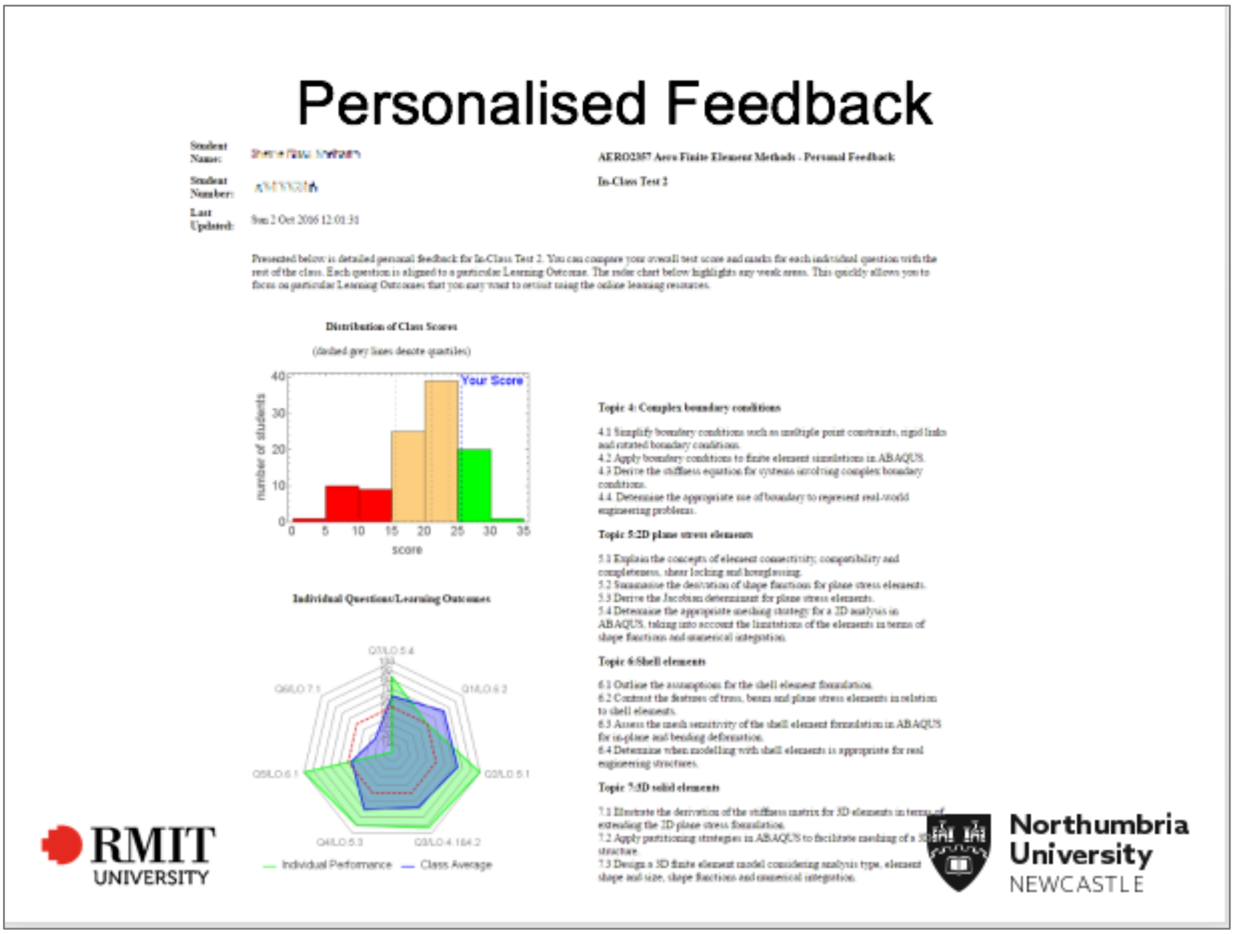
Personalised Feedback
AERO2357 Aero Finite Element Methods - Personal Feedback
In-Class Test 2
Distribution of Class Scores
Your Score
number of students
score
Individual Questions/Learning Outcomes
Individual Performance
Class Average
Topic 4: Complex boundary conditions
Topic 5: 2D plane stress elements
Topic 6: Shell elements
Topic 7: 3D solid elements
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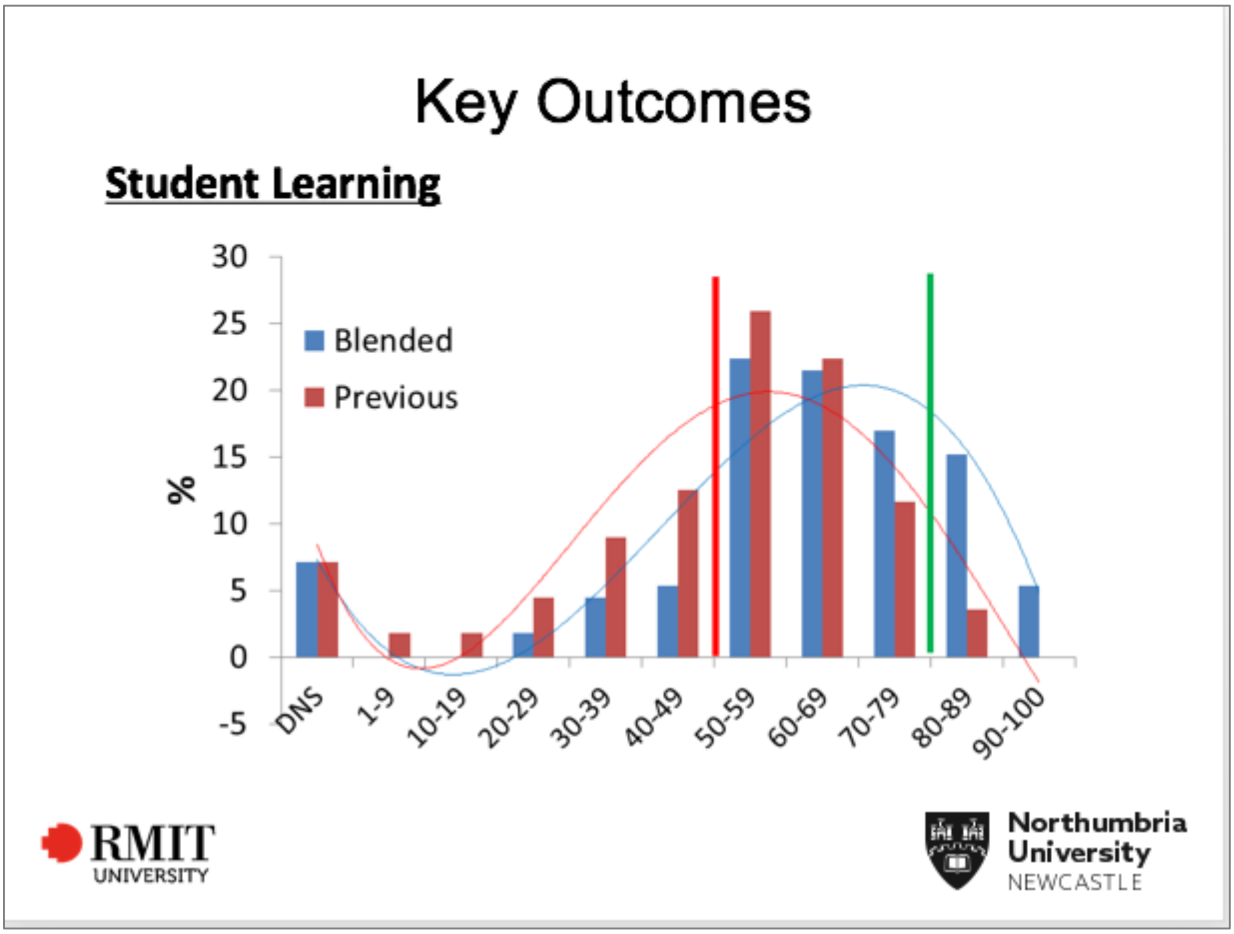
Key Outcomes
Student Learning
Blended
Previous
%
30
25
20
15
10
5
0
-5
DNS
1-9
10-19
20-29
30-39
40-49
50-59
60-69
70-79
80-89
90-100
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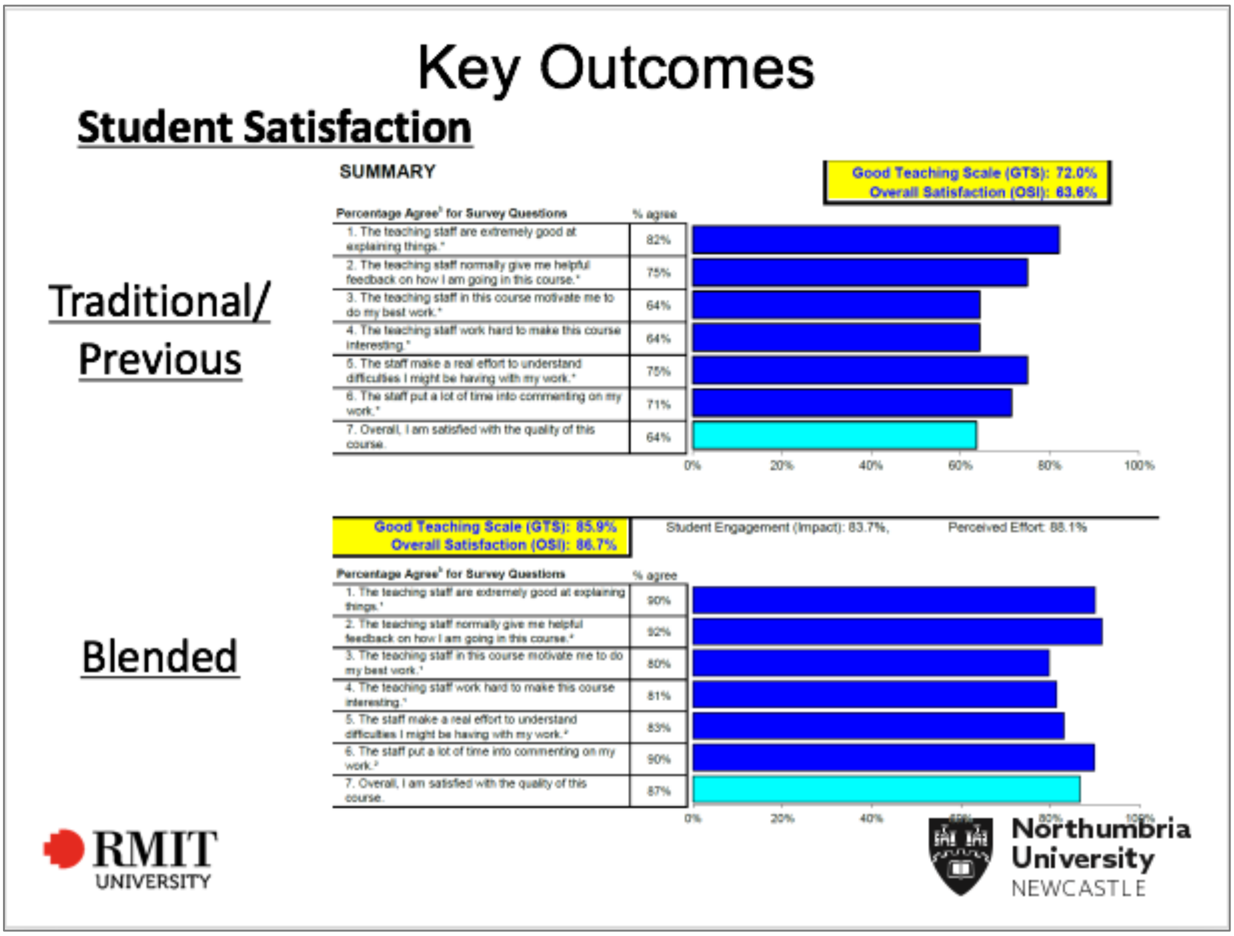
Key Outcomes
Student Satisfaction
Traditional/ Previous
SUMMARY
Good Teaching Scale (GTS): 72.0%
Overall Satisfaction (OSI): 63.6%
Percentage Agree for Survey Questions
% agree
1. The teaching staff are extremely good at explaining things.* 82%
2. The teaching staff normally give me helpful feedback on how I am going in this course.* 75%
3. The teaching staff in this course motivate me to do my best work.* 64%
4. The teaching staff work hard to make this course interesting.* 64%
5. The staff make a real effort to understand difficulties I might be having with my work.* 75%
6. The staff put a lot of time into commenting on my work.* 71%
7. Overall, I am satisfied with the quality of this course. 64%
0% 20% 40% 60% 80% 100%
Blended
Good Teaching Scale (GTS): 85.9%
Overall Satisfaction (OSI): 86.7%
Student Engagement (Impact): 83.7%,
Perceived Effort: 88.1%
Percentage Agree for Survey Questions
% agree
1. The teaching staff are extremely good at explaining things.* 90%
2. The teaching staff normally give me helpful feedback on how I am going in this course.* 92%
3. The teaching staff in this course motivate me to do my best work.* 80%
4. The teaching staff work hard to make this course interesting.* 81%
5. The staff make a real effort to understand difficulties I might be having with my work.* 83%
6. The staff put a lot of time into commenting on my work.* 90%
7. Overall, I am satisfied with the quality of this course. 87%
0% 20% 40%
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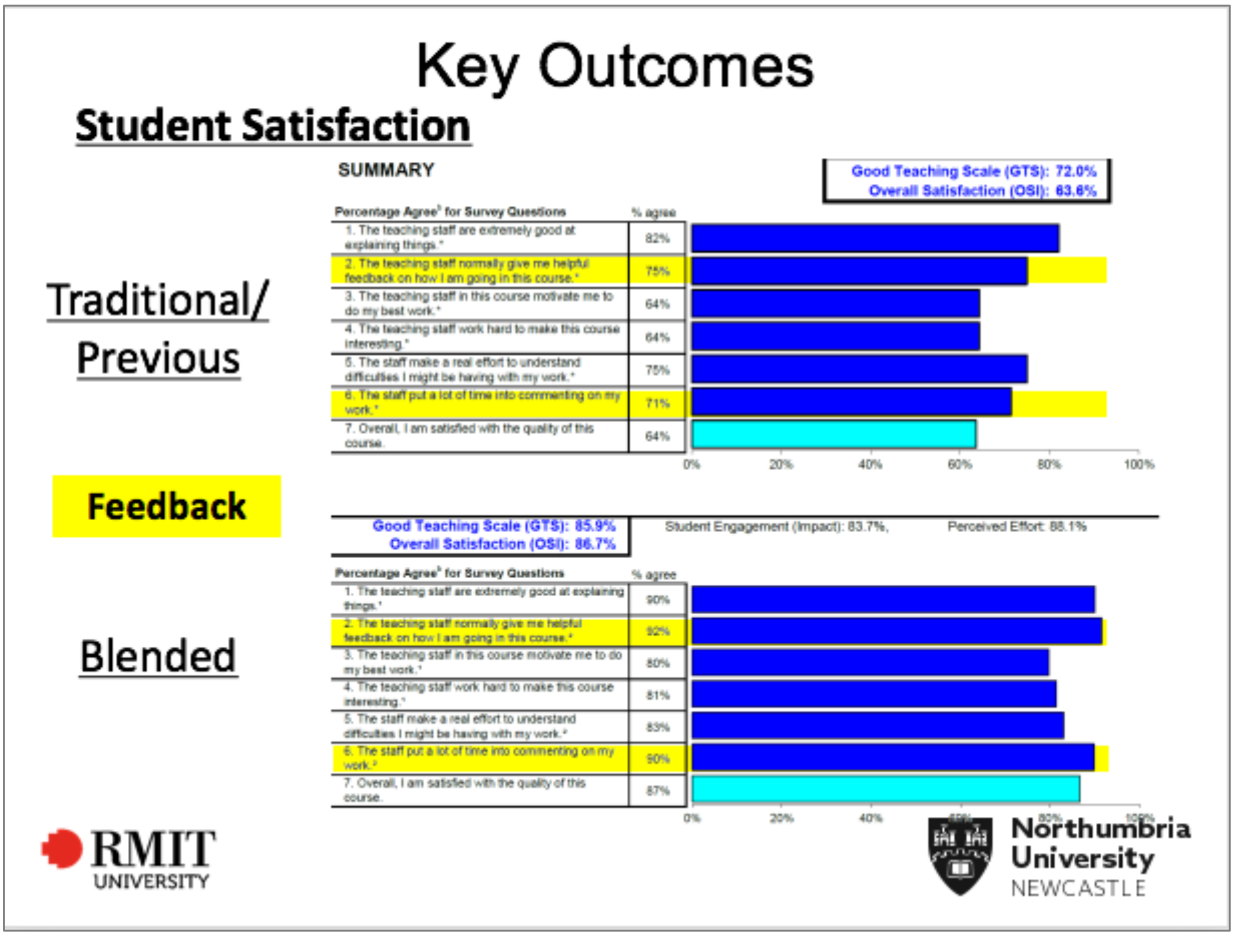
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Feedback
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0% 20% 40% 60% 80% 100%
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6. The staff put a lot of time into commenting on my work.* 90%
7. Overall, I am satisfied with the quality of this course. 87%
0% 20% 40%
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Key Outcomes

Student Satisfaction

"Greatly enjoy the new teaching method. I believe it works really well. Definitely utilises lecture times efficiently. Quick feedback response."

"Induces actual learning instead of just learning for exams then forgetting after."

"I feel I have learned something truly appropriate to industry."

"Huge improvement from last year. Love the new teaching method... I might even say that I'm glad I failed the subject last year."

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Key Outcomes

Student Feedback – Focus Group

- Some students preferred video style. Some did not.
- Students are very aware of the need to develop key skills.
- Students very happy with level of feedback.
- Students happy because they see you are willing to change

Potential Issues

- Effort required to set up
- Engaging students in large class/lecture hall
- Ensuring students study material before class
- Lots of changes. Difficult to quantify.

