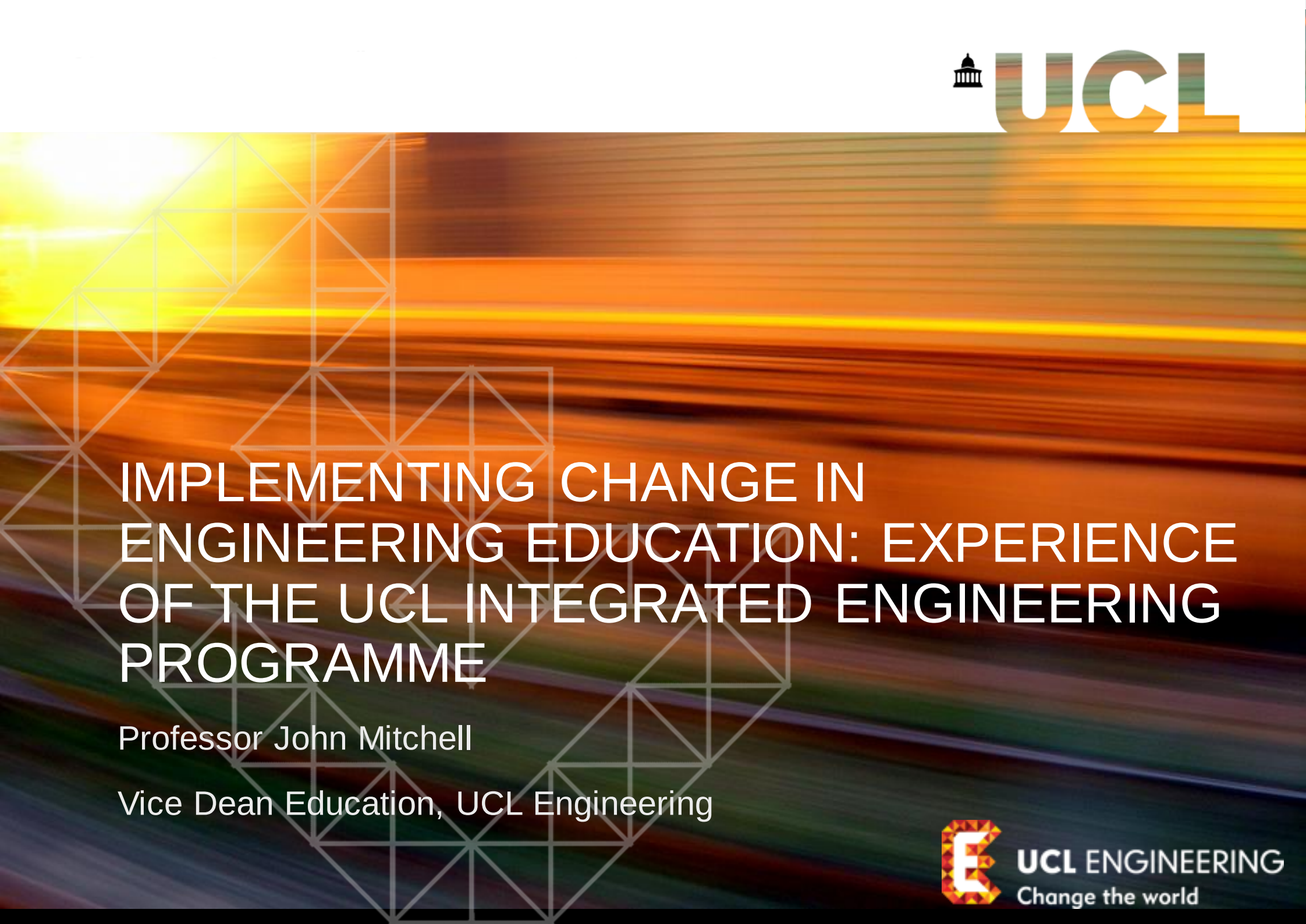
UCL
IMPLEMENTING CHANGE IN ENGINEERING EDUCATION: EXPERIENCE OF THE UCL INTEGRATED ENGINEERING PROGRAMME
Professor John Mitchell
Vice Dean Education, UCL Engineering
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LONDON'S GLOBAL UNIVERSITY

UCL

Founded in 1826 as University of London

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

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

> 6,000 academic and research staff

> 40,000 Students, 52% at Graduate Level

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

About the Faculty

In 1827 UCL founded the one of the first laboratories in the world devoted to engineering education. This was the beginning of Engineering at UCL.