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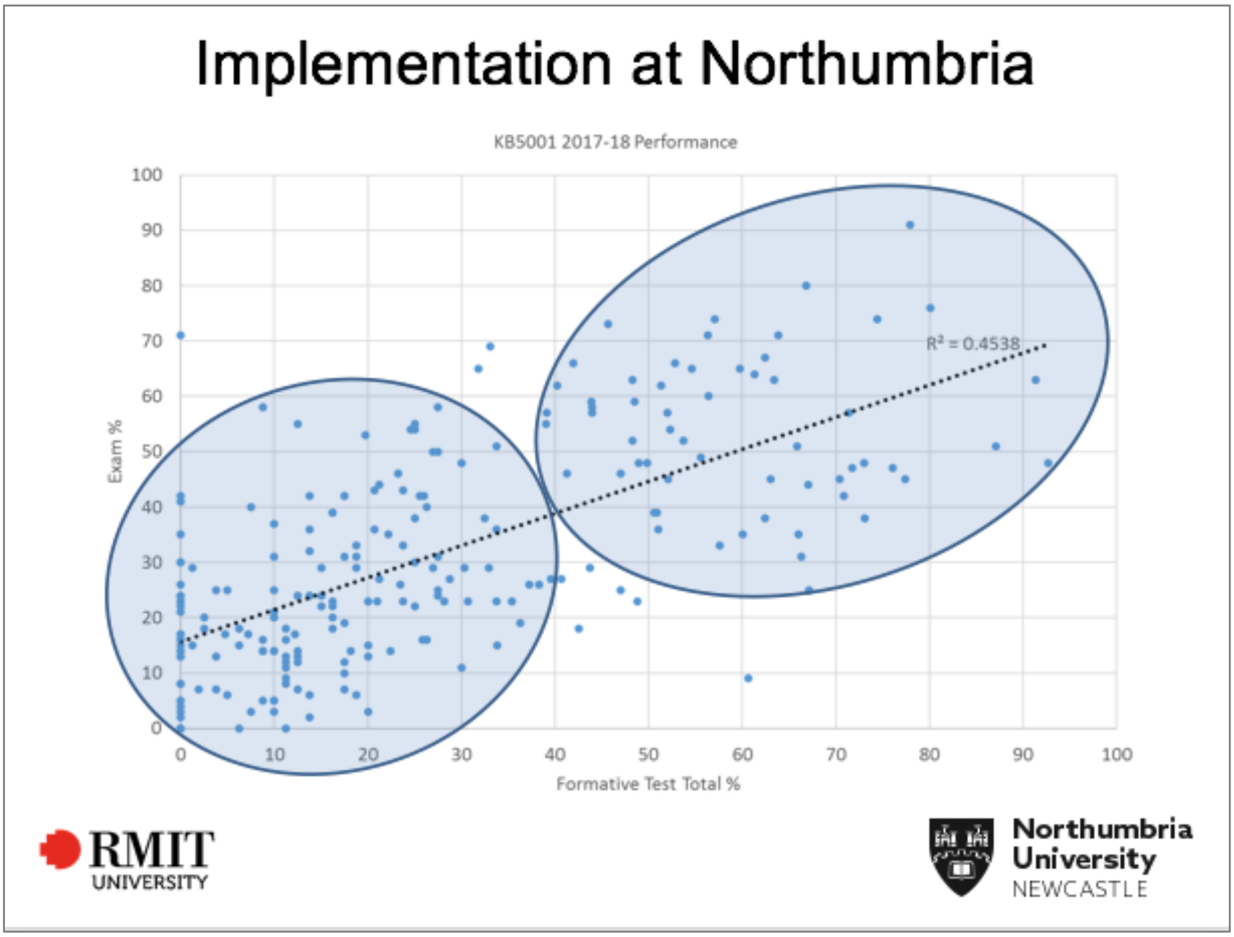
Implementation at Northumbria
KB5001 2017-18 Performance
R² = 0.4538
Exam %
Formative Test Total %
0
10
20
30
40
50
60
70
80
90
100
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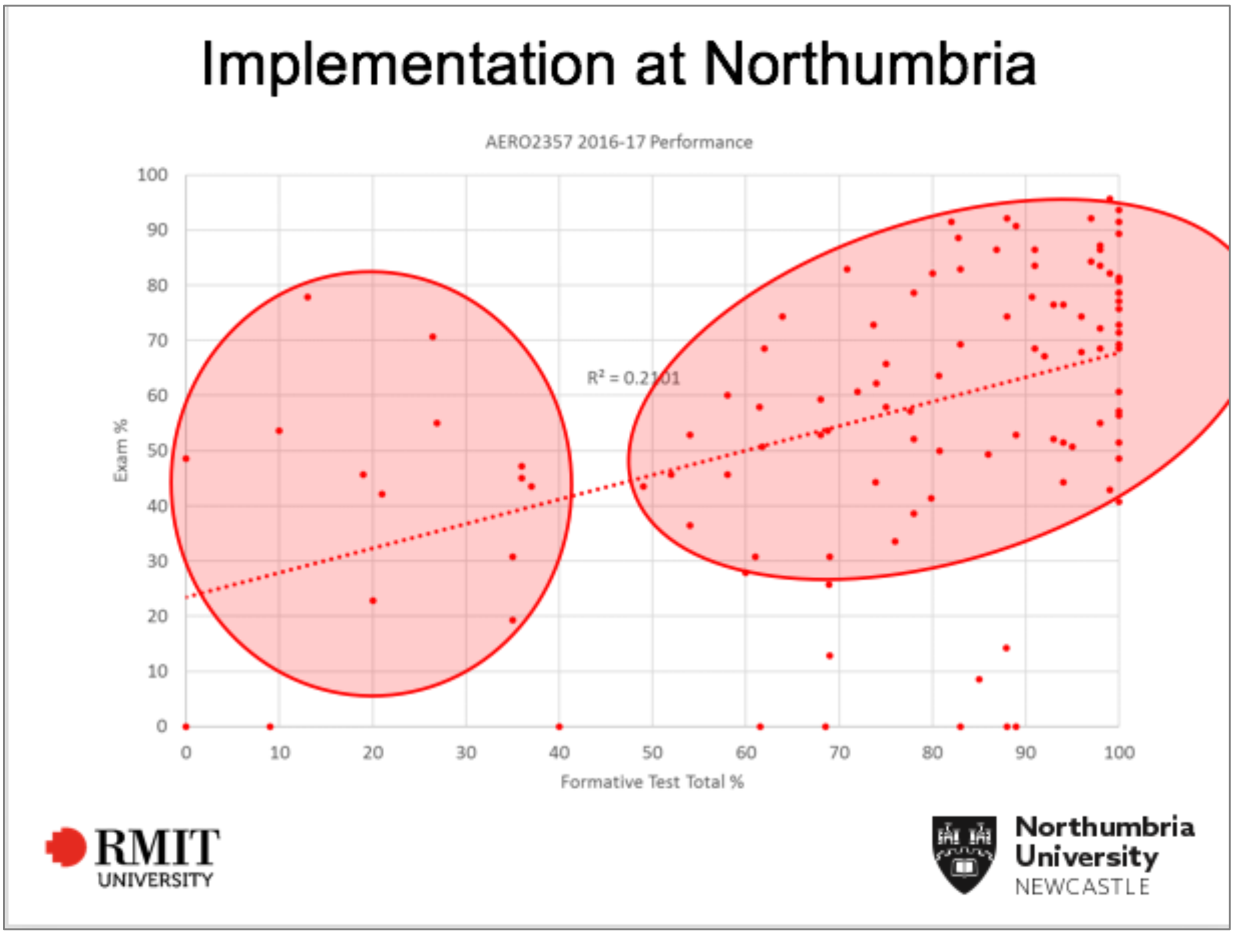
Implementation at Northumbria
AERO2357 2016-17 Performance
R² = 0.2101
Exam %
Formative Test Total %
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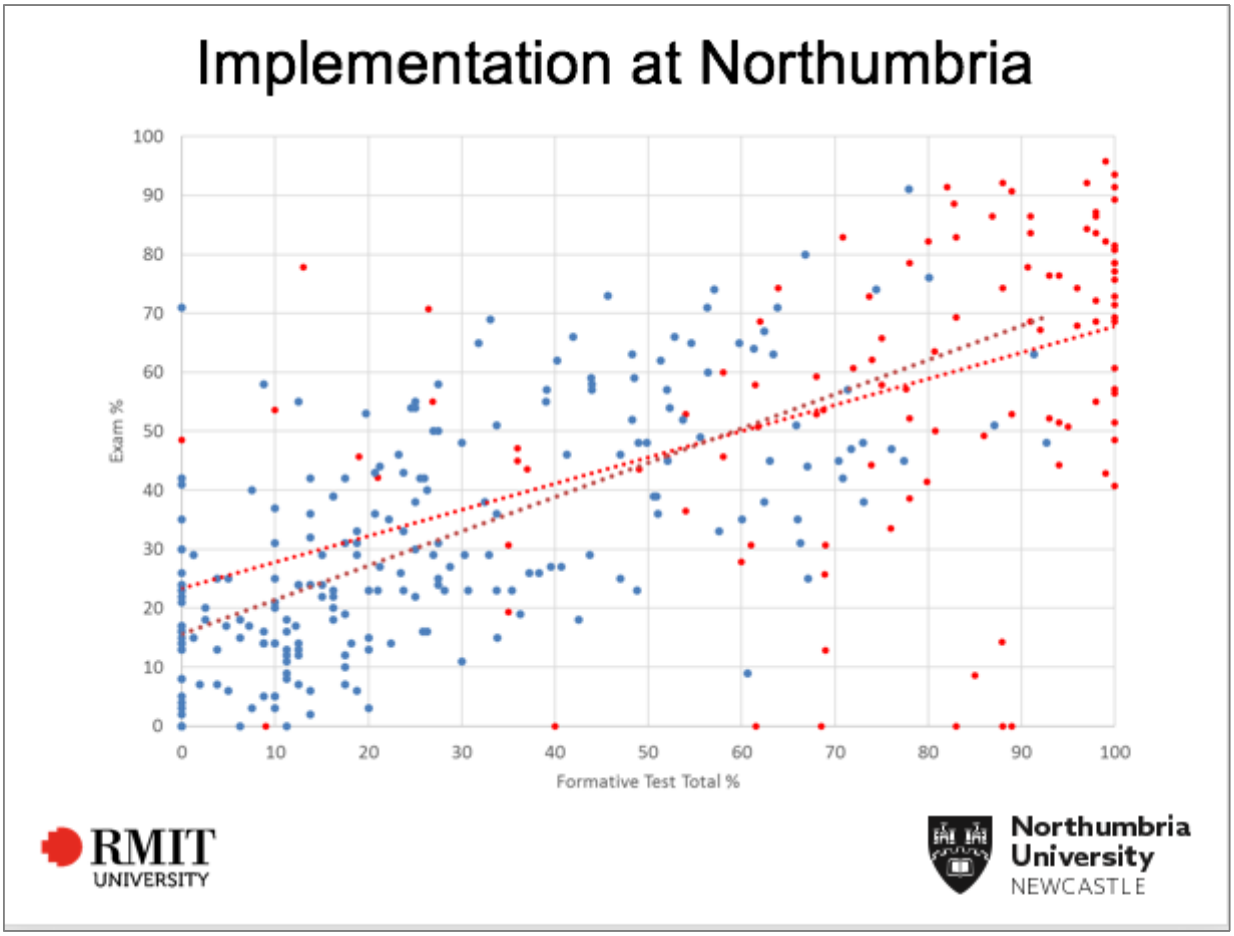
Implementation at Northumbria
Exam %
Formative Test Total %
0
10
20
30
40
50
60
70
80
90
100
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NEWCASTLE

The Academic Perspective: A study of academic conceptions of the importance of professional skills in engineering programmes in Ireland

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Keywords: Phenomenography, Professional skills

Introduction

This presentation outlines a phenomenographic research study which aims to explore engineering academics experiences and conceptions towards developing professional skills within engineering students in Ireland. The research is undertaken in two phases. Phase One is an online survey circulated to academics teaching on engineering programmes in Ireland (n=273). Phase Two will consist of in-depth interviews.

The overall phenomenographic study aims to answer the research question;

- What are the qualitatively different ways that academics experience and conceptualise teaching and the development of professional skills in engineering programmes in Ireland?

This presentation reports on the results of the Phase 1 survey. Whilst the principal aim of the survey was to identify participants for Phase 2 interviews, we also sought to answer the following research question;

- What factors influence an academic's consideration of the relative importance of specific professional skills?

The outcomes highlight aspects of an academic's life experience which has an influence on their views on the importance of professional skills, which we suggest influences their actions in the classroom and the curriculum itself. The results of this survey provide an initial insight into the perceptions held by academic staff, which will be explored further in the main phenomenographic study.

Context

Engineering graduates in today's world face a global industry where professional skills are as important as the intellectual prowess gained by obtaining a degree itself. The acknowledgement of the importance of these skills is abundant in literature, yet so too is an ongoing barrage from industry that Higher Educational Institutions (HEIs) are not developing sufficient professional skills within students (IOT, 2011).

Much has been written in the last ten years about the need for reform in engineering education and in particular the need to prepare graduates to work on a global scale in diverse teams (UNESCO, 2010; ASEE, 2013; Wulf, 2008; Miller, 2015). Engineering education research has responded by informing innovative teaching pedagogies but there is limited research investigating the human influence on engineering education; the academic's perspective

Survey Design

An online survey was circulated to all academics teaching on engineering programmes in Ireland. A response rate of 34% was achieved and n=273 (29%) respondents answered all questions. The survey collected demographic information on; gender, age, employer, qualifications, membership of professional bodies, extent of academic experience, role and number of teaching hours, extent of industry experience, involvement with graduate recruitment or initial training of graduates.

Respondents were also asked to score the importance of a list of professional skills for today's engineering graduates. The list of skills was created from a systematic literature review of recent engineering educational publications and research papers and comprised 17 'non technical' skills with just one 'technical' skill option. The survey aimed to show some correlations and relationships between different aspects of the response data.

Findings

This presentation is limited to highlighting the results of the relative importance of professional skills only. A sliding scale was provided with 'Not important' (scored as 0) to 'Essential' (scored as 4). Table 1 shows the average score for a selection of skills differentiated by gender.

Table 1. Average scores of respondents on the importance of specific skills

	Female Average Score(n=60)	Male Average Score (n=197)	Difference between Female - Male score
Problem Solving	3.78	3.71	0.08
Communication	3.71	3.59	0.12
Critical Thinking	3.78	3.53	0.26
Practical Focus	3.69	3.50	0.19
Self-Direction	3.62	3.44	0.17
Teamwork & Collaboration Skills	3.71	3.41	0.30
Character and Interpersonal Skills	3.60	3.27	0.33*
Excellence in Technical Skills	3.17	3.23	-0.07*
Project Management	3.22	3.07	0.14*
Health & Safety	3.20	2.94	0.26
Research Skills	3.12	2.82	0.31
Risk Management	2.97	2.66	0.31
Leadership	2.82	2.56	0.26
Global Outlook	2.80	2.46	0.34
Business Acumen	2.42	2.31	0.10
General Knowledge	2.15	2.01	0.15
Foreign Language Skills	1.58	1.43	0.16

*Indicates cases in which a statistically significant correlation was observed with regard to gender.

In all but one professional skill, women appeared more likely to score more highly than men, i.e., they place more importance on each skill than men do. Only 'Excellence in technical skills' was scored as less important by women than men. Since excellence in technical skills could be considered the only technical skill presented within the survey, and all others are non-technical, this suggests that female academics place more importance on non-technical skills in engineering graduates than male academics.

Although this initial result suggested a gendered difference, a statistical test carried out on SPSS sought to clarify which factor was the highest determinant of scoring of each professional skill comparing; Age, Gender and Length of Industrial Experience. The results are shown in Table 2.

Table 2. Pearson's Coefficient analysis to identify correlations between scoring of skills and other factors such as Age, Gender and Length of Industry Experience.

	Character and Interpersonal Skills	Teamwork; Collaboration Skills	Communication	Excellence in Technical Skills
Gender	0.144*	0.128*	-0.004	0.145*
Age	-0.010	0.127*	0.045	-0.042
Length of Industry Experience	0.005	0.021	0.059	0.090

*Correlation is significant at the 0.05 level (2 tailed)

There were no correlations observed with regard to length of industry experience. A significant correlation was observed between Age and the importance of Teamwork and Collaboration Skills (Pearson coeff= 0.127 at the 0.05 level). The results also indicated that whilst there was no significant correlation observed between the overall average score and gender, significant correlations were identified between Gender and the importance of Character and Interpersonal Skills (Pearson coeff=0.144) Teamwork and Collaboration (Pearson coeff=0.128) and Excellence in Technical Skills (Pearson coeff=0.145), all at the 0.05 level.

Conclusions and Further Work

One aim of this survey was to consider influences on an academics' opinions on the importance of specific professional skills in engineering graduates of today. The study showed that gender appears to have a significant influence not only on the importance of all professional skills, but particularly in relation to the importance of pure technical skills over non-technical skills. There is evidence to suggest that an academic's experience in industry also influences their judgements on the importance of professional skills. This finding suggests that there is value in the proposed phenomenographic study and in particular to investigate differences in gender profiles of academic staff and their attitudes or approaches to teaching non-technical skills.

References

IOT Report, (2011), Engineering graduates: Preparation and Progression. Institutes of Technology Honours Bachelor Degree Engineering Graduate Study. Dublin Institute of Technology, p.8.

UNESCO (2010), Engineering: Issues, challenges and Opportunities for Development, Paris Retrieved March 21st 2018 from http://unesdoc.unesco.org/images/0018/001897/189753e.pdf

ASEE (2013), Transforming Undergraduate Education in Engineering Phase I: Synthesizing and Integrating Industry Perspectives, Arlington, May 9-10, 2013 Workshop Report. Retrieved January 21st from: https://www.asee.org/TUEE_PhaseI_WorkshopReport.pdf

Wulf, WM.A, (2008), The Urgency of Engineering Education Reform, The Bridge Vol. 28, No. 1. Retrieved January 23rd from: https://www.nae.edu/Publications/Bridge/EngineeringCrossroads/TheUrgencyofEngineeringEducationReform.aspx

Miller, R., (2015), Why the hard science of engineering is no longer enough to meet the 21st century challenges. Olin College, May. Retrieved January 2nd, 2016 from http://www.olin.edu/sites/default/files/rebalancing_engineering_education_may_15.pdf

Loughborough University

Mathematics Education for 21st Century Engineering; extended abstract.

Peter Willmot and Rebecca Simms.
P.Willmot@lboro.ac.uk, School of Mechanical, Electrical and Manufacturing Engineering.

Introduction.

Engineering industry has changed massively over the last 50 years. For analysis, IT based tools, CAE software and statistical packages have become the workhorses of engineers who, half a century ago would have used slide-rules and log tables. The mathematics curriculum for Undergraduate Engineers has, however, changed little. This presentation provided a summary of work-in-progress on a locally-funded project.

A literature survey was completed, which suggested that the issue was much broader than just defining an appropriate curriculum. Teaching methods have a huge influence on students' ability to relate mathematics within engineering and design modules. Also, entry levels of understanding were found to be important and have been the subject of much previous research. The findings from literature informed the design of two surveys that gained responses from 100 students and 78 industrial engineers. The majority of students were studying either mechanical engineering or product design engineering and most of the industrialists were drawn mainly from the aerospace or automotive sector. The initial findings from the surveys were reported and are summarised below in respect of the appropriateness of the present curriculum for industry, teaching methods in year-1 mathematics modules and the appropriateness of qualifications such as the 'A' level.

Results.

Figure 1 compares, on the left, the expectations of students to need different aspects of the undergraduate mathematics curriculum in industry with, on the right, the percentage of students who actually used the same maths on industrial placements.

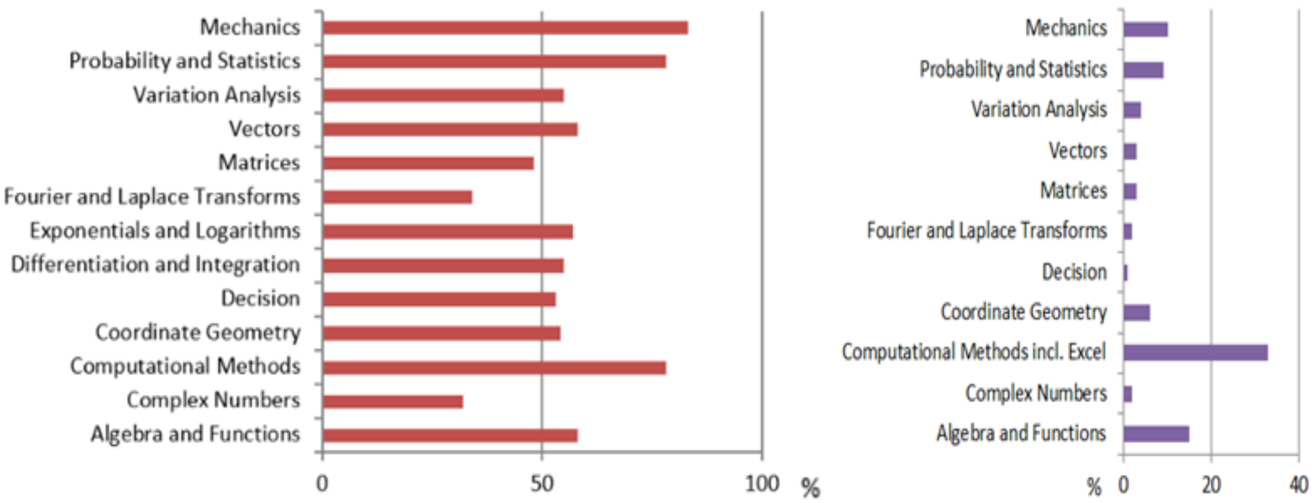


Figure 1: The perceived usefulness of maths topics in industry.

Industrialists were asked to rate the importance of a similar range of topics and the results are displayed in figure 2.

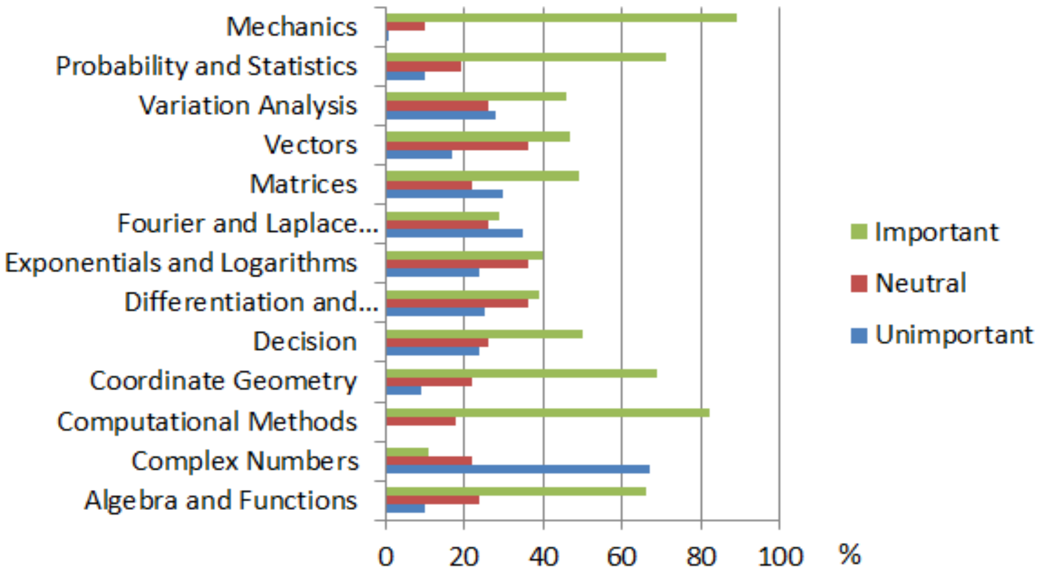


Figure 2: Industrialists perceived importance of maths topics.

80% of the student sample had arrived at university with good A level grades in maths/further maths while the minority offered the international baccalaureate, Scottish Highers etc. and students felt overwhelmingly well prepared in a number of the more fundamental aspects although not all, in the same aspects.

The surveys also solicited many free text comments. The three most common themes were:

1) Mathematics delivery should be more 'engineering' focussed using real world applications.
2) Coverage of statistical methods and computational analysis are particularly important but often underplayed.
3) Courses must retain a fundamental understanding of mathematical methods and the ability to interpret computed results.

Brief conclusions.

- Students arrived well prepared for selected topics but the variations across the topics points to a need for more innovative inclusive approaches as duplication can result in a lack of motivation.
- Both surveys show high level of satisfaction with the syllabus but hint at more emphasis in Statistics and Computational methods. (these, with mechanics are seen as the 3 most important topics).
- There is a very powerful need to connect teaching with 'real world' examples that demonstrate the usefulness and applications of the mathematics taught.

SEFI 2018

A more comprehensive report of this project will be presented at the annual SEFI conference in Copenhagen, September 2018.

Reflections from an Engineering Education Research PhD

Support for Newer Researchers in EER

Dr Jenna Tudor & Dr Roger Penlington

Extended Abstract

Due to the nature of the discipline, many researchers beginning their Engineering Education Research (EER) journey come to the field with expertise of research in other subjects. Some may have a technical background in Engineering and move into the field through an interest in the pedagogy that supports the education of engineers, often as education practitioners. Whereas others come to the discipline through their interest in education or social science and migrate towards EER as an area of application.

With such a broad basis for those entering EER there is no surprise that whilst new researchers bring to the field a wealth of valuable experience there is also a need to support these researchers and induct them into the EER discipline.

It is custom for new PhD students to read the standard 'how to do a PhD?' text books. These books layout suggested formats for PhD research projects, including: the feasibility study, the detailed proposal and then the literature analysis, a research design phase, followed by data gathering and analysis, and then suggesting a conclusion with recommendations. This commonplace list of items imply a linear structure to research where data analysis comes after data collection. This linear presentation of the research process however oversimplifies the complex nature of research; in reality, experienced researchers agree that data collection and data analysis are in fact intertwined and cannot be considered in isolation from each other. Decisions made at the data collection stage impact the analysis that can subsequently be performed therefore the two aspects of research need to be considered in parallel, and not in the sequential manner as implicitly suggested by the text books. This may also challenge those familiar with technical research expecting to find standard validated research tools ready to be applied to their particular problem.