- 10 Departments
- ~ 3500 UG over 22 undergraduate programmes
- ~ 2000 PGT over 56 postgraduate taught programmes
- ~ 1000 PGR
- 1161 FTE Staff (313 FTE Academics)
- 34% female, 66% male, 48.5% Overseas from 131 countries (2017/18)
- 14.7 - Student-Staff Ratio (2017/18)

Why re-engineer engineering education?

What is Engineering?

engineering

….the art and practice

of

changing the physical world

for

the use and benefit of all

Prof Chris Wise, UCL Civil, Environmental and Geomatic Engineering and Expedition Engineering

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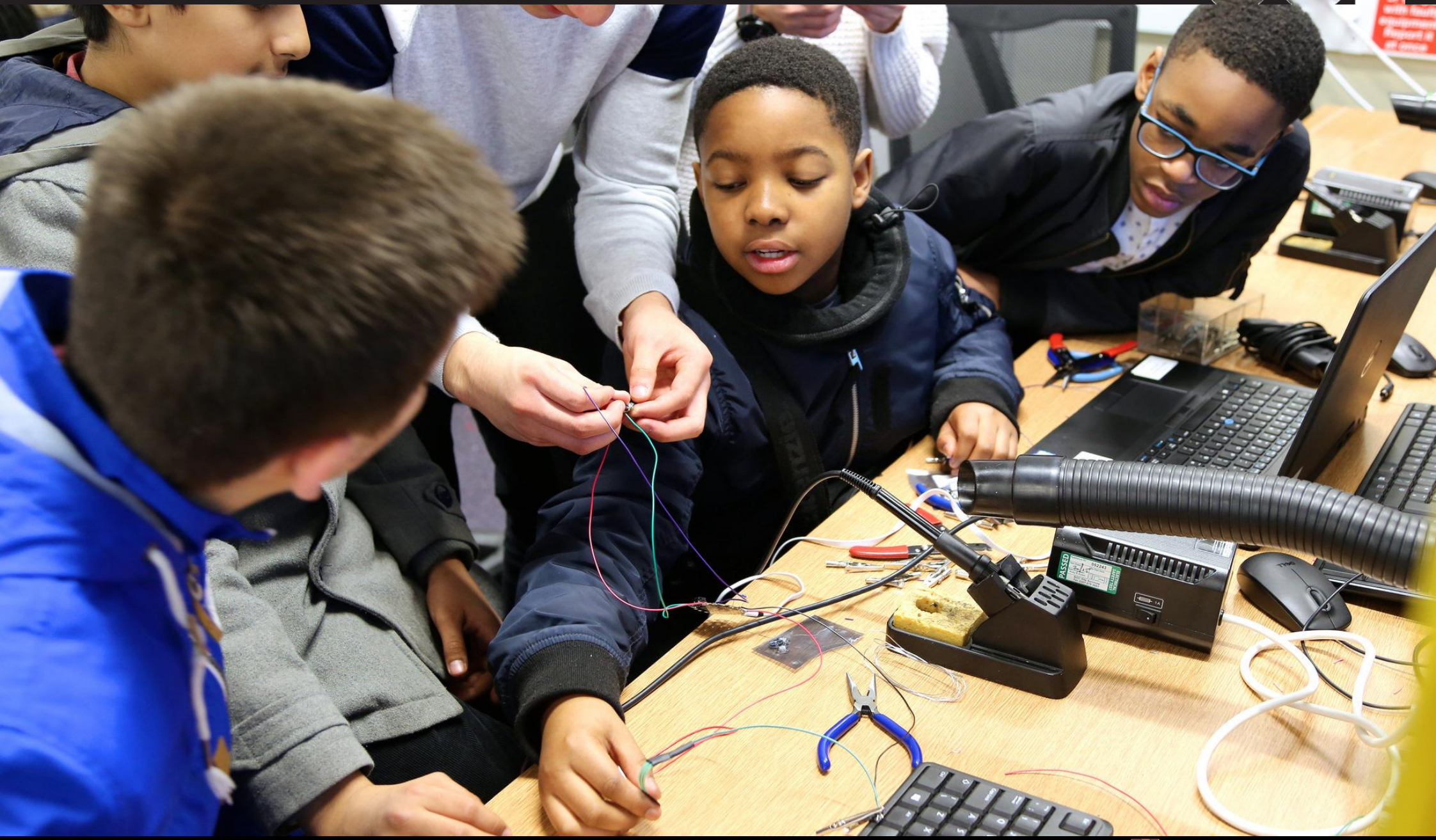
Art - Creativity