Many research projects include a pilot phase. The value that comes from a pilot study should not be underestimated by new researchers in EER. Researchers that are new to the discipline should be encouraged to carry out pilot studies not least to enable them to adequately familiarise themselves with the context and complex nature of an engineering education environment. In addition to gaining clarity over the context, the period of time during which a pilot phase can be conducted also allows for methodological decisions to be made, data collection techniques to be developed and refined, and also for data analysis practices to be explored in detail. For the newer researcher seeking confidence, their supervisor or mentor must share an openness of the exploratory nature of this stage and reflect upon their experience to support a dialogue of enquiry.

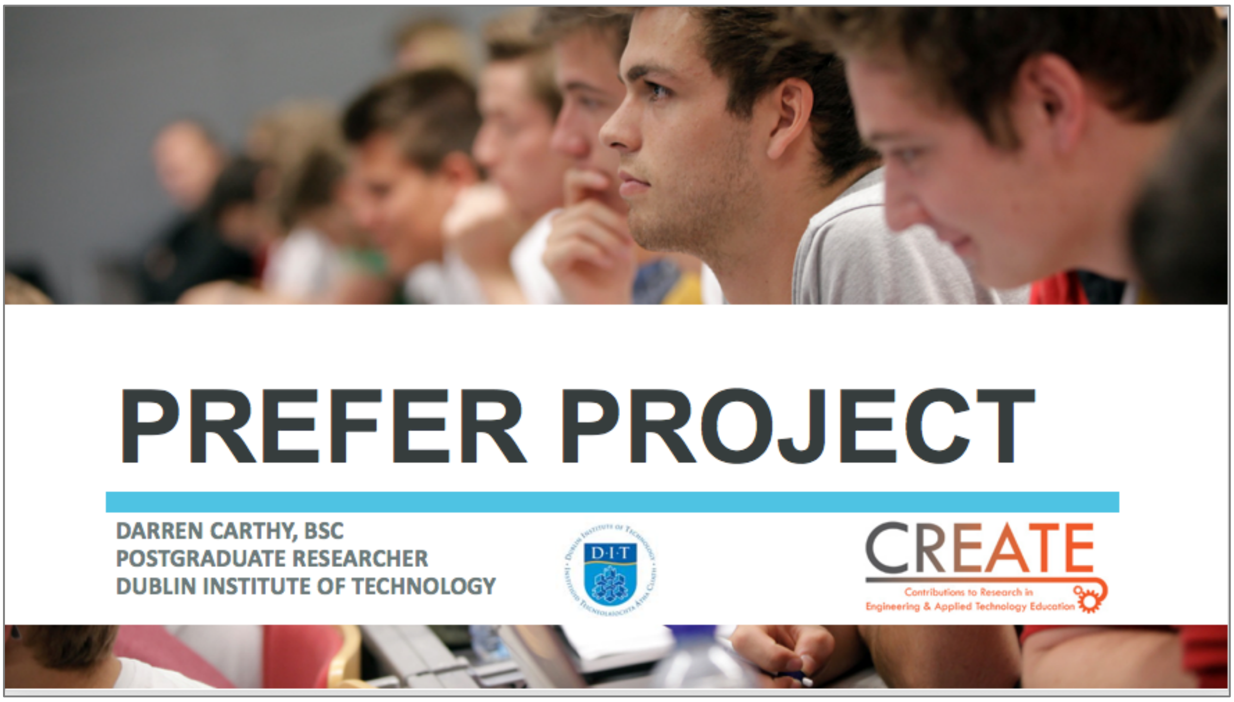
A great deal of focus is put into developing a research methodology and on newer researchers being confident and comfortable with terms such as 'epistemology', 'ontology' and 'conceptual framework'. These are terms which those from a technical engineering

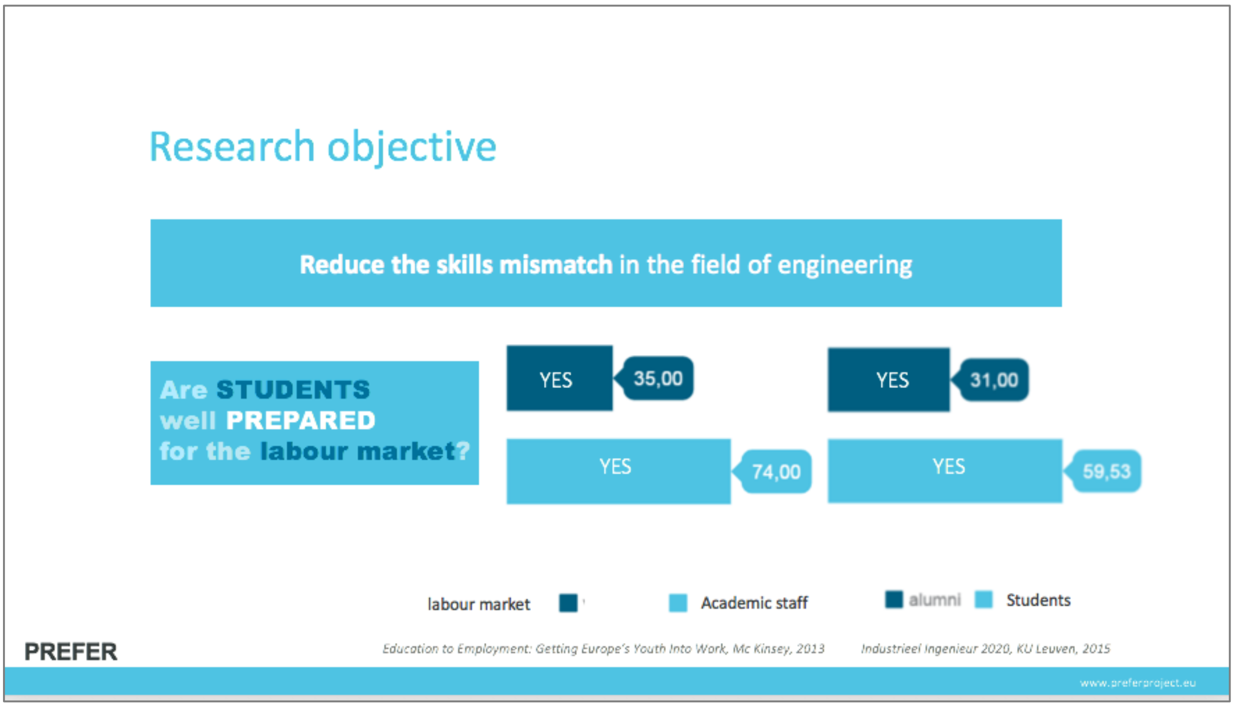
background may find daunting, these are very likely to be terms which those from an engineering background may never have had the occasion to consider in the largely well codified realm of physical science. As the newer researcher develops their knowledge of unfamiliar terms and discipline specific terminology, they may focus, rightly so, on their methodology. We would suggest however that the focus on methodology is heavily weighted and is potentially at the expense of thinking about the finer details of data collection or data analysis (which also need to be rigorous and valid). For the supervisor or mentor there may be a desire for the researcher to 'get on with the job' but it must be remembered that gaps in the methodology may manifest as gaps in the data which cannot always be filled later. Effectiveness will be achieved through forward planning and balance in exploration.

It is suggested that as a discipline EER needs to encourage newer researchers to have the confidence not to rush ahead with their research. To take their time to explore the elements of their research design and to consider the implications of decisions they might make at the initial stages of their research. Even when good balance is achieved it is likely that there will be some data which later seems unrelated to the main focus of the work. Rather than being a sign of poor planning this is likely to be a symptom of true exploration and largely serve to confirm that a complexity is being understood. Decisions will also be influenced by what is common within the field and what is expected within publications and funding proposals. This may create difficulties for a newer researcher spanning research areas in establishing the value of their work against established performance criteria. Again, becoming familiar with the discipline to ensure that decisions made at the early stages of the research complement existing work, meet the expectation of the EER community and develop the research work of those already established within the field.

Established EER researchers need to support the induction of newer researchers into the discipline to ensure that the research that is undertaken adds to the rigorous body of engineering education research that has developed over recent years. Established researchers should also take the time to learn from the experiences and new ideas that those entering the discipline can bring. The established researcher acting as supervisor or mentor can also play an important role in giving continuity to research themes, longitudinal studies are rare, yet are of great value, bringing newer perspectives broadens the opportunities for continued reflection and research skill development.

Both newer and more established researchers need to spend time developing quality abstracts so that EER papers can be searched and cited, thus supporting a raise in the profile of EER. This is particularly important when work is disseminated through a large number of channels, formal and informal, across the globe. The supervisor or mentor has an important role to play in ensuring that the full breadth of literature is drawn upon in the earlier stages of the work and added to in its latter stages. Engineering education has been internationalised through accreditation and recognition processes and therefore any local context is unlikely to be totally unique and of little interest to the broader EER community if the work is well founded, executed and reported.


PREFER PROJECT
DARREN CARTHY, BSC
POSTGRADUATE RESEARCHER
DUBLIN INSTITUTE OF TECHNOLOGY
D·I·T
CREATE
Contributions to Research in
Engineering & Applied Technology Education


Research objective
Reduce the skills mismatch in the field of engineering
Are STUDENTS
well PREPARED
for the labour market?
YES
35,00
YES
74,00
YES
31,00
YES
59,53
labour market
Academic staff
alumni
Students
PREFER
Education to Employment: Getting Europe's Youth Into Work, Mc Kinsey, 2013
Industrieel Ingenieur 2020, KU Leuven, 2015
www.preferproject.eu

Consortium

TU Delft | KU LEUVEN | DIT
SIEMENS | KIVI | ENGIE | ie net | AGORIA | ESB | Engineers Ireland
BDO
eoni | SEFI

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Some of the pieces of the puzzle

KU LEUVEN

- Developing a **model of professional roles** to frame a set of transversal skills.
- **Validate the model** with expert panels and surveys with Industry
- Give students a **better understanding** of types of roles available at graduation

TU DELFT

- Developing **unique curriculum elements** to help develop transversal skills.
- **Validate these curriculum elements** with students at undergraduate and masters level.
- Provide students with the **opportunity to advance** their professional development

DIT

- Validating and aiding the development of a **psychometric test** to measure level these transversal skills.
- **Validate the test** using a large cohort of engineering students.
- Provide **meaningful feedback** to students about the state of their transversal skills.

PREFER

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1. A rolling model of professional competencies

- Based on model by **Treacy & Wiercema model**
- Validated using industry surveys & expert panels
- Surveys at job fairs representing **188** respondents to date
- **6** Expert panels with industry held to-date including:
  - ENGIE in Belgium
  - Siemens in the Netherlands
  - Electrical Supply Board in Ireland

PREFER

1. A rolling model of professional competencies

KU LEUVEN

PREFER

2. Unique curriculum elements

Focused on 4 sets of professional competencies, **Innovation, Communication, teamwork & Lifelong Learning**

Communication and **Lifelong learning** curriculum elements in pilot phase at Delft

TU Delft

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2. Unique curriculum elements

Innovation competences	Communication and networking competences	Teamwork competences and ways of thinking	Lifelong learning competences
Stakeholder management	Quality of presentation method	Cultural respect	Knowledge awareness
Value/cost consciousness	Presentation skills	Interdisciplinary collaboration	Strength and weakness awareness
Creativity	Writing skills	Engagement in team work	Professional role awareness
Problem solving	Listening skills	Critical thinking	Non-credit activity participation
Curiosity for innovation	English language skills	Collaborative goal oriented	Autonomous work
Idea implementation	Adaptive communication style	Goal settings	
	Self-confidence	Project Management	
	Interconnection/interrelation ability	Constructive feedback	
	Pitching skills	Managing conflict	

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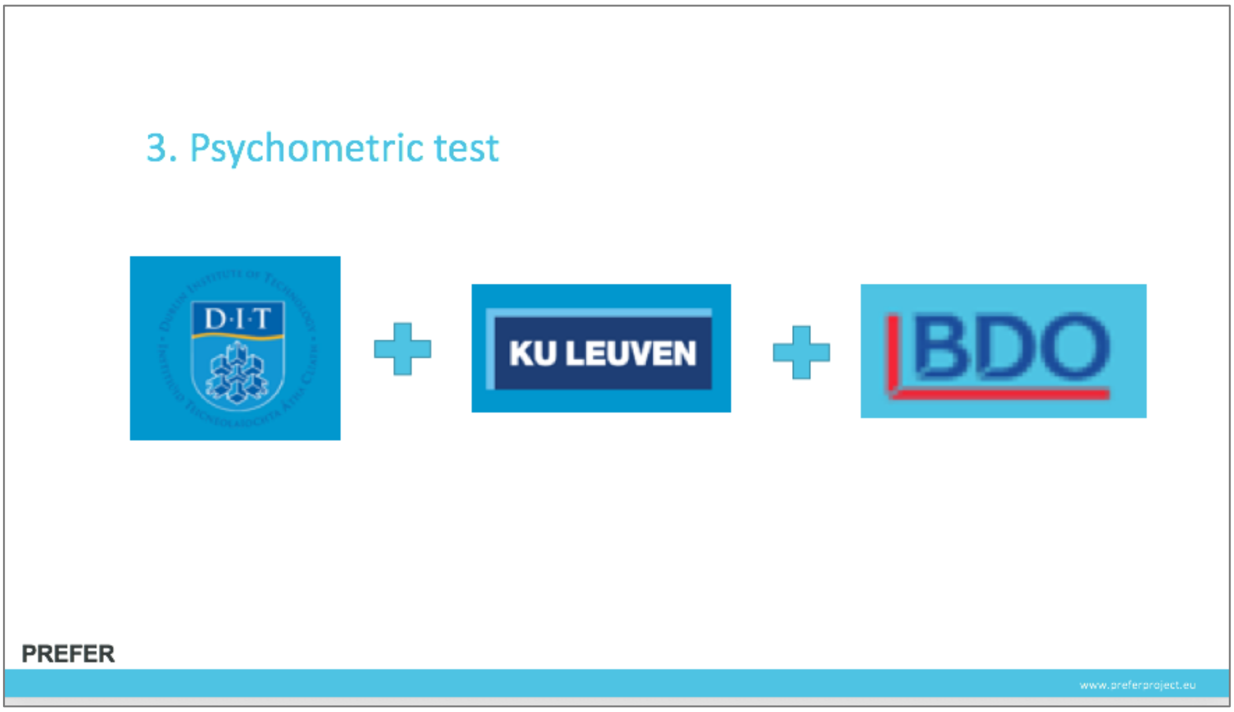
3. Psychometric test
D·I·T
KU LEUVEN
BDO
PREFER
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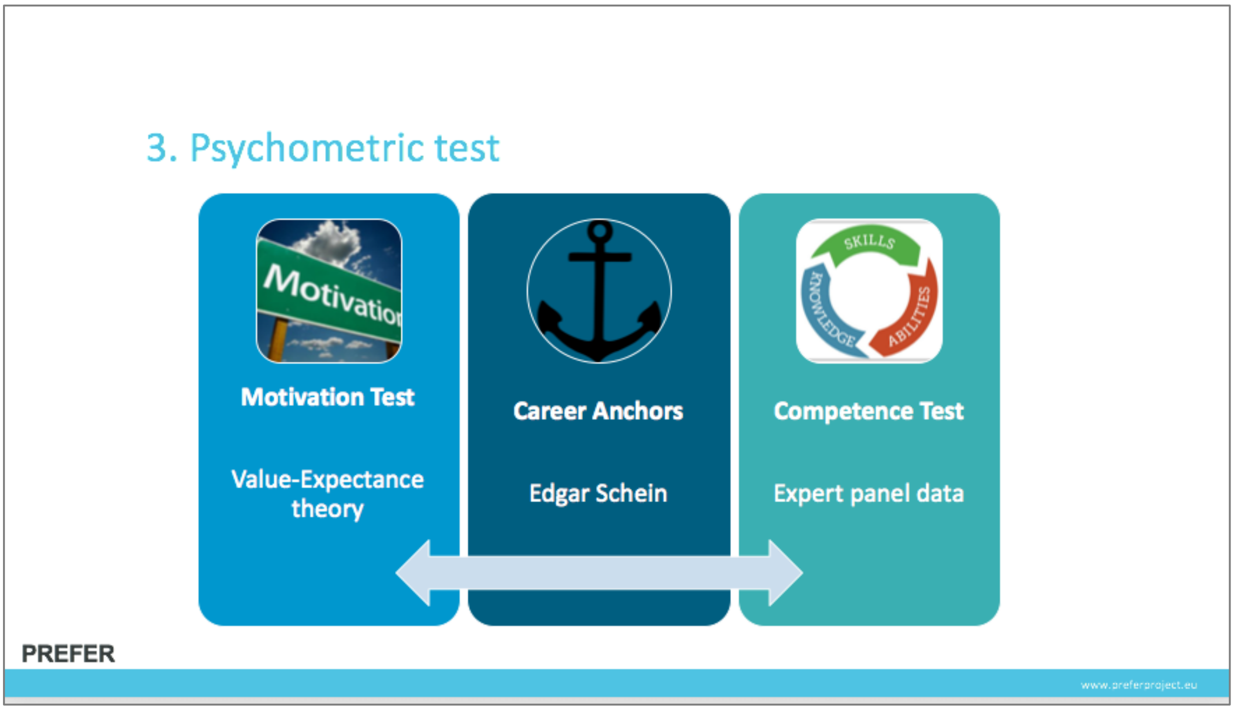
3. Psychometric test
Motivation
Motivation Test
Value-Expectance theory
Career Anchors
Edgar Schein
SKILLS
KNOWLEDGE
ABILITIES
Competence Test
Expert panel data
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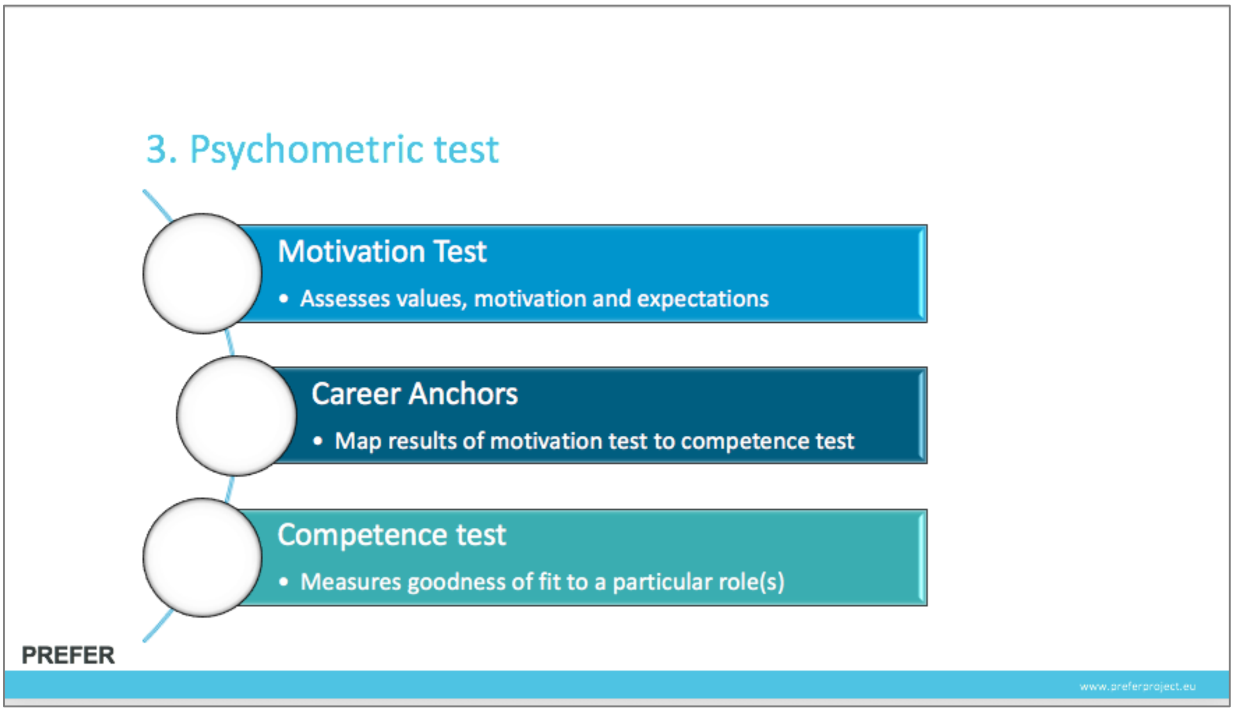
3. Psychometric test
Motivation Test
• Assesses values, motivation and expectations
Career Anchors
• Map results of motivation test to competence test
Competence test
• Measures goodness of fit to a particular role(s)
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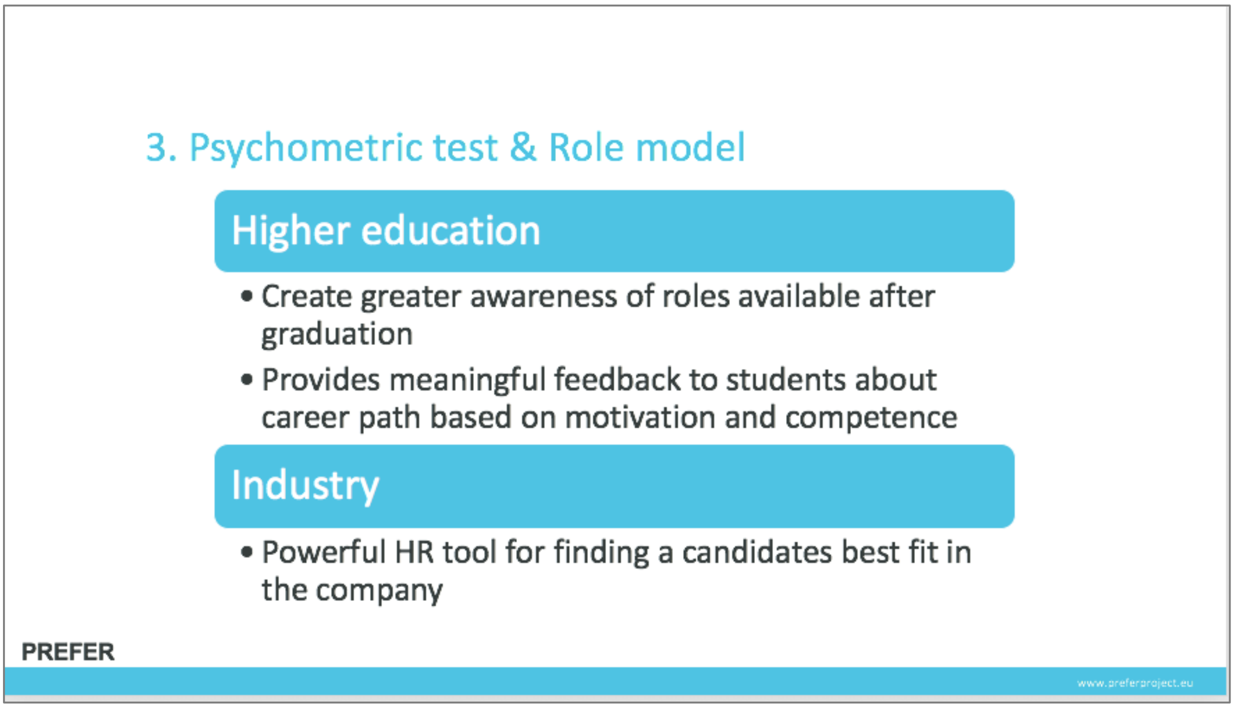
3. Psychometric test & Role model
Higher education
• Create greater awareness of roles available after graduation
• Provides meaningful feedback to students about career path based on motivation and competence
Industry
• Powerful HR tool for finding a candidates best fit in the company
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Thus far?