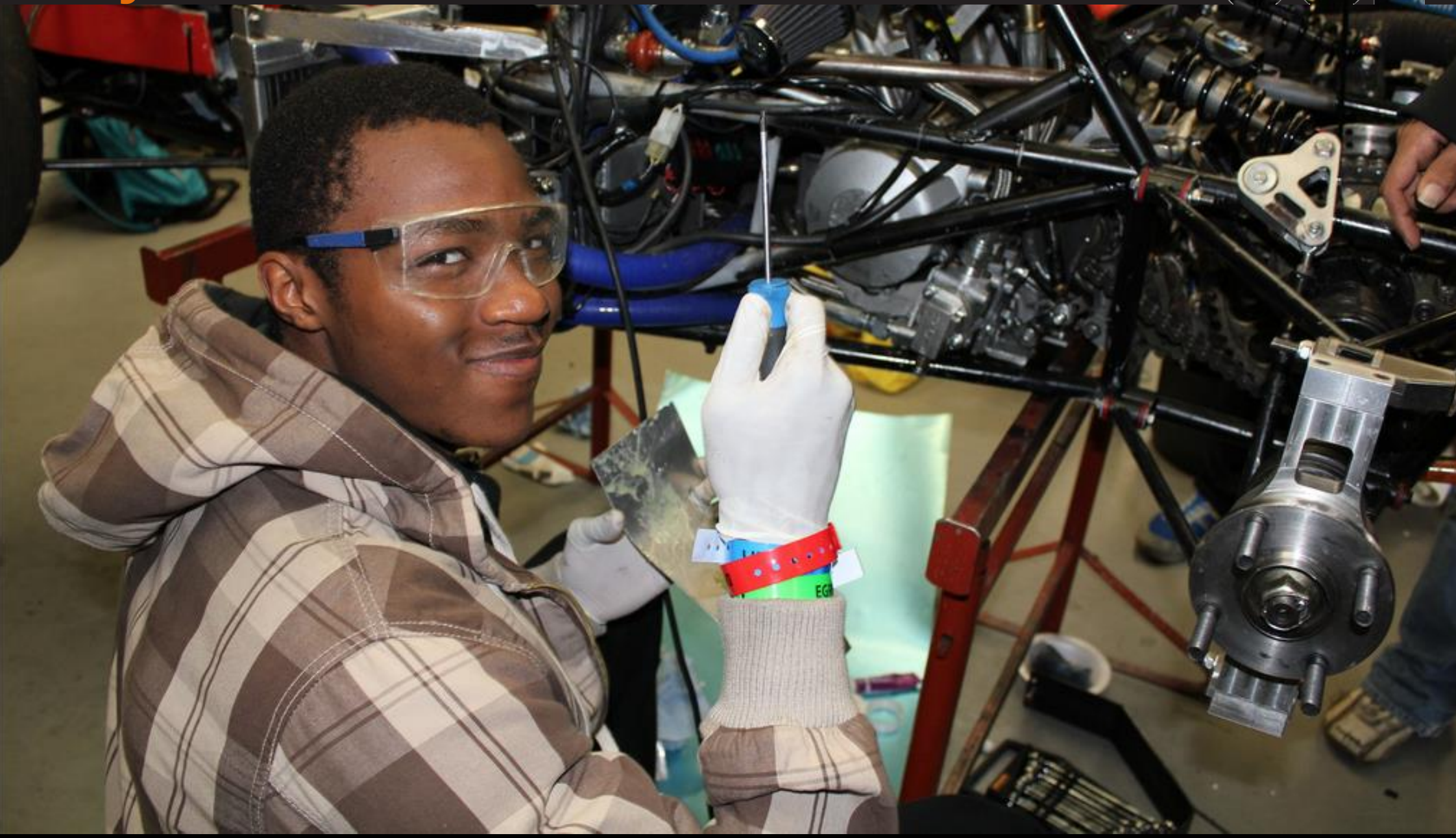
"I think I would have done engineering if I'd known what a creative subject it was and not just about solving equations"