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Mobility Event in The Netherlands Feb 2018

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Meeting with Engineers Ireland & KIVI (Royal Society of Engineers in The Netherlands) in the Hague

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Meeting with Siemens in the Field Lab in Delft

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Visualisation Workshop with Mark Van Huystee
OPTIMIZE
CUSTOMIZE
INNOVATE
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RESCUE

Expert Panel with ESB International April 2018

Operational Excellence	Product leadership	Customer Intimacy
Achieve Goals	Conceptualize	Communicate clearly
Perseverance	Creativity	Empathy
Efficient organization	Perseverance	Customer focus
Insight into the organization	Initiative	Networking
Solution-oriented	Innovate	Negotiate
Planning and organizing	Inspire	Solution-oriented
Positive critical attitude	Customer focus	Persuasiveness
Result orientation	Persuasiveness	Establish relationships
	Renovation	Result orientation
	Vision	Stress resistance

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Up coming activities

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SEFI in Copenhagen, Sept 2018

- Concept paper submitted to SEFI 2018
- *"Mapping reflection to engineering program outcomes"*
- Systematic literature review of competences important to industrial stakeholders
- Mapped competences to EI's criteria
- Difficulty mapping "reflective practice" to a criteria
- Argument for explicit outcome for DIT program outcomes? – To follow in future work

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Meetings/Mobility events

Venue	Location	Date
~~TU Delft~~	~~The Netherlands~~	~~Feb 2018~~
SEFI 2018	Copenhagen	Sept 2018
SEFI 2019	TBA	Sept 2019
DIT	Ireland	Nov/Dec 2019
SEFI 2020	TBA	Sept 2020
KU Leuven	Belgium	Nov/Dec 2020

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Improving efficiency and effectiveness in delivering outstanding education and student experience; a case study

Dr Andy Weightman – Director of Post Graduate Taught Studies
Andrew.weightman@manchester.ac.uk

Mr Tim Jones – Director of Teaching and Learning

The University of Manchester
School of Mechanical, Aerospace and Civil Engineering

UK&IE EER network

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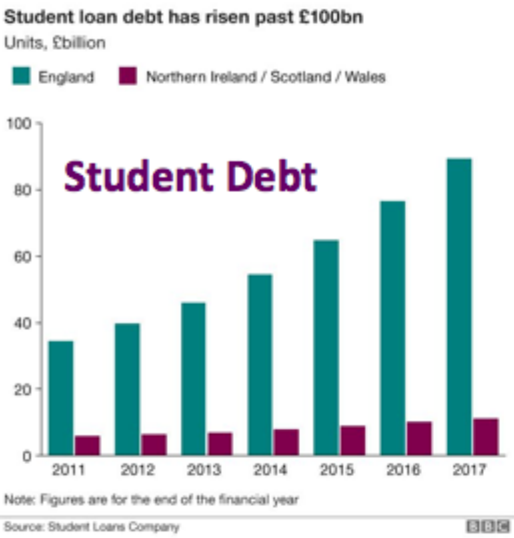
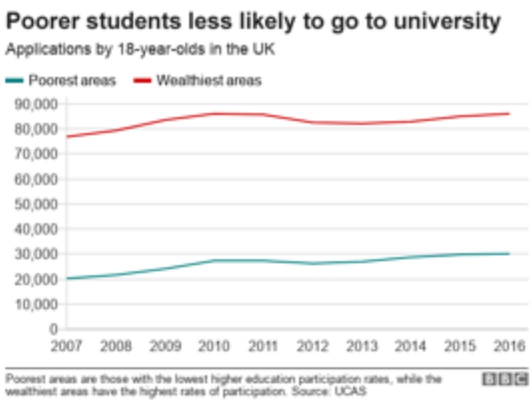
A constantly changing and challenging environment in Higher Education



Equality



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A constantly changing and challenging environment in Higher Education

KPI's

POSTGRADUATE TAUGHT EXPERIENCE SURVEY

NSS National Student Survey

TEF Teaching Excellence Framework

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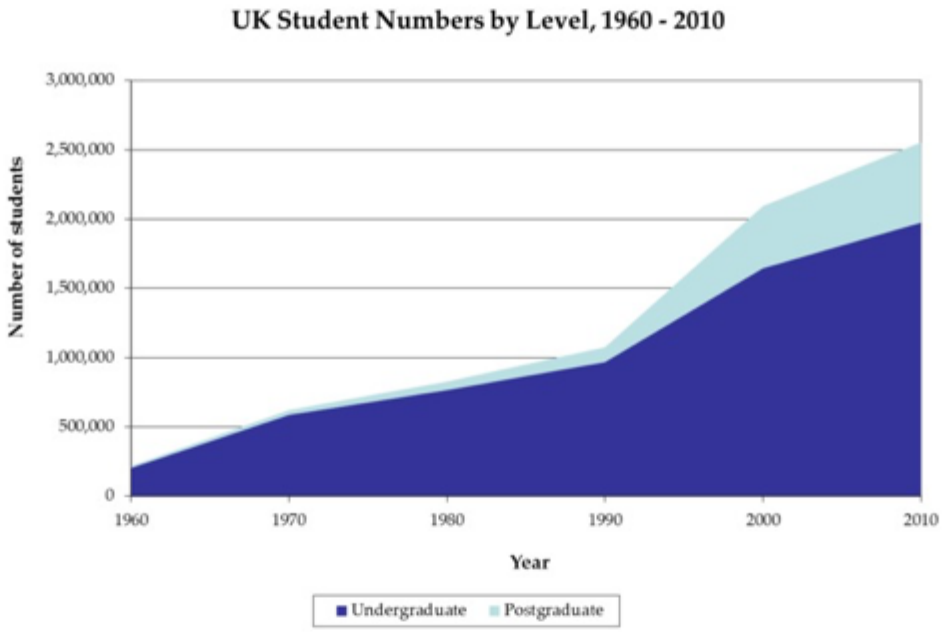
Growth in student numbers



Source: University of York, Department of Education 2014

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Increasing Load and Finite Resource

- Over the last few decades **loading on universities and their staff has increased** e.g. volume of students, NSS, PTES, TEF etc
- There has **not been a proportionate increase in resource** (staff, facilities etc)
- **Have we adapted our processes** sufficiently (or at all?) to cope with demand and ensure we are efficient and effective?

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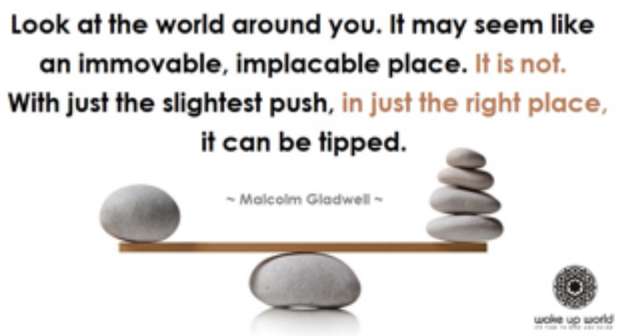
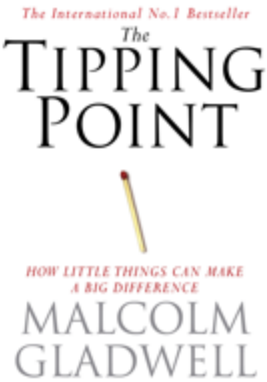
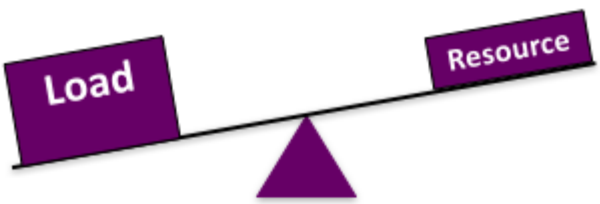
Did universities reach a tipping point?







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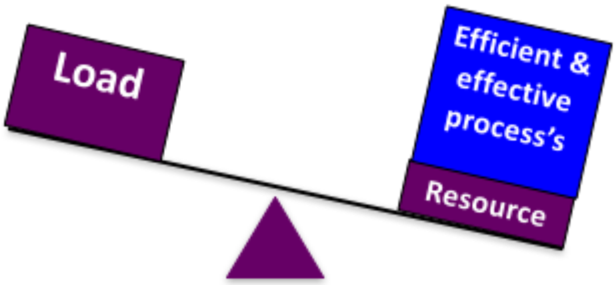
Can we contribute push the scales back by adapting process's

- Can we contribute to rebalancing the scales back by **reviewing and adapting our processes to improve our efficiency and effectiveness?**



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Case study – School of MACE PGT dissertation projects

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Background: School of MACE Undergraduate

BEng & MEng
Mechanical Engineering

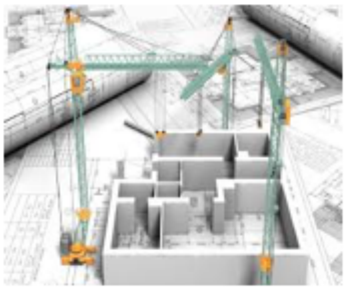
- 3 and 4 year courses
- ~ 200 students per year

BEng & MEng
Aerospace Engineering

- 3 and 4 year courses
- ~ 100 students per year

BEng & MEng
Civil Engineering

- 3 and 4 year courses
- ~ 80 students per year



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Background: School of MACE Post Graduate Taught

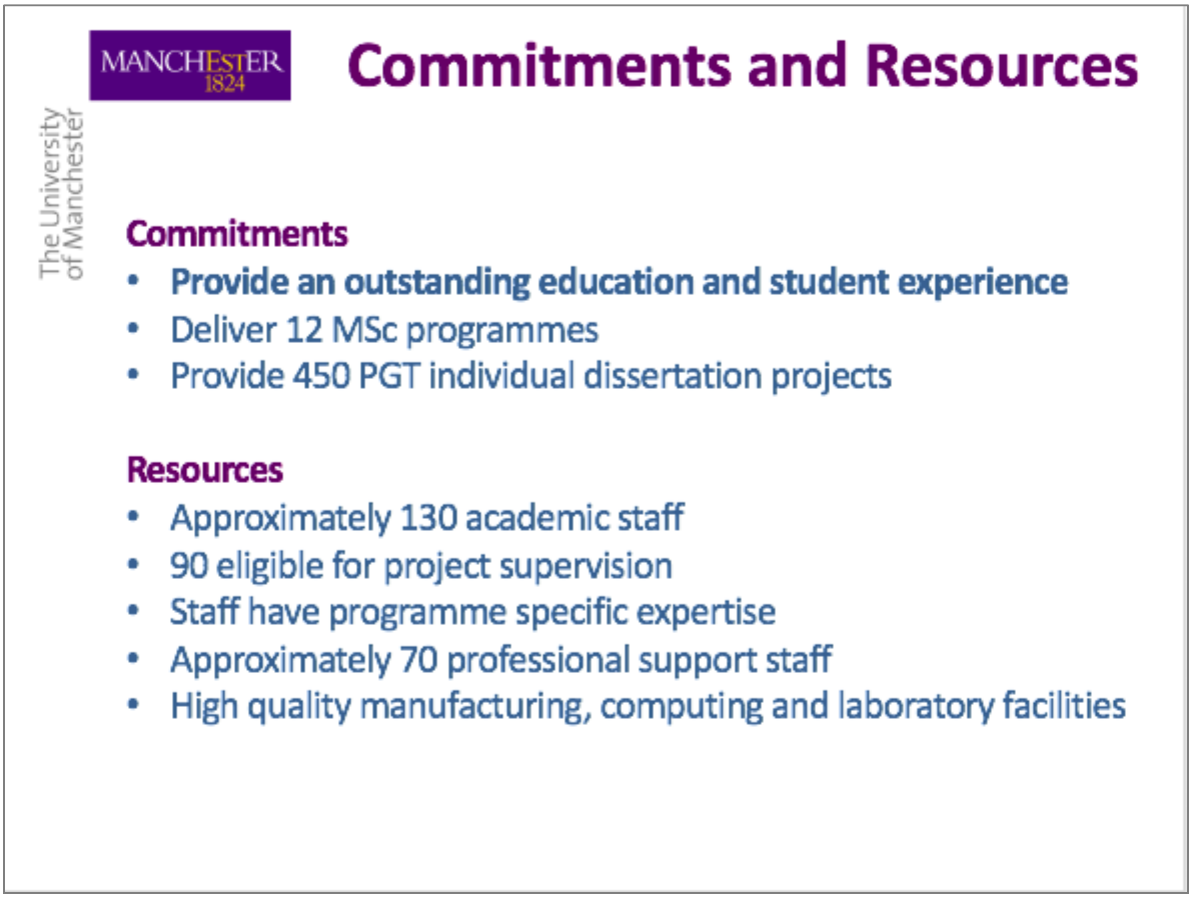
Technical at Manchester Group

1. MSc Advanced Manufacturing Technology
2. MSc Aerospace Engineering
3. MSc Mechanical Engineering Design
4. MSc Structural Engineering
5. MSc Thermal Power and Fluid Engineering
6. MSc Renewable Energy and Clean Tech (EEE)
7. MSc Reliability Engineering and Asset Mgmt

Management of Projects Group

8. MSc Commercial project Mgmt
9. MSc Construction project Mgmt
10. MSc Engineering project Mgmt
11. MSc Management of projects
12. MSc Project Management Professional Development Programme

Around 450 PGT students on campus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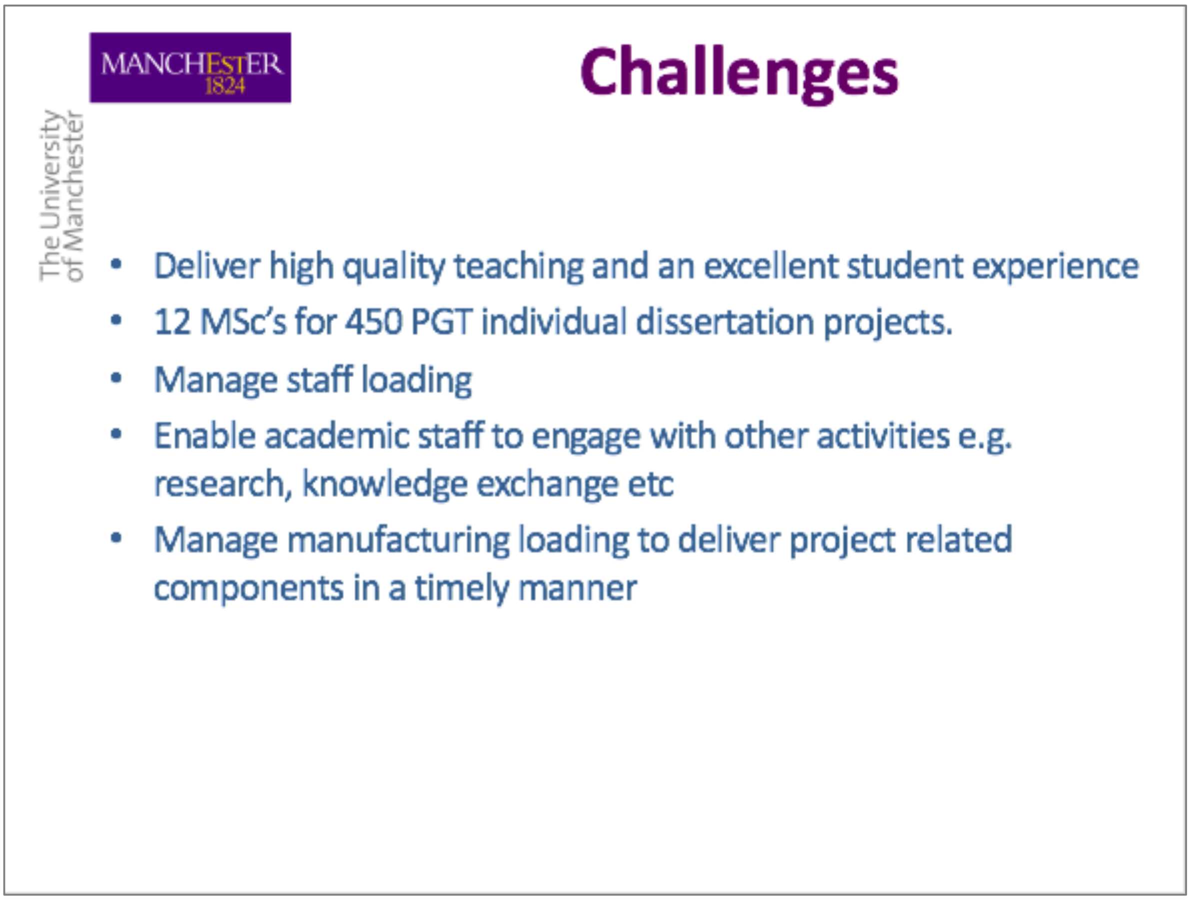
Commitments and Resources
Commitments
Provide an outstanding education and student experience
Deliver 12 MSc programmes
Provide 450 PGT individual dissertation projects
Resources
Approximately 130 academic staff
90 eligible for project supervision
Staff have programme specific expertise
Approximately 70 professional support staff
High quality manufacturing, computing and laboratory facilities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Challenges
Deliver high quality teaching and an excellent student experience
12 MSc's for 450 PGT individual dissertation projects.
Manage staff loading
Enable academic staff to engage with other activities e.g. research, knowledge exchange etc
Manage manufacturing loading to deliver project related components in a timely manner

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Legacy PGT project call and allocation

1. PGT students arrive at the start of the academic year
2. Determine cohort sizes for each MSc
3. Projects per member of staff = (cohort size/number of staff) + 2
4. Staff asked to submit a spreadsheet of project titles
5. Professional support staff compile list of projects titles
6. Titles disseminated to students
7. Students read projects description + discuss with staff (1 week)
8. Students submit paper forms to programme team office

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Legacy process problems

Wait until students arrive to collect information? Busiest time of year.