Virginia – UCL BASc Engineering Pathway student

Practice



Physical World



Use and benefit of All

Caminos de Agua - **EWB Summer School 2016**

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Inclusivity and Diversity

- We must grow our intake into engineering qualifications, casting our net wider *beyond* those traditionally drawn to engineering
- Essential to attract creative, enthusiastic, engaged students from all backgrounds and demographics
- Go beyond the narrow pool of mathematics and physics A-level students

So what are the demands on engineering education?

Student Demands

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

Industry Demands

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Engineering Education

What is it for?

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

What might it look like?

Curriculum innovation includes cross-disciplinarity with increasing use of:

- problem and project-based learning,
- group learning and assessment,
- authentic workplace learning, and
- research-based/enquiry learning,

supported by:

- engineering education research,
- industry engagement,
- connections with alumni,
- staff development and expansive teaching spaces.


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INTEGRATED ENGINEERING PROGRAMME (IEP)
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What is the IEP?

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

Aims

Demonstrate the Interdisciplinary nature of Engineering

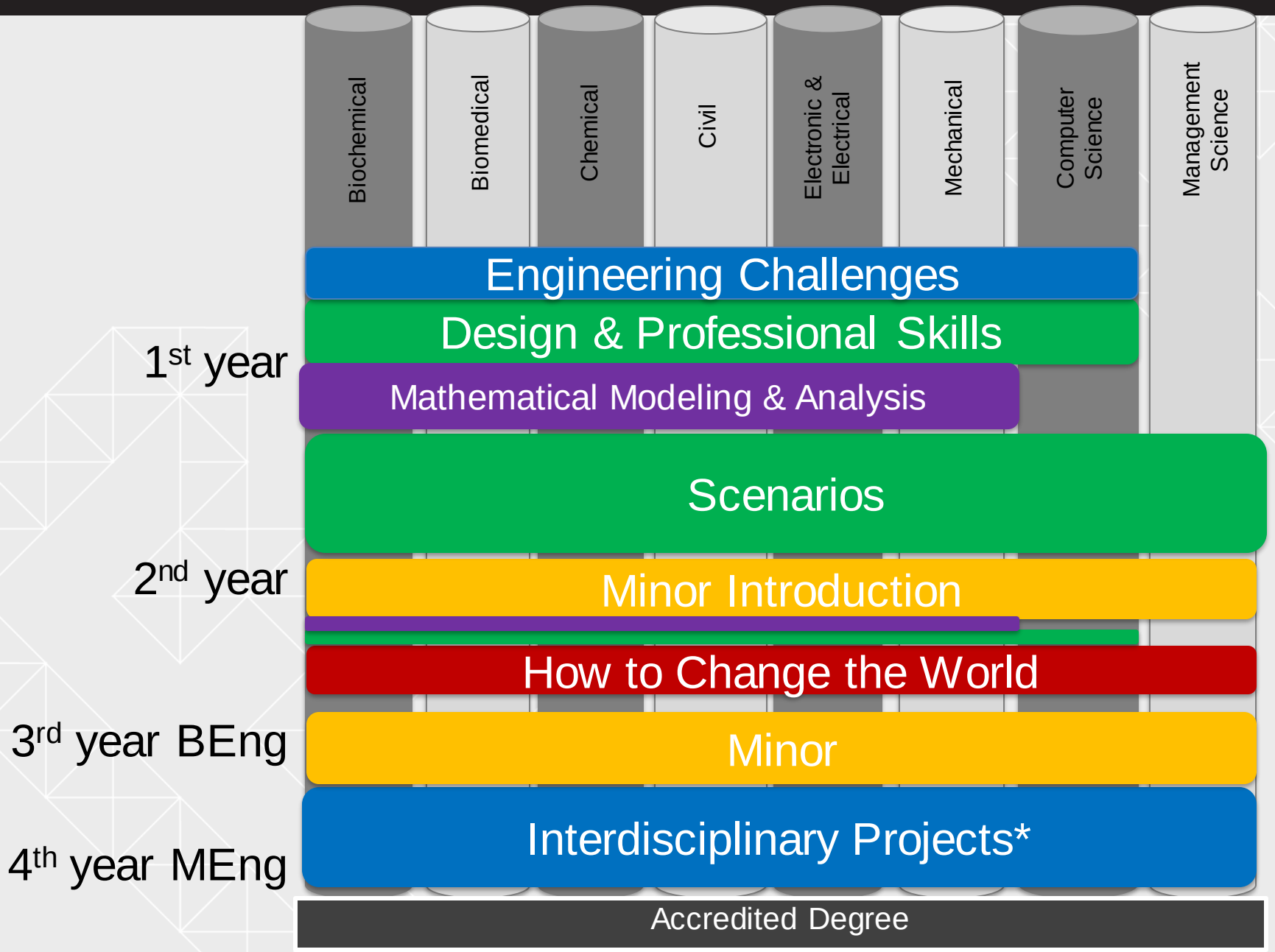
Develop and inclusive curriculum promoting diversity