1. PGT students arrive at the start of the academic year
2. Determine cohort sizes for each MSc
3. Projects per member of staff = (cohort size/number of staff) + 2
4. Staff asked to submit a spreadsheet of project titles
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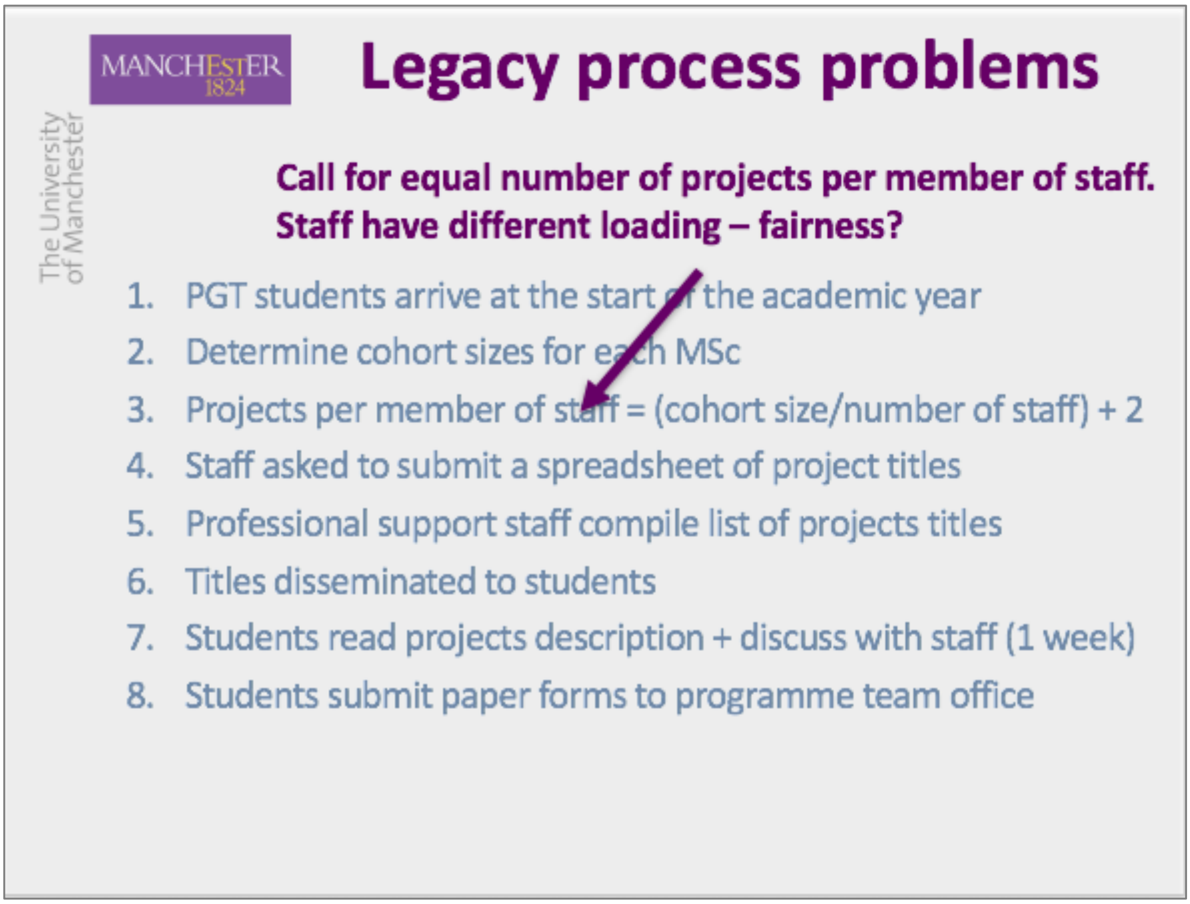
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Legacy process problems
Call for equal number of projects per member of staff.
Staff have different loading – fairness?
1. PGT students arrive at the start of the academic year
2. Determine cohort sizes for each MSc
3. Projects per member of staff = (cohort size/number of staff) + 2
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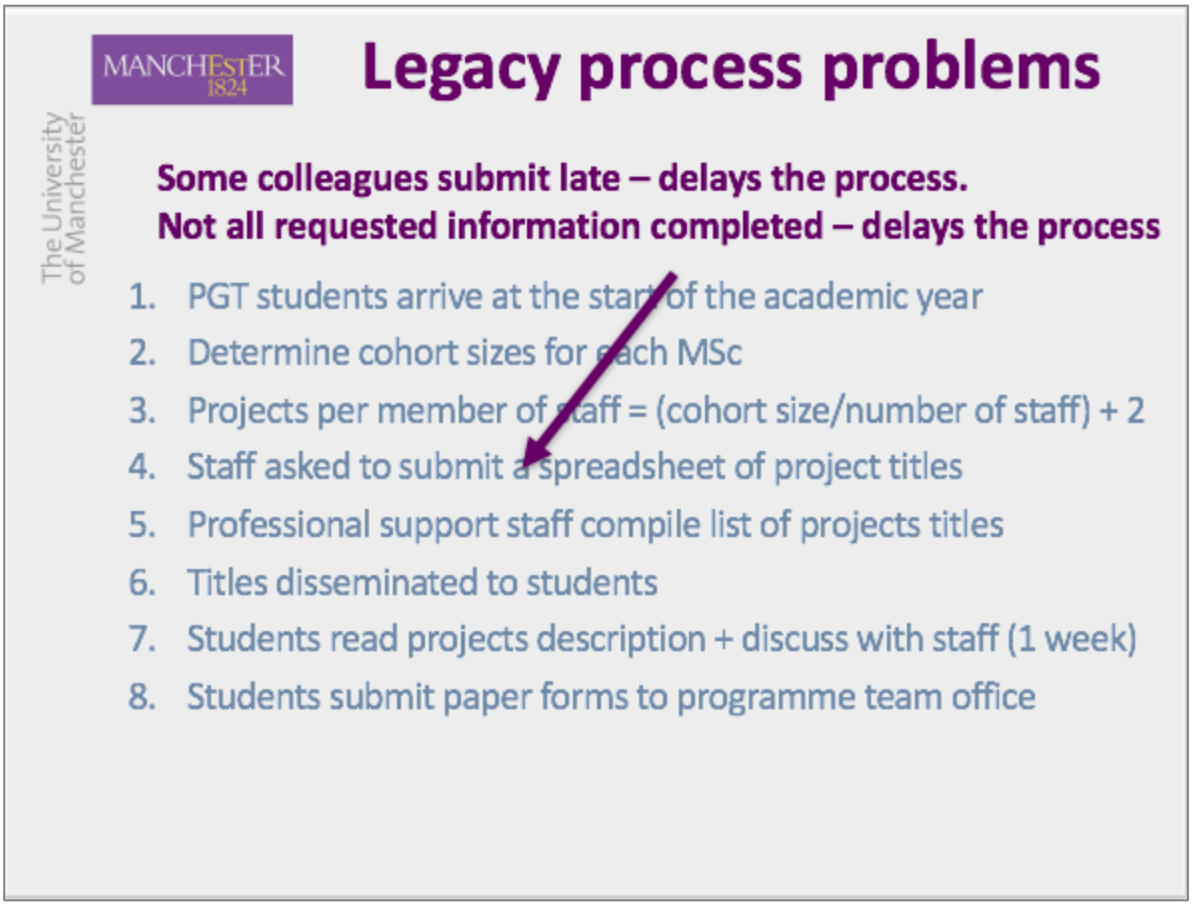
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Legacy process problems
Some colleagues submit late – delays the process.
Not all requested information completed – delays the process
1. PGT students arrive at the start of the academic year
2. Determine cohort sizes for each MSc
3. Projects per member of staff = (cohort size/number of staff) + 2
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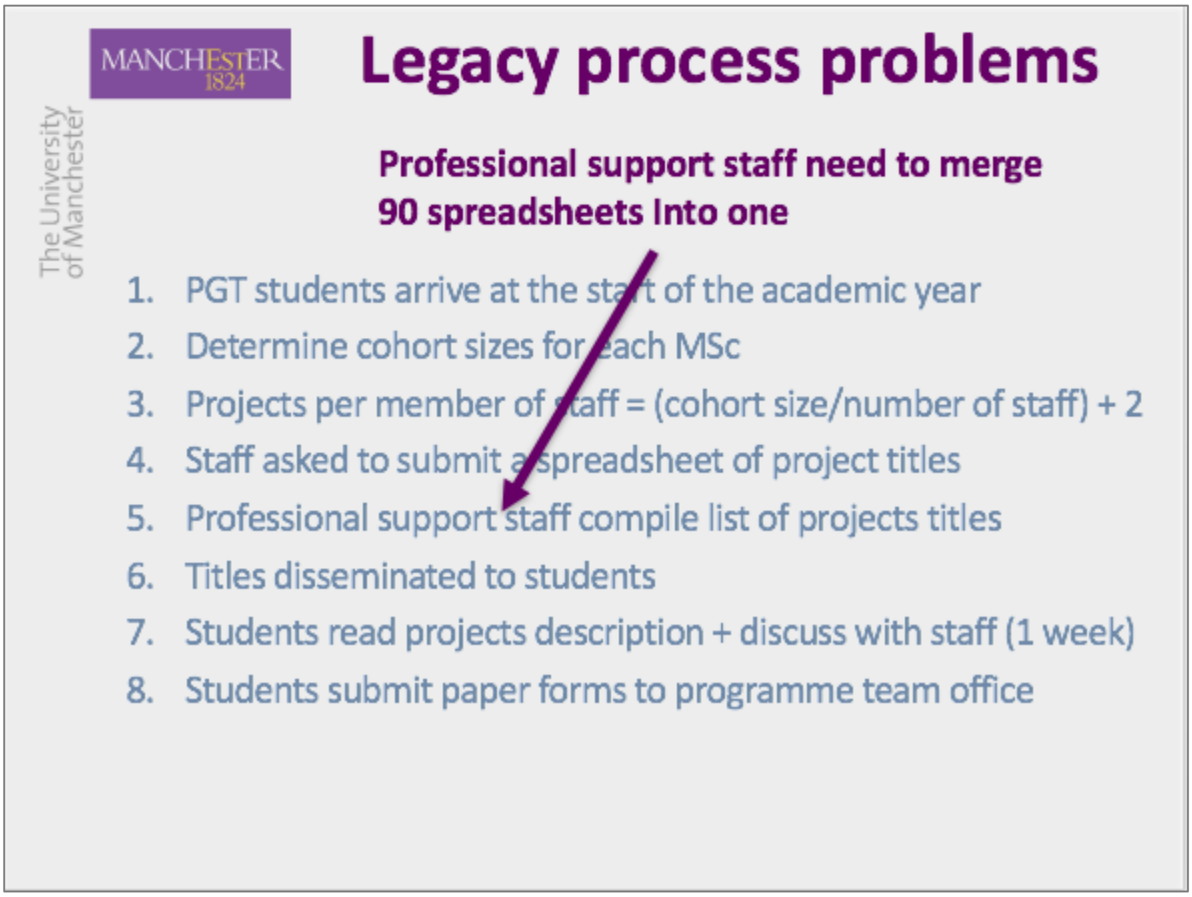
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Legacy process problems
Professional support staff need to merge
90 spreadsheets Into one
1. PGT students arrive at the start of the academic year
2. Determine cohort sizes for each MSc
3. Projects per member of staff = (cohort size/number of staff) + 2
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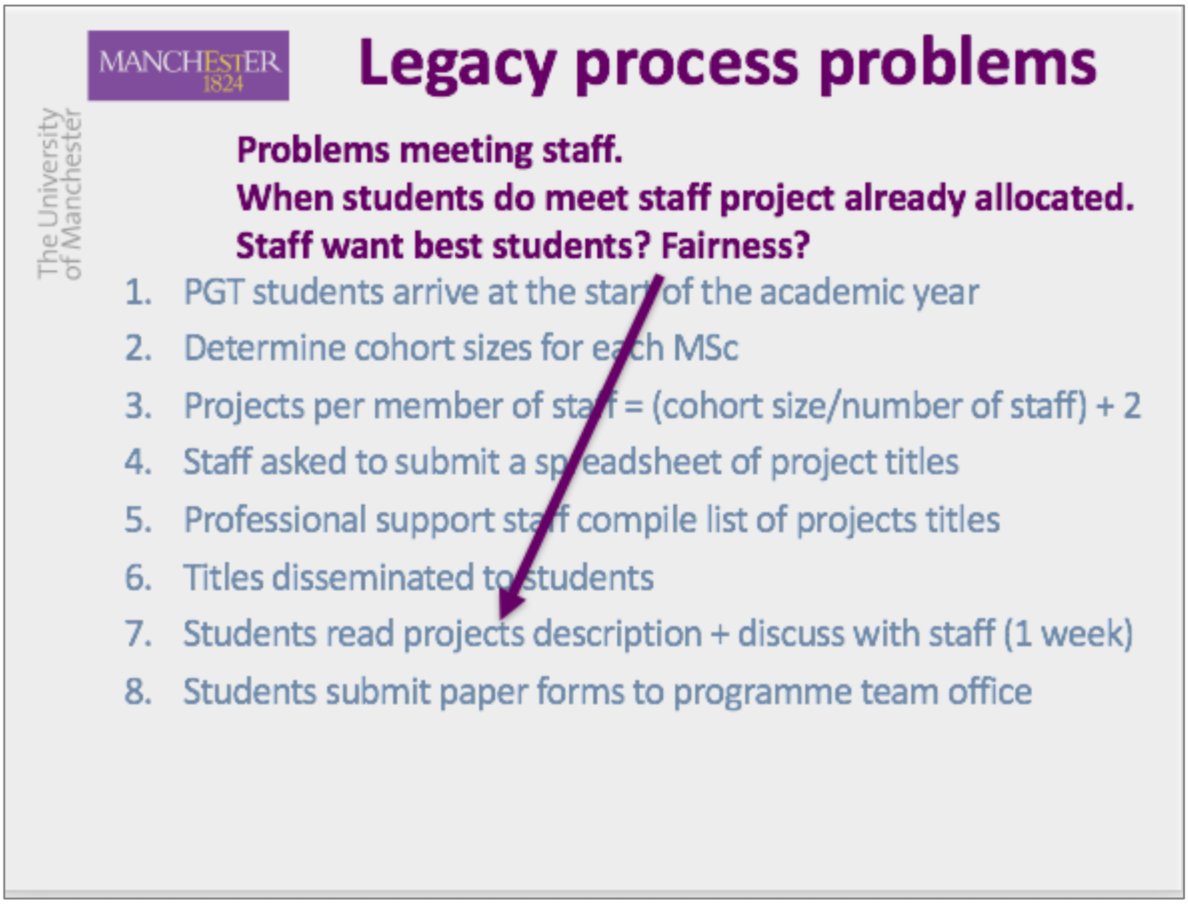
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Legacy process problems
Problems meeting staff.
When students do meet staff project already allocated.
Staff want best students? Fairness?
1. PGT students arrive at the start of the academic year
2. Determine cohort sizes for each MSc
3. Projects per member of staff = (cohort size/number of staff) + 2
4. Staff asked to submit a spreadsheet of project titles
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7. Students read projects description + discuss with staff (1 week)
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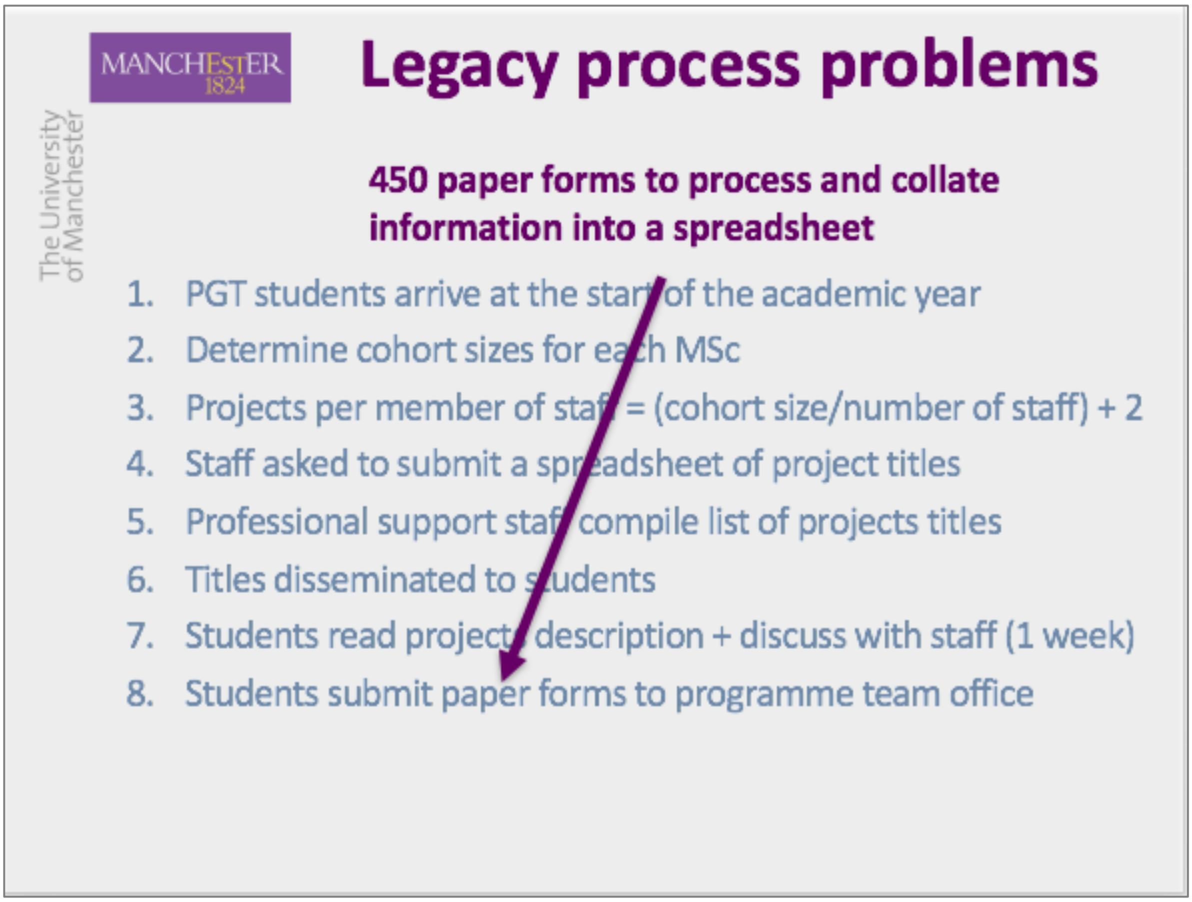
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Legacy process problems
450 paper forms to process and collate information into a spreadsheet
1. PGT students arrive at the start of the academic year
2. Determine cohort sizes for each MSc
3. Projects per member of staff = (cohort size/number of staff) + 2
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5. Professional support staff compile list of projects titles
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7. Students read projects description + discuss with staff (1 week)
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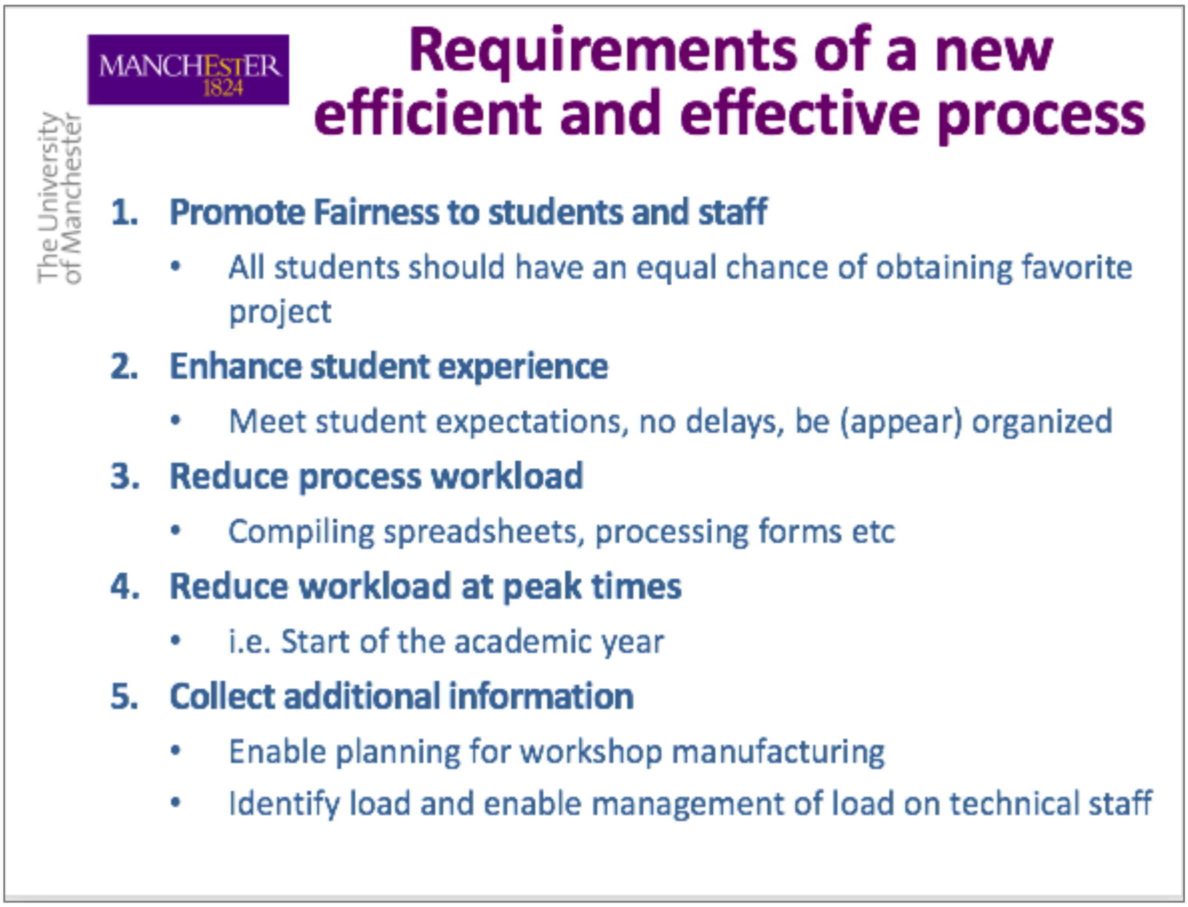
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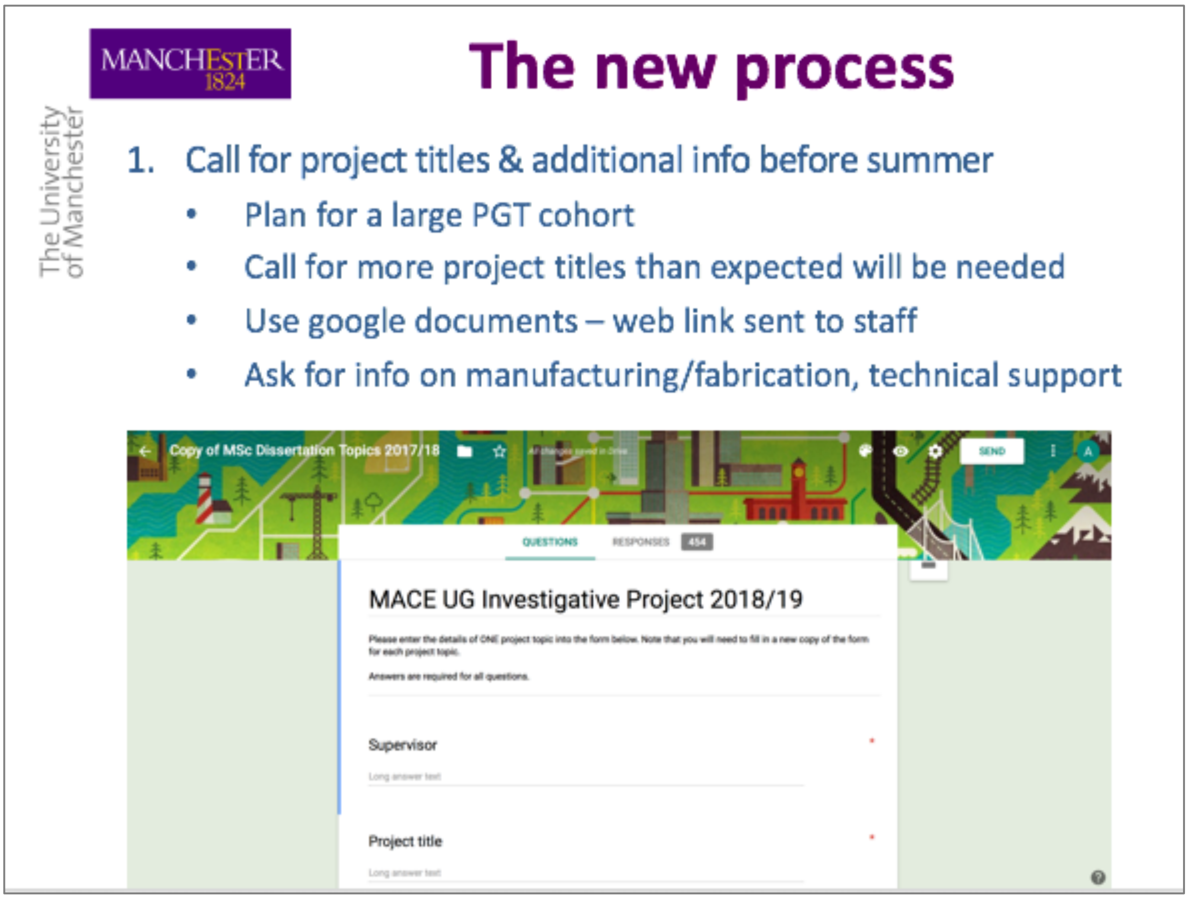
Requirements of a new efficient and effective process
1. Promote Fairness to students and staff
• All students should have an equal chance of obtaining favorite project
2. Enhance student experience
• Meet student expectations, no delays, be (appear) organized
3. Reduce process workload
• Compiling spreadsheets, processing forms etc
4. Reduce workload at peak times
• i.e. Start of the academic year
5. Collect additional information
• Enable planning for workshop manufacturing
• Identify load and enable management of load on technical staff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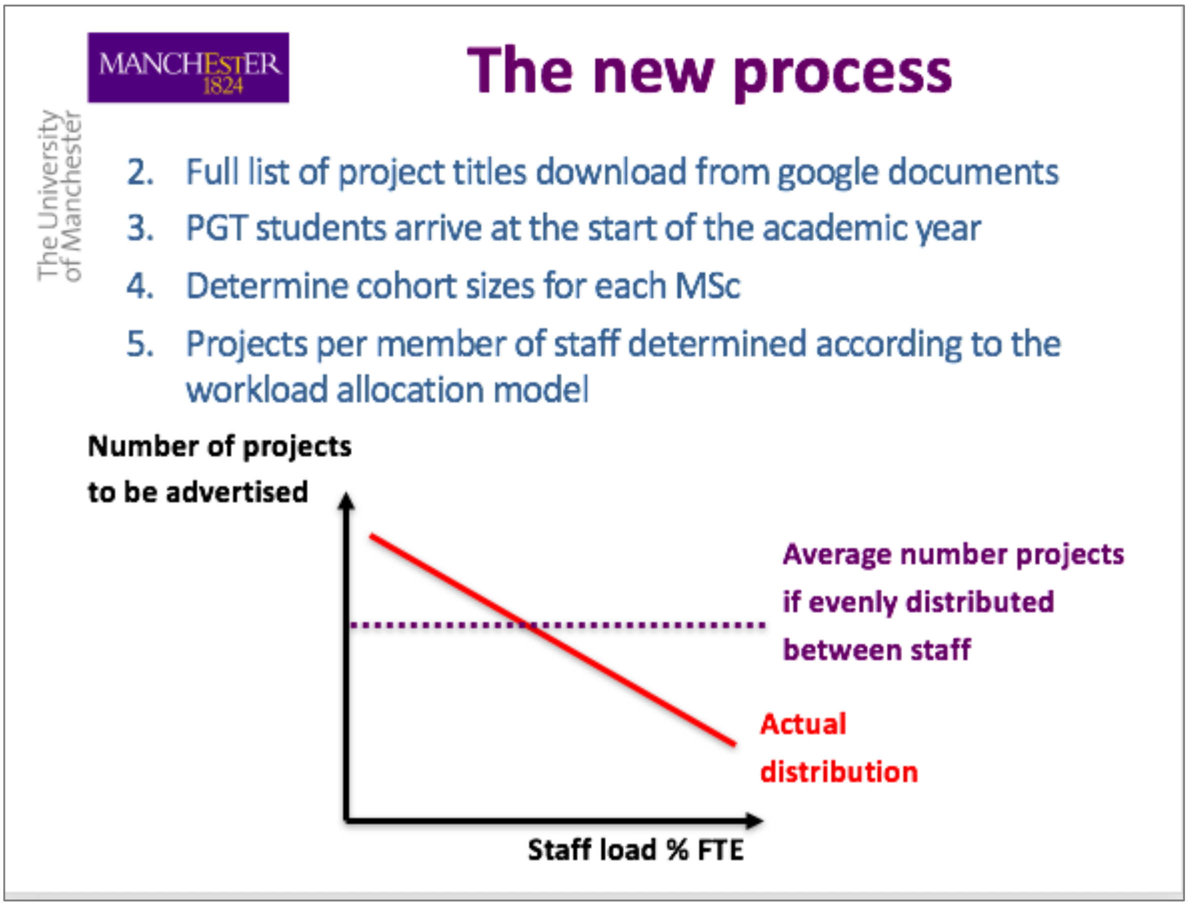
The new process
1. Call for project titles & additional info before summer
• Plan for a large PGT cohort
• Call for more project titles than expected will be needed
• Use google documents – web link sent to staff
• Ask for info on manufacturing/fabrication, technical support
Copy of MSc Dissertation Topics 2017/18
SEND
QUESTIONS
RESPONSES 454
MACE UG Investigative Project 2018/19
Supervisor
Project title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The University of Manchester
The new process
2. Full list of project titles download from google documents
3. PGT students arrive at the start of the academic year
4. Determine cohort sizes for each MSc
5. Projects per member of staff determined according to the workload allocation model
Number of projects to be advertised
Average number projects if evenly distributed between staff
Actual distribution
Staff load % FTE

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The new process

6. Titles disseminated to students
7. Students read projects description and meet staff on a particular afternoon to discuss
8. Students submit top 5 project choices via virtual learning environment
9. An algorithm assigns projects which maximizes the number of students getting their most preferred project
10. Results disseminated

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The University of Manchester

Impact

The new process has achieved the desired objectives of:

1. **Promoting Fairness to students and staff**
2. **Enhancing student experience**
3. **Reducing process workload**
4. **Reduce workload at peak times**
5. **Collect additional information**
    - Manufacturing/fabrication requirements used to plan staffing levels at peak times
    - Some technical staff identified as highly loaded enabling support plans to be implemented

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Lessons learned

1. **Support needed for colleagues to adapt to changes in process**
    - Vital to convince the majority of the need for change

2. **Support needed for students to see why they cant sign up for a project with the professor they want.**

1. **Clear communication and a transparent process needed**

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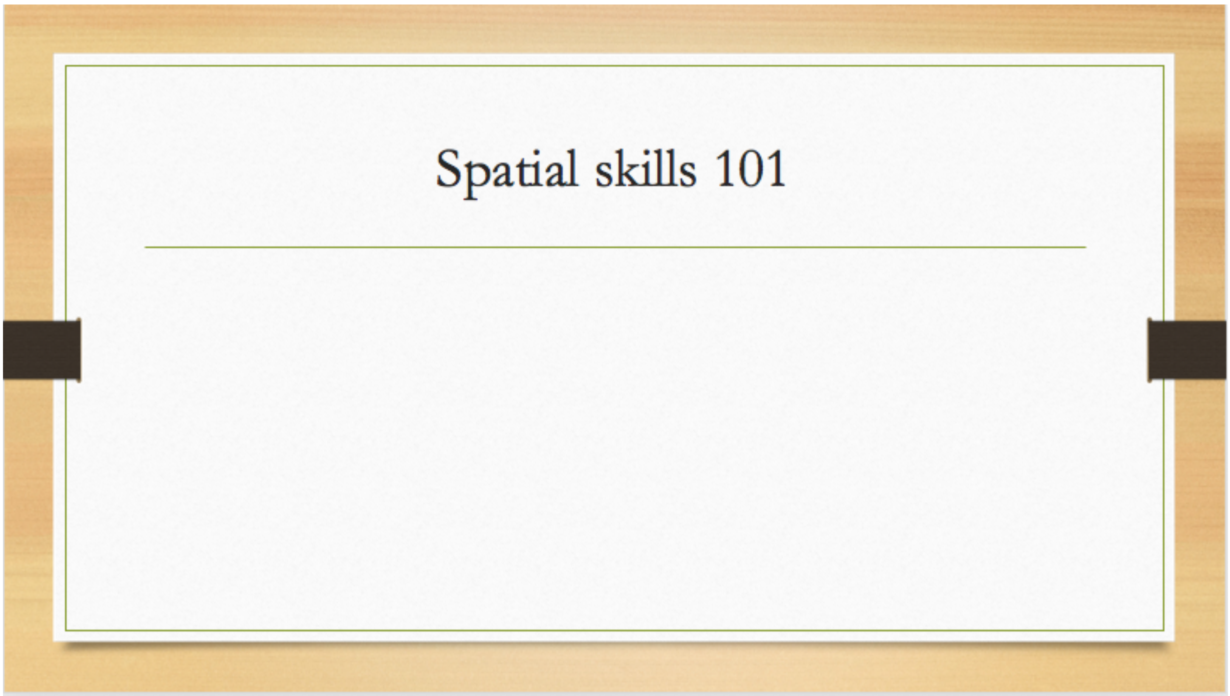
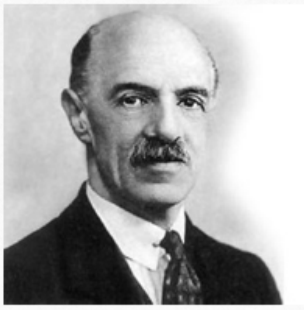
Conclusions

1. **We have had a positive impact**

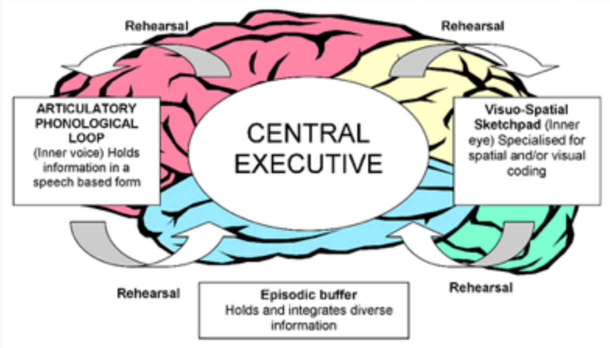
2. **More opportunities for improving efficiency and effectiveness**
    - **Submission of coursework grades by staff**
    - **Dissertation marking process**
    - **Separate processes across different MSc's/UG courses**


Spatial ability deserves greater attention in engineering education research
Gavin Duffy
D·I·T
CREATE
Contributions to Research in Engineering & Applied Technology Education


Spatial skills 101

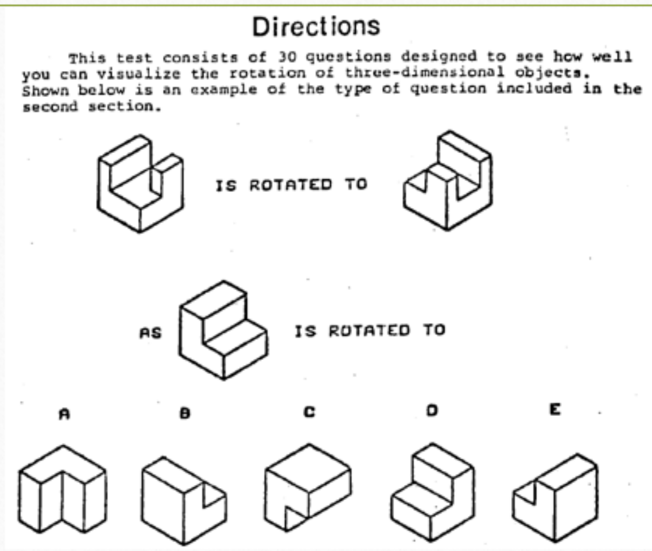


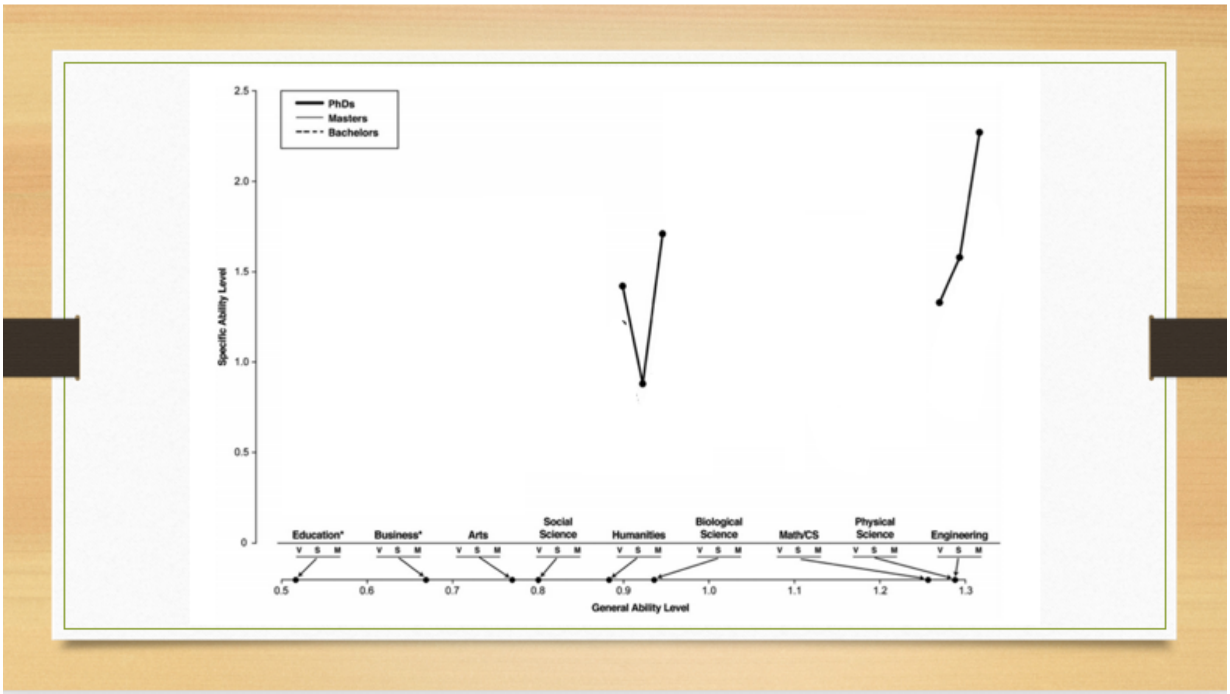
Memory models of cognition

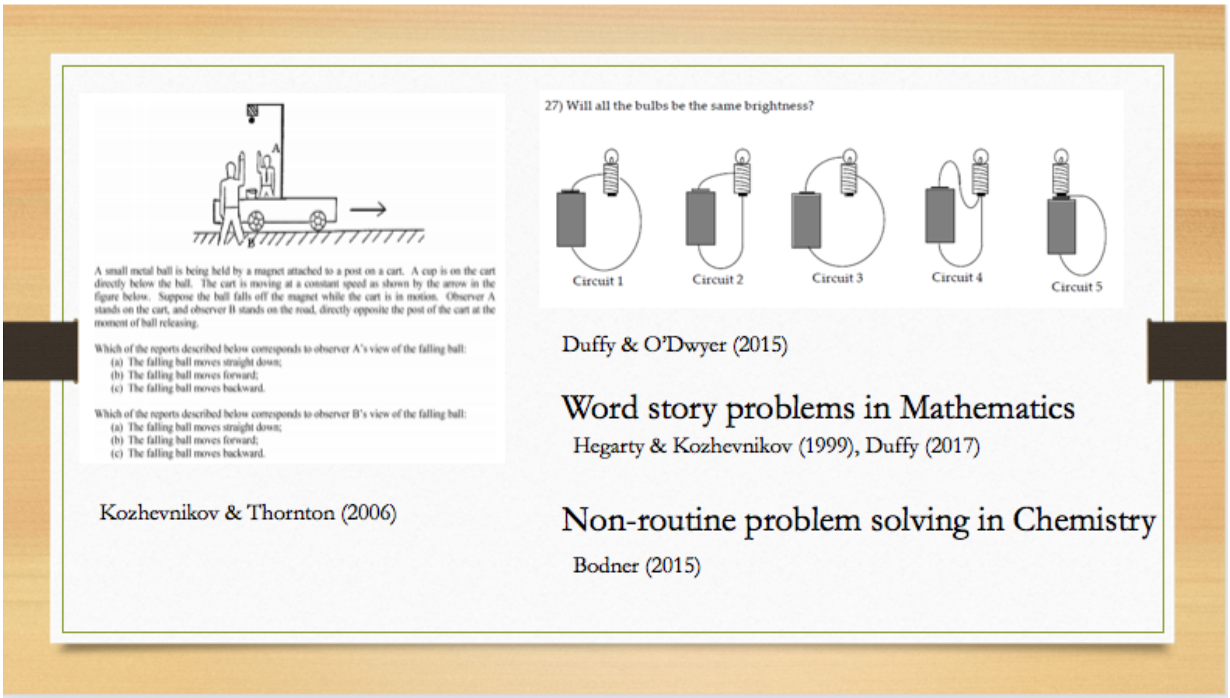


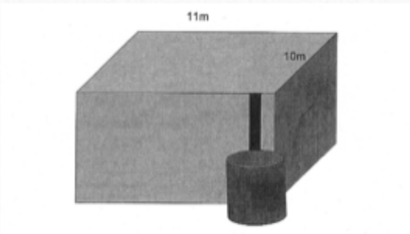
Spearman (1904) – hierarchical factors
1st level = g, general intelligence
2nd level = s, specific abilities – verbal, math
Spatial

Spatial ability is g (Lohman, 1995)

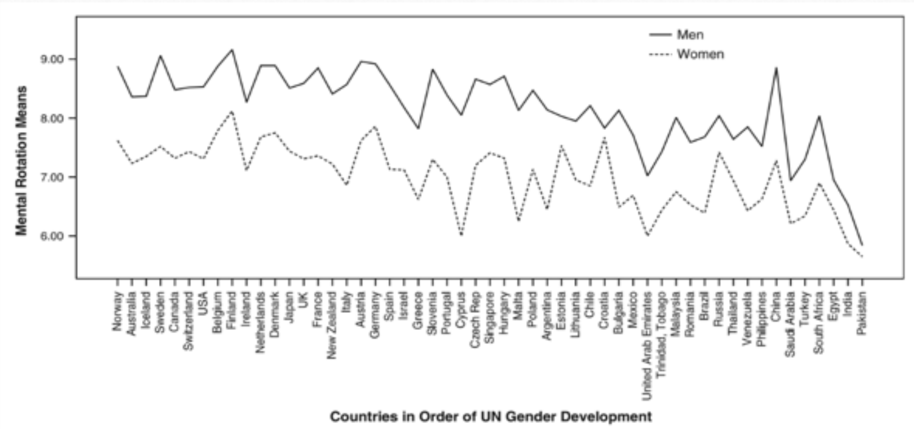



PhDs
Masters
Bachelors
Specific Ability Level
2.5
2.0
1.5
1.0
0.5
0
Education*
Business*
Arts
Social Science
Humanities
Biological Science
Math/CS
Physical Science
Engineering
V S M
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
General Ability Level

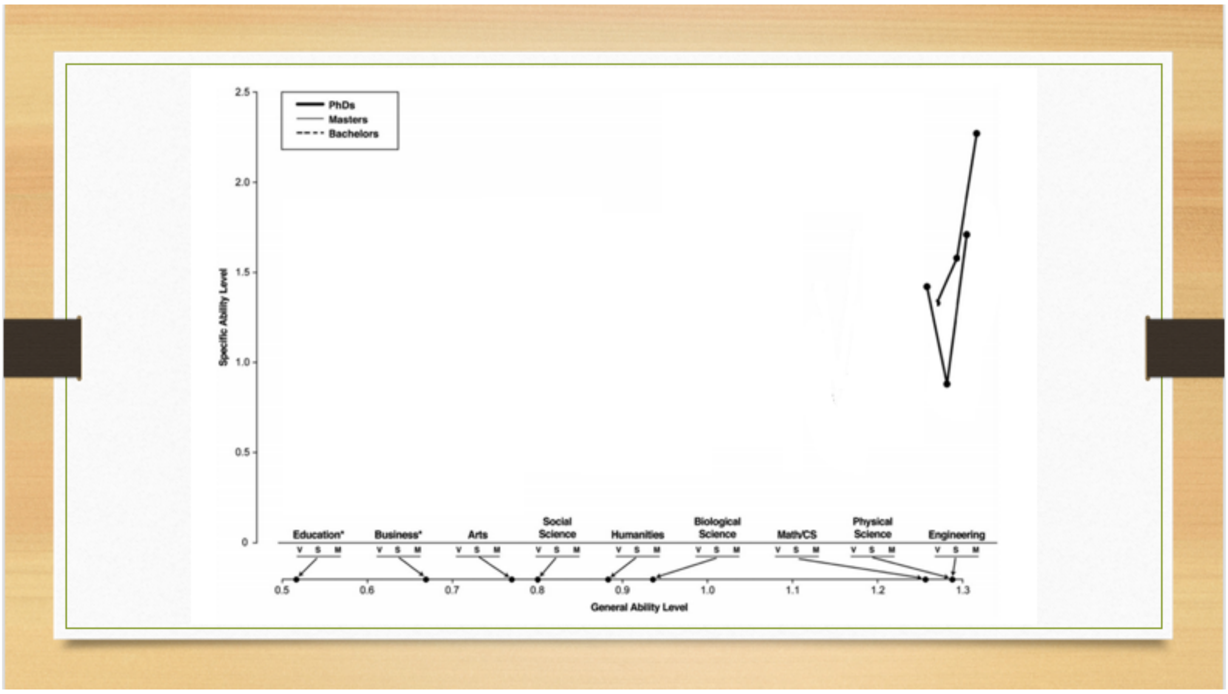

A
B
A small metal ball is being held by a magnet attached to a post on a cart. A cup is on the cart directly below the ball. The cart is moving at a constant speed as shown by the arrow in the figure below. Suppose the ball falls off the magnet while the cart is in motion. Observer A stands on the cart, and observer B stands on the road, directly opposite the post of the cart at the moment of ball releasing.
Which of the reports described below corresponds to observer A's view of the falling ball:
(a) The falling ball moves straight down;
(b) The falling ball moves forward;
(c) The falling ball moves backward.
Which of the reports described below corresponds to observer B's view of the falling ball:
(a) The falling ball moves straight down;
(b) The falling ball moves forward;
(c) The falling ball moves backward.
Kozhevnikov & Thornton (2006)
27) Will all the bulbs be the same brightness?
Circuit 1
Circuit 2
Circuit 3
Circuit 4
Circuit 5
Duffy & O'Dwyer (2015)
Word story problems in Mathematics
Hegarty & Kozhevnikov (1999), Duffy (2017)
Non-routine problem solving in Chemistry
Bodner (2015)