Authentic Practical Engineering from the start

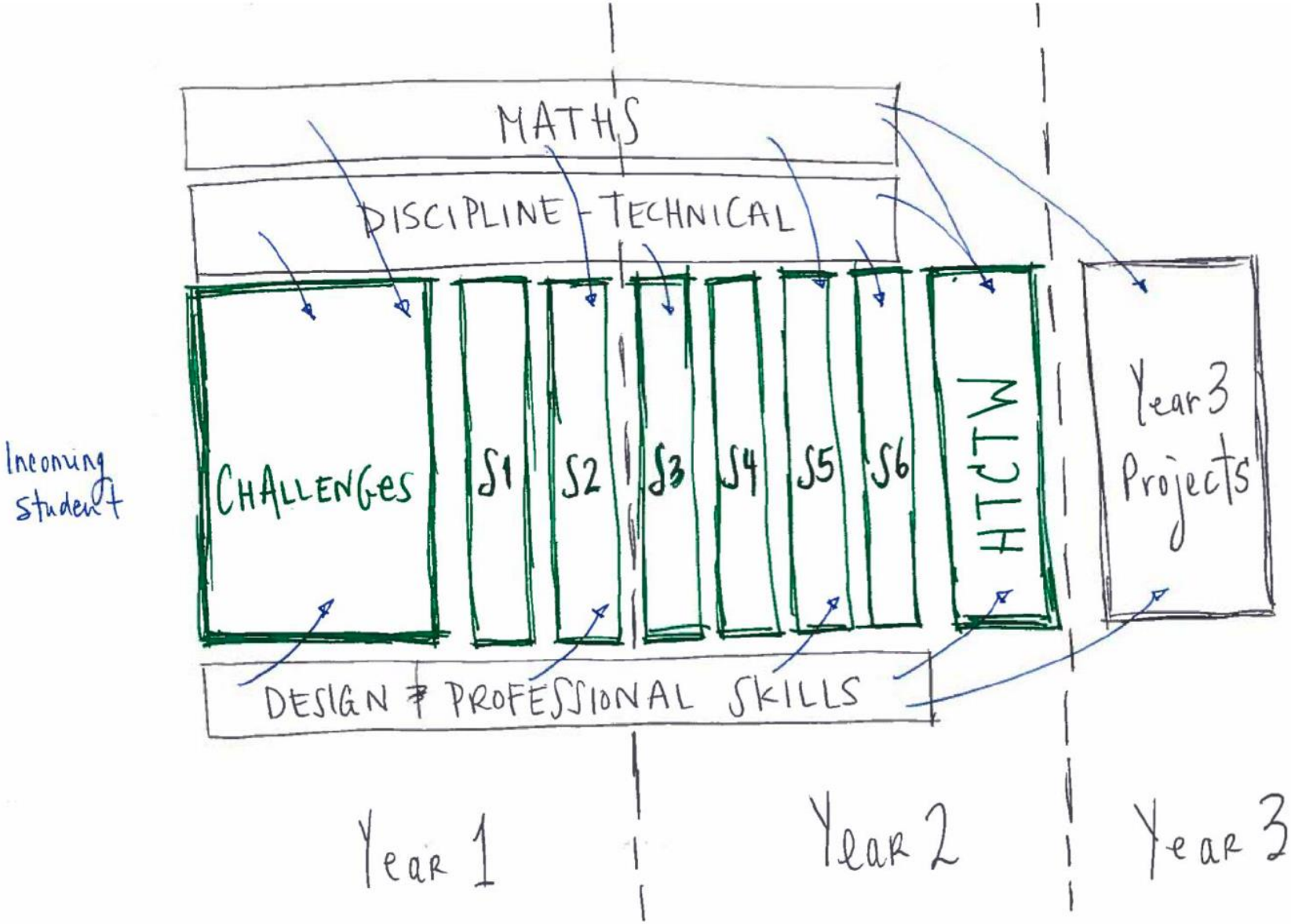
Emphasis on Design and Professional Practice