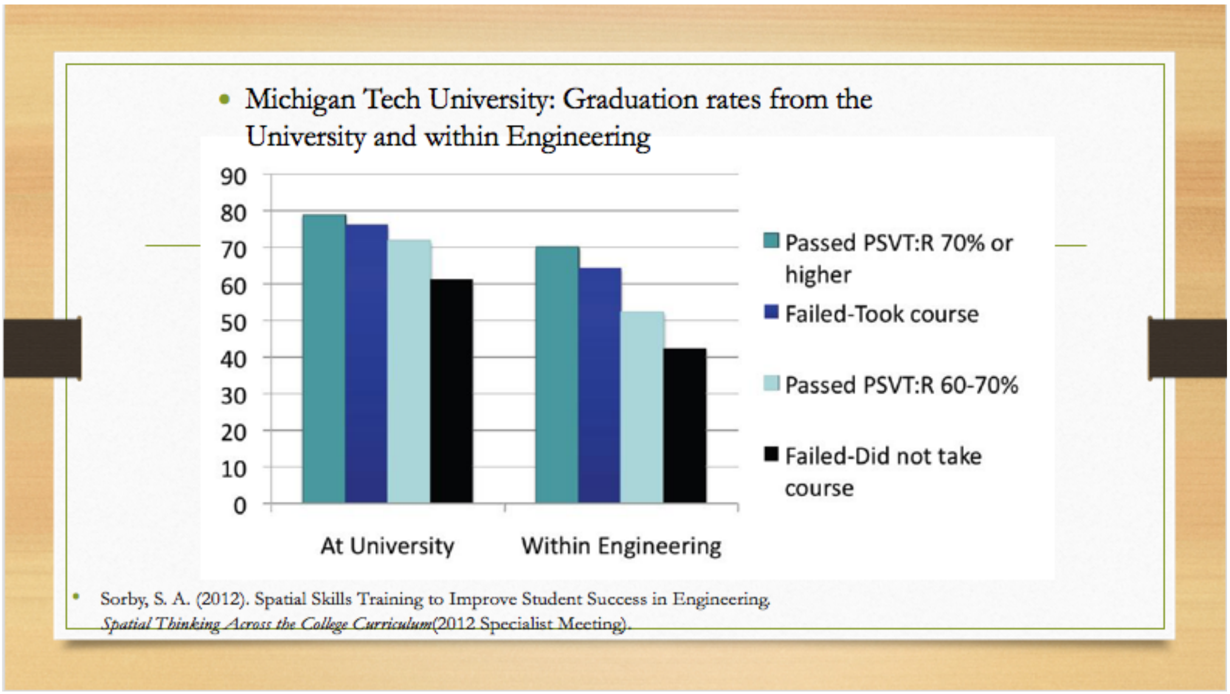


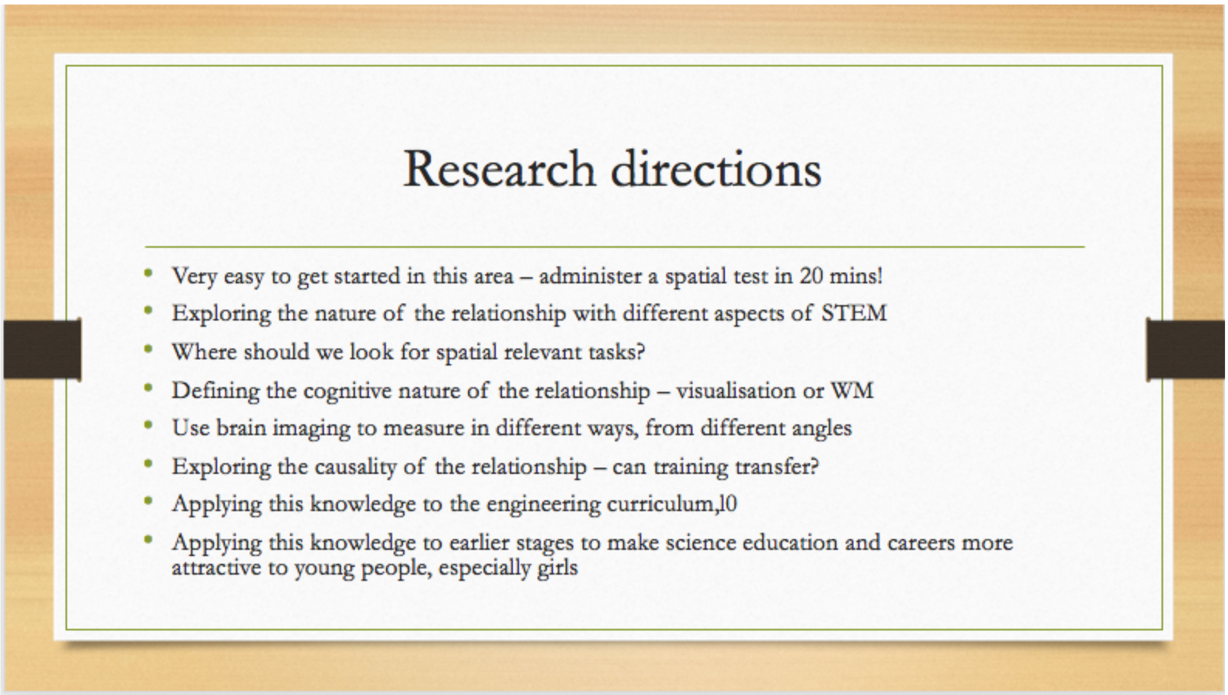
The diagram above shows the dimensions of a flat roofed commercial shed. During one week 5 mm of rain fell on the roof of the shed. The rain was collected by gutters that flowed into a cylindrical water barrel with a **diameter** of 1 m. By how much did the depth of the water in the barrel increase as a result of this rain?

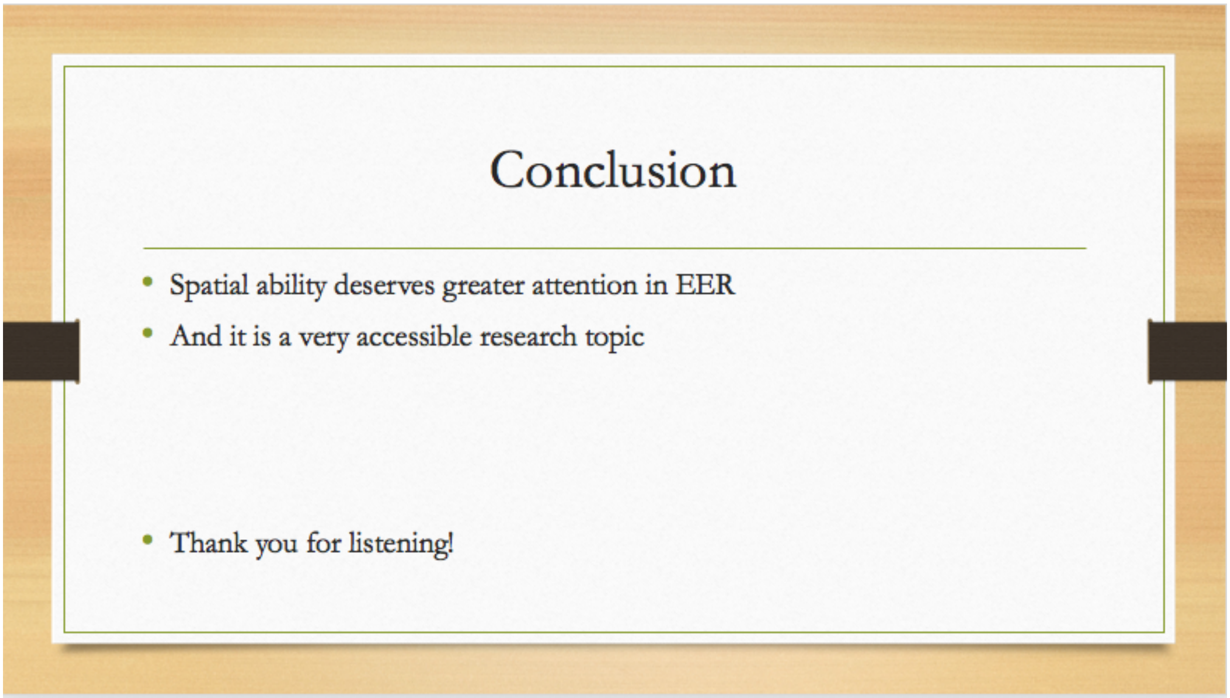


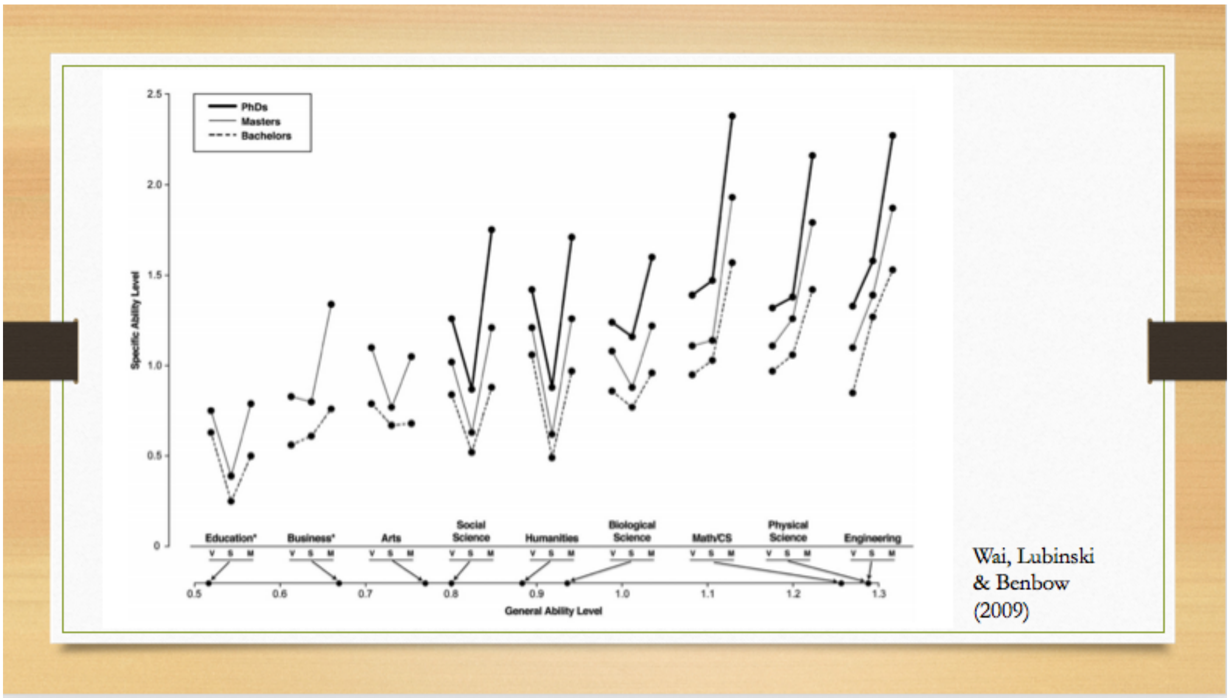
Lippa, R. A., Collaer, M. L., & Peters, M. (2010). Sex differences in mental rotation and line angle judgments are positively associated with gender equality and economic development across 53 nations. Archives of Sexual Behavior, 39(4), 990–997

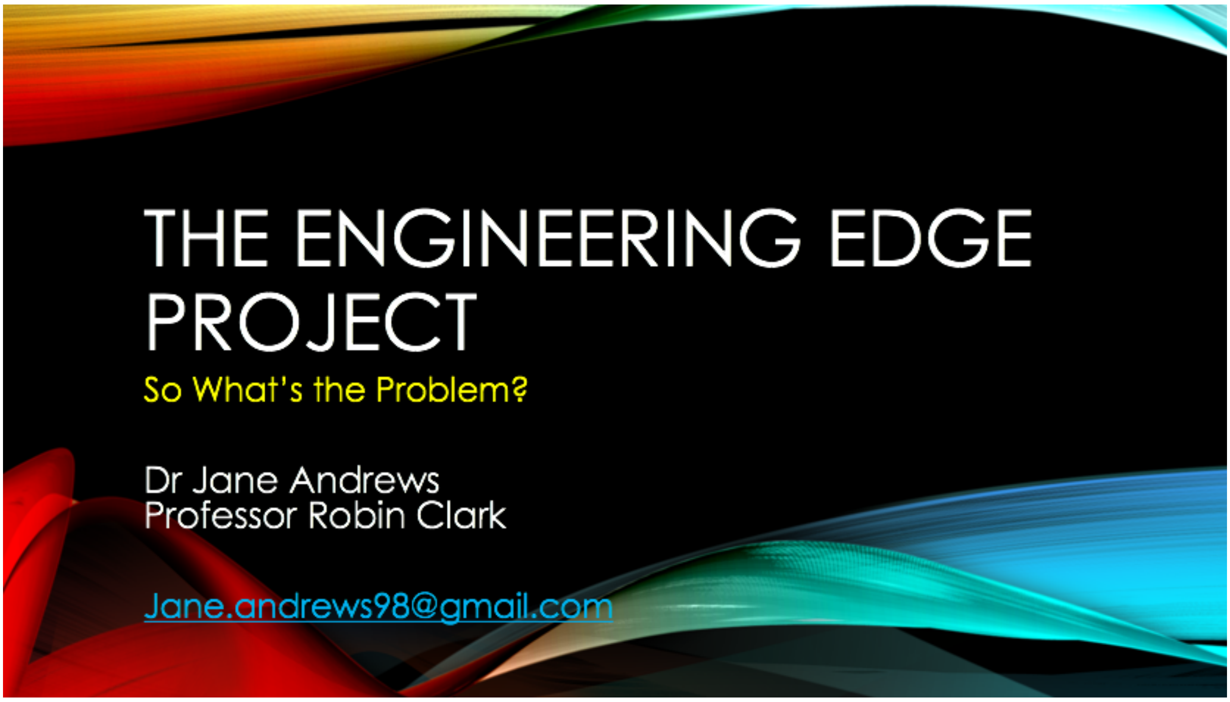

PhDs
Masters
Bachelors
Specific Ability Level
2.5
2.0
1.5
1.0
0.5
0
Education*
Business*
Arts
Social Science
Humanities
Biological Science
Math/CS
Physical Science
Engineering
V S M
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
General Ability Level

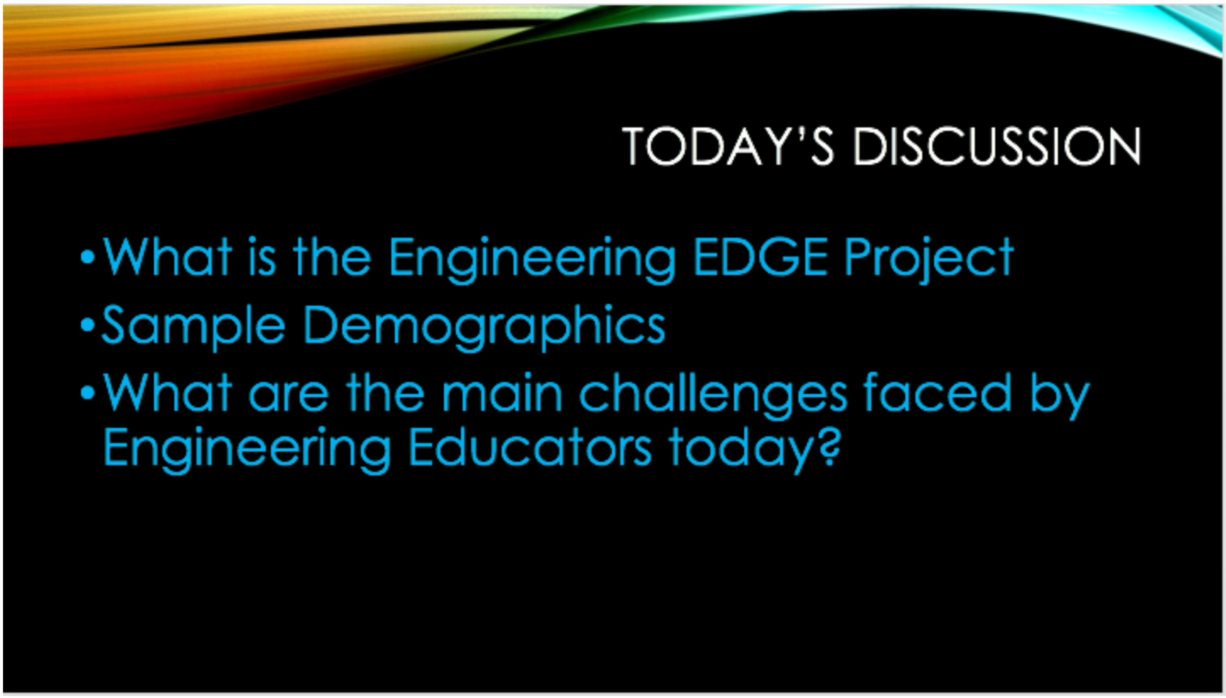

Michigan Tech University: Graduation rates from the University and within Engineering
90
80
70
60
50
40
30
20
10
0
At University
Within Engineering
Passed PSVT:R 70% or higher
Failed-Took course
Passed PSVT:R 60-70%
Failed-Did not take course
Sorby, S. A. (2012). Spatial Skills Training to Improve Student Success in Engineering. Spatial Thinking Across the College Curriculum(2012 Specialist Meeting).


Research directions
Very easy to get started in this area – administer a spatial test in 20 mins!
Exploring the nature of the relationship with different aspects of STEM
Where should we look for spatial relevant tasks?
Defining the cognitive nature of the relationship – visualisation or WM
Use brain imaging to measure in different ways, from different angles
Exploring the causality of the relationship – can training transfer?
Applying this knowledge to the engineering curriculum,10
Applying this knowledge to earlier stages to make science education and careers more attractive to young people, especially girls


Conclusion
Spatial ability deserves greater attention in EER
And it is a very accessible research topic
Thank you for listening!


PhDs
Masters
Bachelors
Specific Ability Level
General Ability Level
Education*
Business*
Arts
Social Science
Humanities
Biological Science
Math/CS
Physical Science
Engineering
Wai, Lubinski & Benbow (2009)


THE ENGINEERING EDGE PROJECT
So What's the Problem?
Dr Jane Andrews
Professor Robin Clark
Jane.andrews98@gmail.com


TODAY'S DISCUSSION
•What is the Engineering EDGE Project
•Sample Demographics
•What are the main challenges faced by Engineering Educators today?

WHAT IS THE ENGINEERING EDGE PROJECT?

- A Project undertaken by the UK and Ireland Engineering Education Research Network in partnership with the Royal Academy of Engineering
- A collaboration of 8 different HEI's including:
  - Esat Alpay: University of Surrey
  - Jude Breton: University of York
  - Robin Clark : Warwick University
  - John Davies: Plymouth University
  - Manish Malik: Portsmouth University
  - Roger Penlington: University of Northumbria
  - Ahn Tran: Coventry University
  - Peter Willmott: Loughborough University

Primary Research Question: ***Are Engineering Educators "Fit for Purpose"***

SAMPLE DEMOGRAPHICS

30% of the sample were female (*TOTAL NUMBER IN SAMPLE* = 171)

Sample Gender Distribution

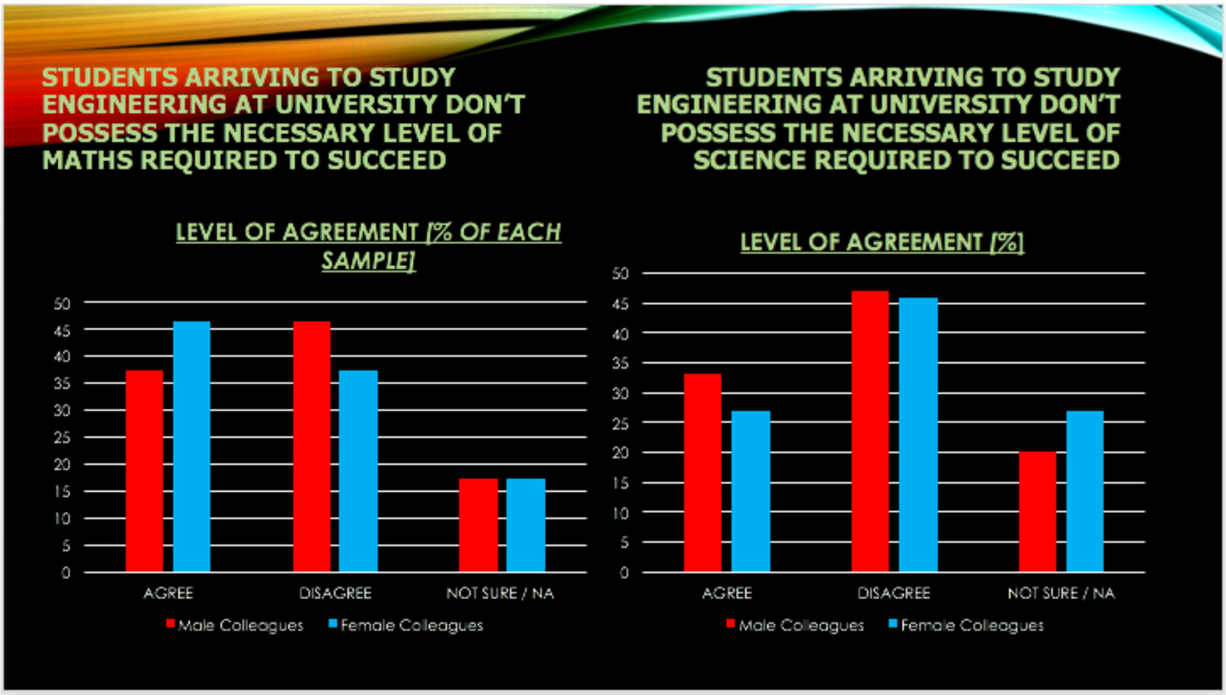
Primary Discipline

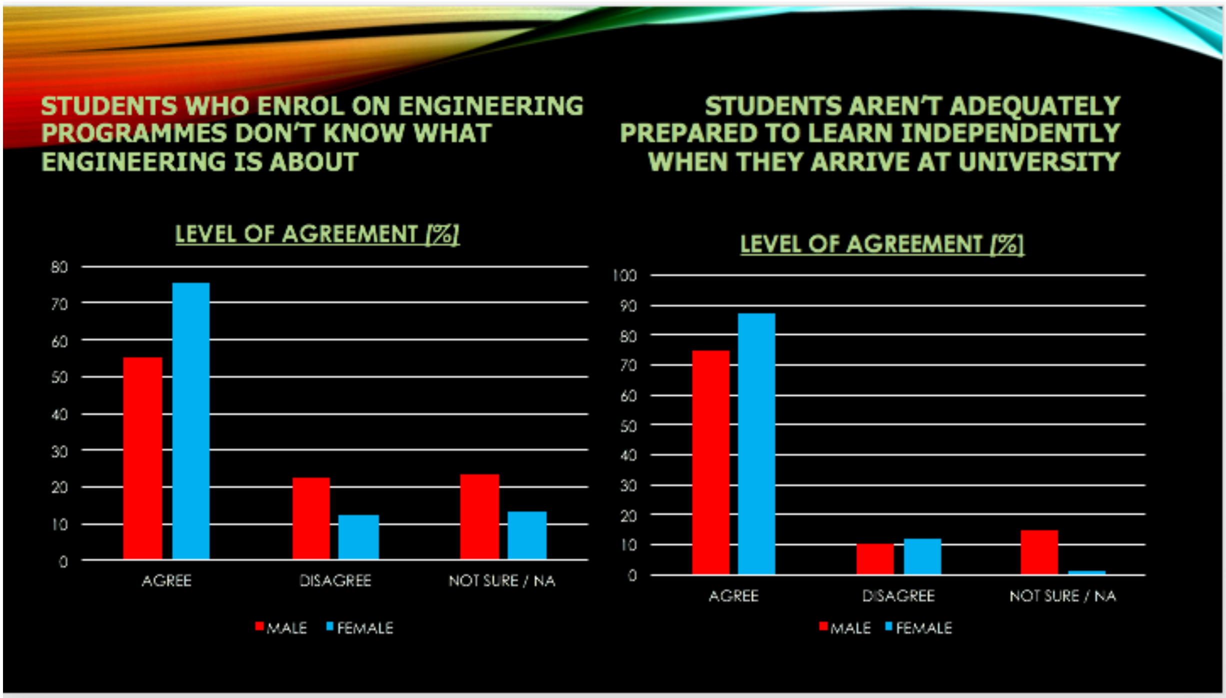
Discipline	Male	Female
Engineering (All engineering fields)	105	43
Applied Science (including Physics, Chemistry)	4	1
Maths	1	2
Biological Science	0	0
Social Science & Humanities	3	6
Other (including multi-or-combined disciplines	6	0
Total	119	52

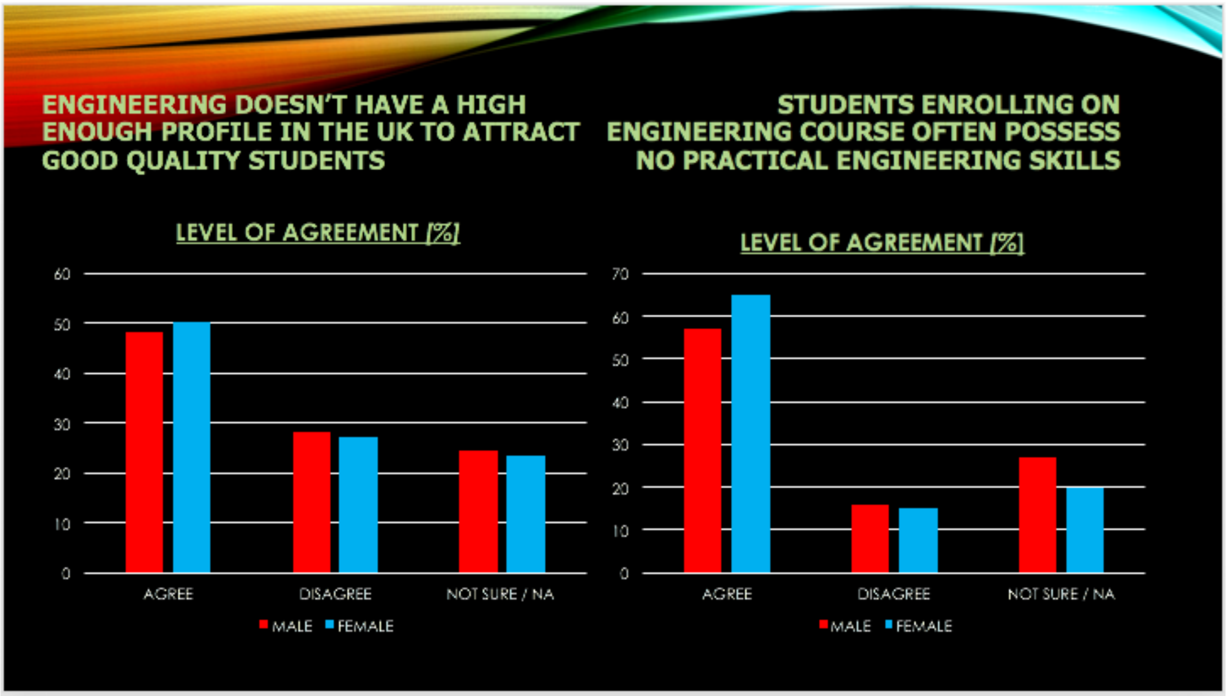
TEACHING QUALIFICATIONS

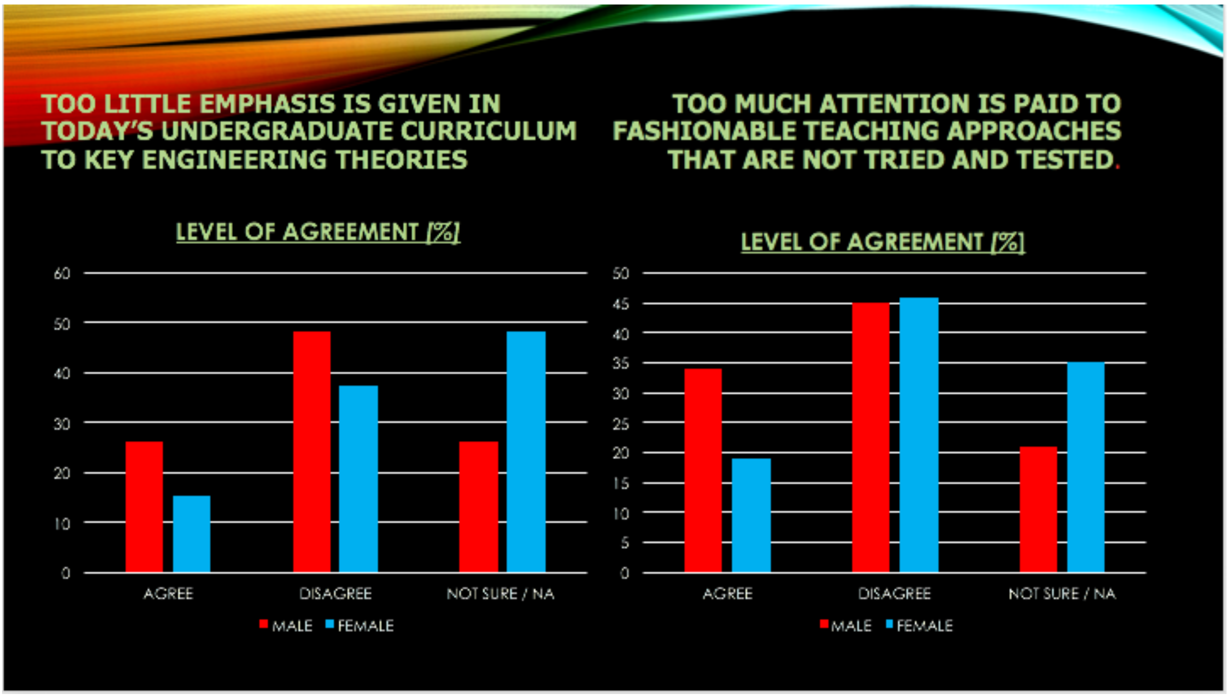
Qualifications & Professional Recognition	M	F
PG Cert in H.E.	52	20
HEA Fellowship	45	16
Senior Fellowship HEA	18	10
Working towards a qualification	12	6
PG DIP in H.E.	7	5
HEA Associate Fellowship	3	9
International teaching qualification	3	2
HEA Principal Fellowship	2	0
Working towards a qualification / Fellowship	12	6
None	20	4

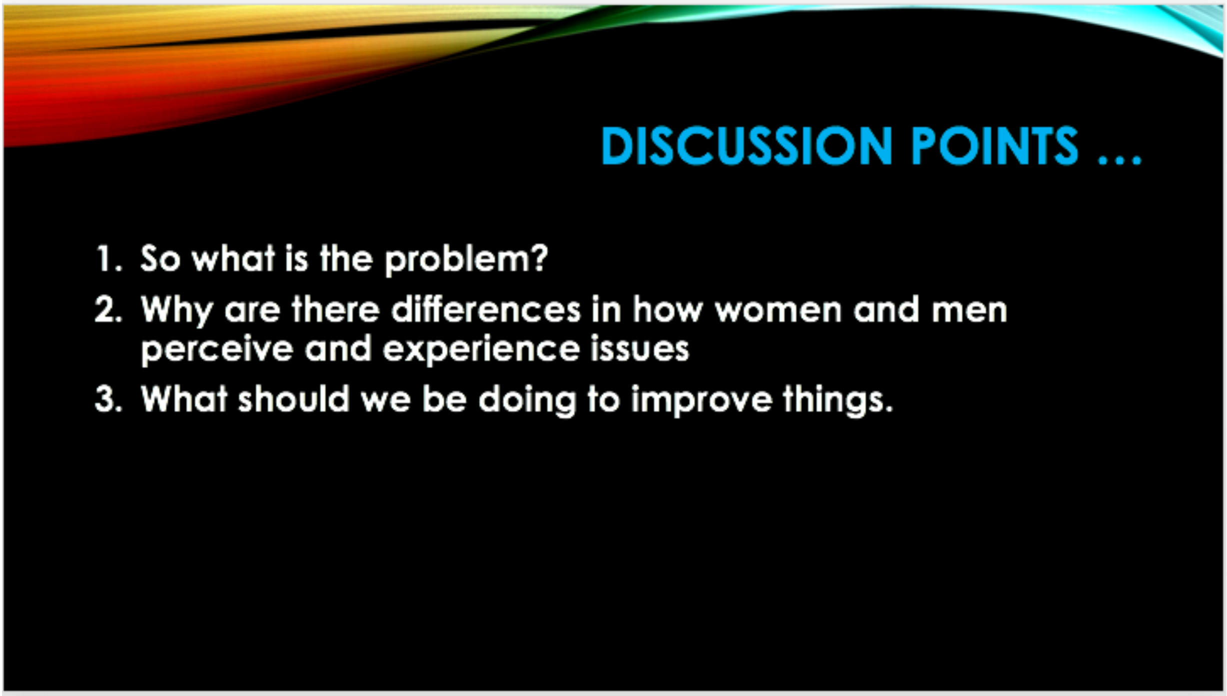
What are the main challenges faced by Engineering Educators?

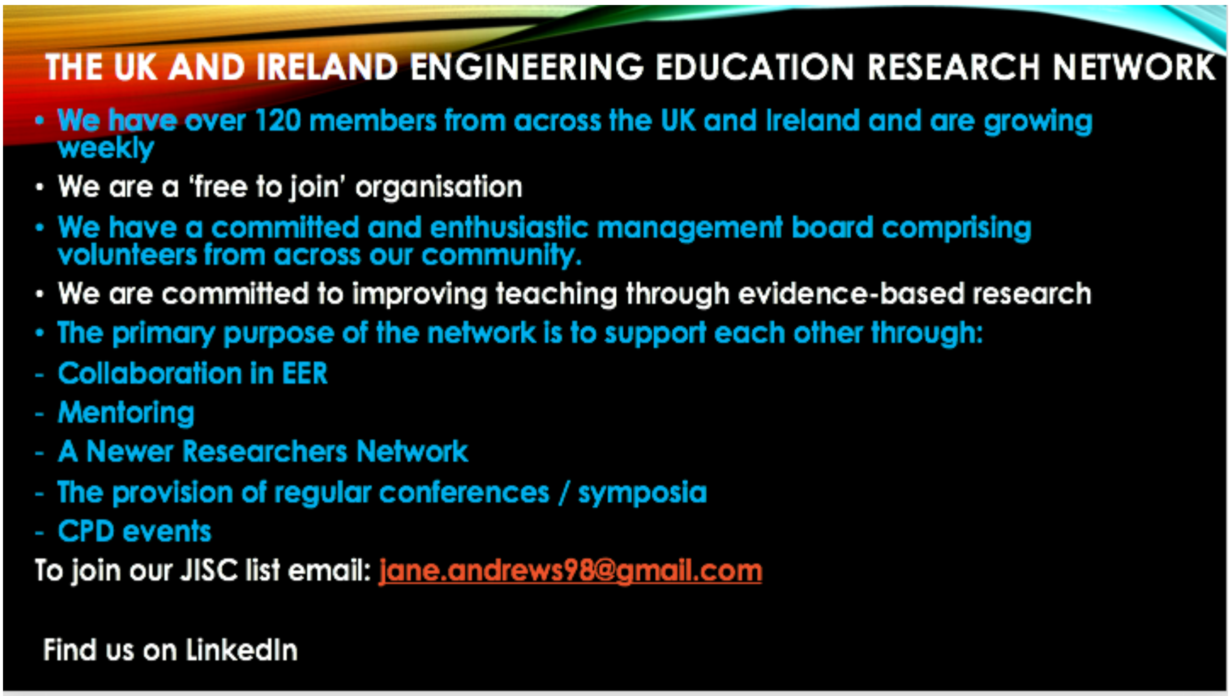

STUDENTS ARRIVING TO STUDY ENGINEERING AT UNIVERSITY DON'T POSSESS THE NECESSARY LEVEL OF MATHS REQUIRED TO SUCCEED
LEVEL OF AGREEMENT [% OF EACH SAMPLE]
50
45
40
35
30
25
20
15
10
5
0
AGREE
DISAGREE
NOT SURE / NA
Male Colleagues
Female Colleagues
STUDENTS ARRIVING TO STUDY ENGINEERING AT UNIVERSITY DON'T POSSESS THE NECESSARY LEVEL OF SCIENCE REQUIRED TO SUCCEED
LEVEL OF AGREEMENT [%]
50
45
40
35
30
25
20
15
10
5
0
AGREE
DISAGREE
NOT SURE / NA
Male Colleagues
Female Colleagues


STUDENTS WHO ENROL ON ENGINEERING PROGRAMMES DON'T KNOW WHAT ENGINEERING IS ABOUT
LEVEL OF AGREEMENT [%]
80
70
60
50
40
30
20
10
0
AGREE
DISAGREE
NOT SURE / NA
MALE
FEMALE
STUDENTS AREN'T ADEQUATELY PREPARED TO LEARN INDEPENDENTLY WHEN THEY ARRIVE AT UNIVERSITY
LEVEL OF AGREEMENT [%]
100
90
80
70
60
50
40
30
20
10
0
AGREE
DISAGREE
NOT SURE / NA
MALE
FEMALE


ENGINEERING DOESN'T HAVE A HIGH ENOUGH PROFILE IN THE UK TO ATTRACT GOOD QUALITY STUDENTS
LEVEL OF AGREEMENT [%]
60
50
40
30
20
10
0
AGREE
DISAGREE
NOT SURE / NA
MALE
FEMALE
STUDENTS ENROLLING ON ENGINEERING COURSE OFTEN POSSESS NO PRACTICAL ENGINEERING SKILLS
LEVEL OF AGREEMENT [%]
70
60
50
40
30
20
10
0
AGREE
DISAGREE
NOT SURE / NA
MALE
FEMALE


TOO LITTLE EMPHASIS IS GIVEN IN TODAY'S UNDERGRADUATE CURRICULUM TO KEY ENGINEERING THEORIES
LEVEL OF AGREEMENT [%]
60
50
40
30
20
10
0
AGREE
DISAGREE
NOT SURE / NA
MALE
FEMALE
TOO MUCH ATTENTION IS PAID TO FASHIONABLE TEACHING APPROACHES THAT ARE NOT TRIED AND TESTED.
LEVEL OF AGREEMENT [%]
50
45
40
35
30
25
20
15
10
5
0
AGREE
DISAGREE
NOT SURE / NA
MALE
FEMALE


DISCUSSION POINTS …
1. So what is the problem?
2. Why are there differences in how women and men perceive and experience issues
3. What should we be doing to improve things.


THE UK AND IRELAND ENGINEERING EDUCATION RESEARCH NETWORK
• We have over 120 members from across the UK and Ireland and are growing weekly
• We are a 'free to join' organisation
• We have a committed and enthusiastic management board comprising volunteers from across our community.
• We are committed to improving teaching through evidence-based research
• The primary purpose of the network is to support each other through:
- Collaboration in EER
- Mentoring
- A Newer Researchers Network
- The provision of regular conferences / symposia
- CPD events
To join our JISC list email: jane.andrews98@gmail.com
Find us on LinkedIn

The Final Word; concluding remarks by Jane Andrews, Network Membership Secretary.

In reading the various papers included within this publication it is evident that the UK and Ireland Engineering Education Research Network's primary aim of enhancing engineering education through empirical education research is being achieved across the EER community. Encouragingly, the number of colleagues who are 'dipping their toes' into the unknown and seeking to get to grips with the social science epistemology that EER requires, is increasing year on year. Indeed, the Network is not only attracting newer researchers who have recently started their academic careers, but is increasingly, and quite uniquely, attracting senior engineering colleagues who have years' of experience conducting engineering research and who have chosen to apply their enquiring mind and distinctive intellect to problems faced within the engineering education environment. The result of this is that rather than rely on social scientists and educationalists to critique engineering teaching, engineering colleagues are picking up the banner of EER themselves and in doing so conducting high quality, applicable research; the outputs of which are not only useful for those of us responsible for teaching in engineering, but may applied across much of the Higher Education Sector.

As a Social Scientist, the fact that colleagues with expertise in engineering have selected to focus their remarkable minds on education is something that I can only view with some considerable awe. Working within the Engineering Education Research community alongside Engineers & Applied Scientists is something few Social Scientists have the privilege to do. Within the pages of this publication, as within the heart of our EER community, there lies a depth of unique and highly useful knowledge. Indeed, the EER community has come a long way in the 6 or so years the Network has been in existence.

The majority of Engineering Educators who engage with EER are tasked with teaching the 'hard subjects' that other disciplines neither understand nor choose to engage with. In seeking to improve how such 'hard subjects' are taught and so learned, colleagues across the Network are beginning to impact learning and teaching outside of our relatively small community; improving practice not only in the UK and Irish Engineering Education Sectors but across Europe and globally. The authors of each paper published here should therefore to be applauded. At the very forefront of change in Engineering Education, our Network represents a collective of EER Pioneers. This first Spring Colloquium represents another milestone on our journey. Moving forward together, the EER community is beginning to make a difference. This will only increase as time passes. I look forward to the adventure!

APPENDIX 1:

The UK & Ireland Engineering Education Research Network: Further Information

With its origins in a partnership between the HEA Engineering Education Centre at Loughborough University and Aston University, the UK EER Special Interest Group (SIG) was founded in 2008. The first National EER SIG Day Conference took place in 2012 at Loughborough University. Since then, the community has grown. Changing its focus from that of a 'group' to a 'network' and bringing Ireland into the fold, the Network now has well over 100 members from across the UK and Ireland; with other members being drawn from Europe and Australia.

Brought together by a passion and belief that Engineering Education should be unpinned by sound pedagogical evidence, the EER Community continues to grow. The 5th Annual Symposium of the Network represented a turning point for our community. Together we now represent numerous perspectives, interests and disciplines. A Newer Researchers SIG is soon to be launched under the auspices of the Network where there is plenty of room for emergent groups to be hosted and views to be heard.

The Network is honoured that the Royal Academy of Engineering provides the 'home' for our website which may be found at: https://hefocus.raeng.org.uk/eern-home/

Joining the Network
Membership of the Network is open to all colleagues with an interest in Engineering Education Research. Primarily for the UK and Irish communities, members from elsewhere are welcomed.

Membership is free of charge and open to academic, professional support staff, postgraduate students, professional body members and representatives as well as any colleagues working in industry.

To become a member please email Dr Jane Andrews jane.andrews98@gmail.com

Dr Roger Penlington
UK & I EERN Vice Chair
Associate Professor
Department of Mechanical and Construction Engineering
Northumbria University
Newcastle upon Tyne UK

Dr Jane Andrews
UK & I EERN Membership Secretary

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