Maintain disciplinary strengths and alignment to research

IEP Structure



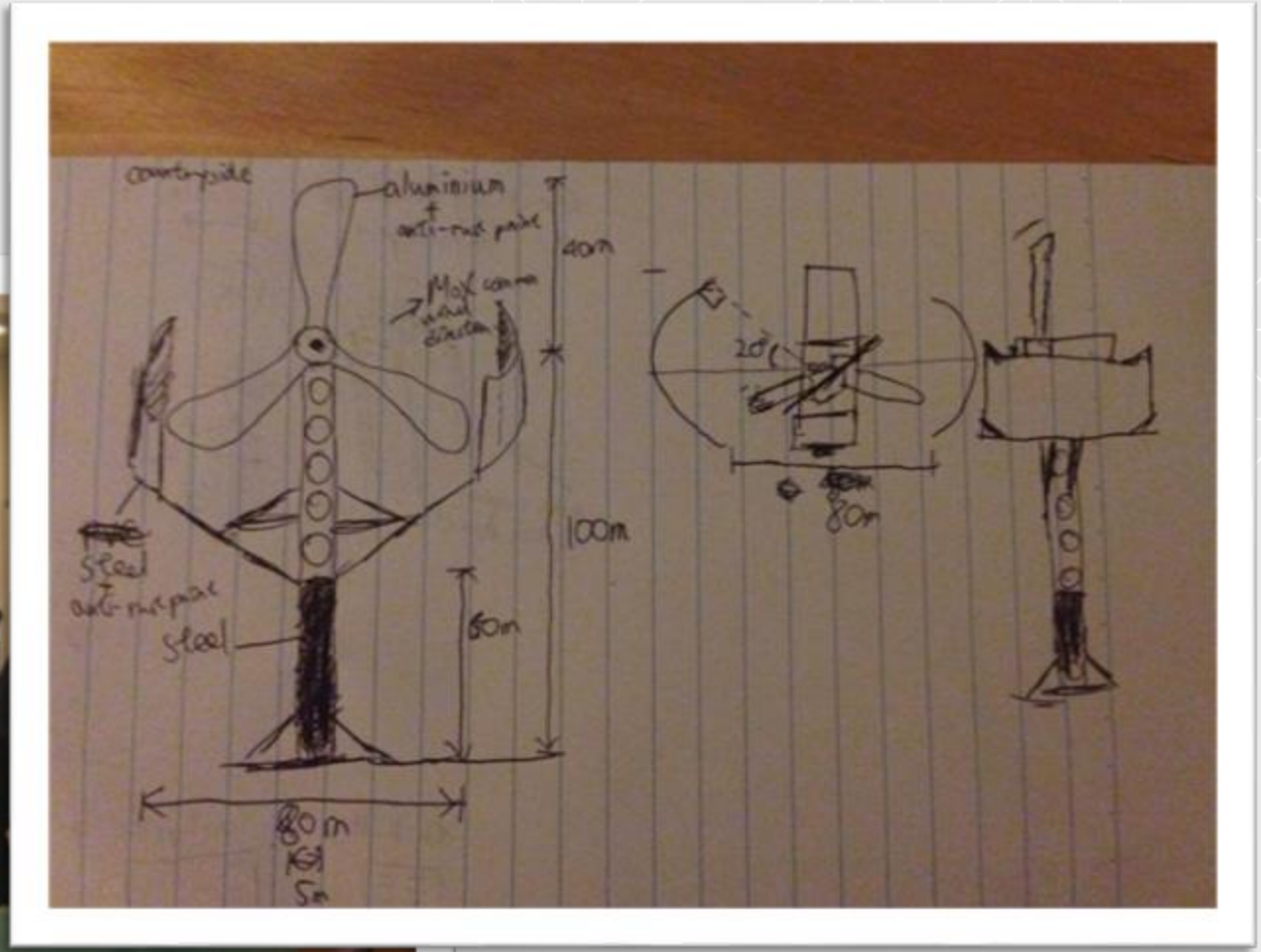
IEP – Project Work



What our Engineering students do?

UCL

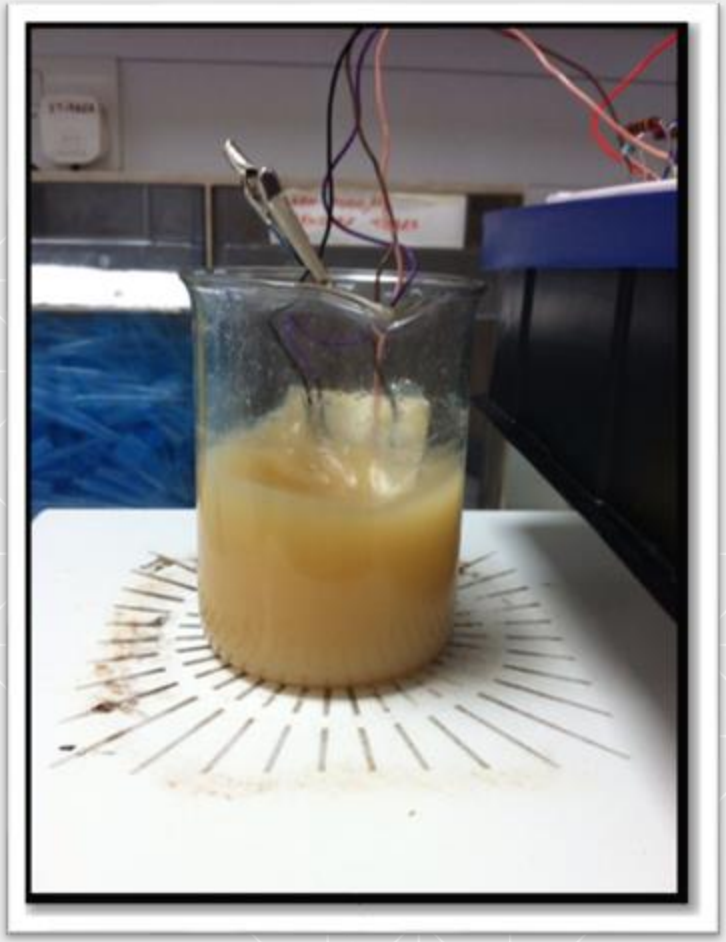
Group work



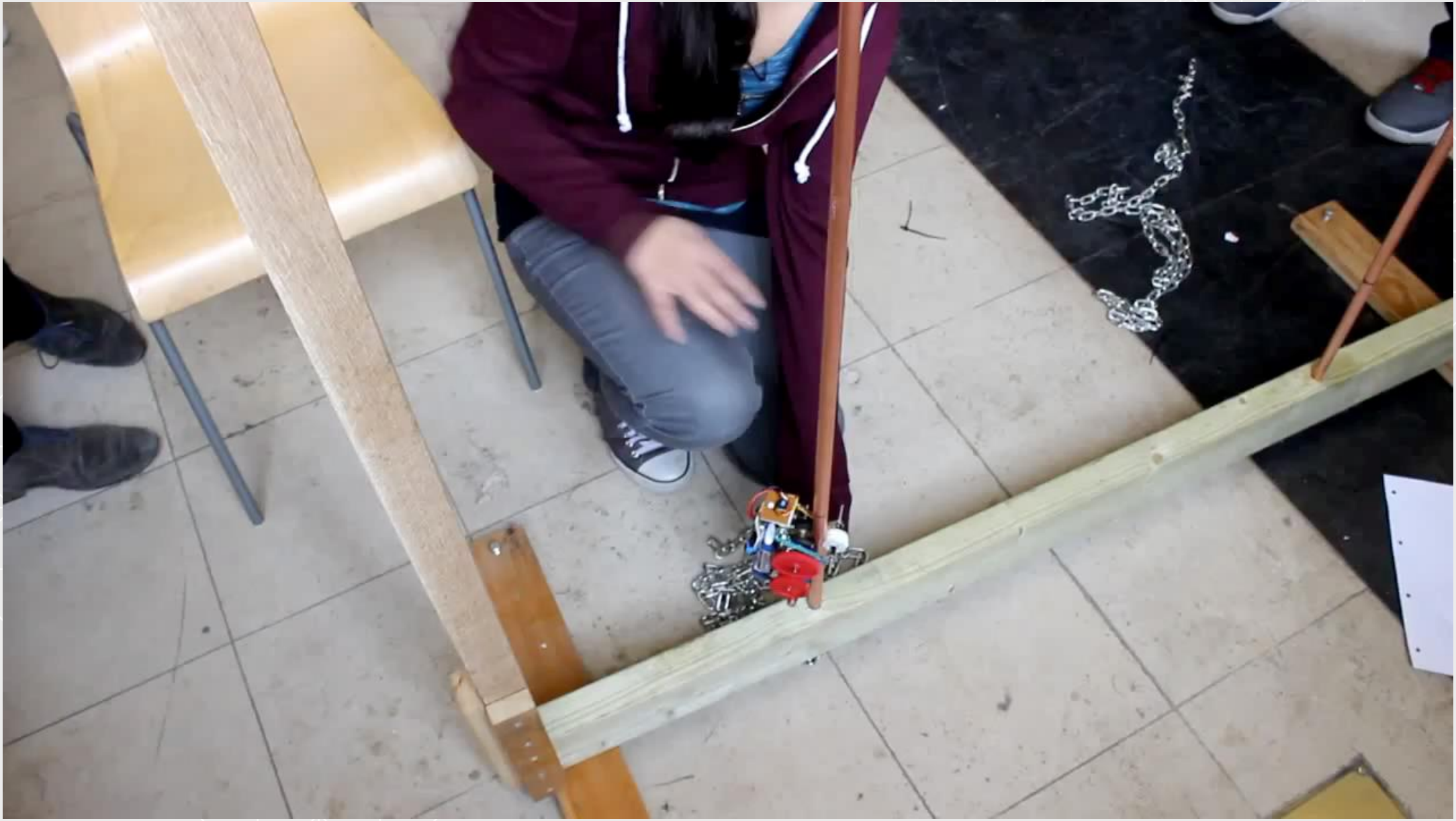
Design

Authentic Learning - Challenges

Challenge 2: TB Vaccine Production in Sub Saharan Africa



Authentic Learning - Scenarios



Interdisciplinarity

How to Change the World

700+ Students, 65 Partners, 5 Cohorts, 50+ Teaching team

A unique, two-week hands-on training programme that equips rising engineering talent with the skills to develop creative and technically robust solutions to 21st-century challenges to bring about positive social change.

http://www.ucl.ac.uk/steapp/how-to-change-the-world

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How to Change the World

2017 partners:

Department for Transport

iied

Internews
Local voices. Global change.

LondonTravelWatch

Volterra

Lloyds Banking Group

ATKINS

ARUP

Ellen MacArthur Foundation

iMC worldwide
Development | Management | Infrastructure

Motorola Solutions

IET The Institution of Engineering and Technology

bre

ASBP The Alliance for Sustainable Building Products

C40 CITIES
CLIMATE LEADERSHIP GROUP

redT energy storage

UK ENGINEERS WITHOUT BORDERS

Department for International Development

highways england
driving forward

MARKIDES ASSOCIATES

ODI

AECOM
Built to deliver a better world

restart

http://www.ucl.ac.uk/steapp/how-to-change-the-world

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

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CHALLENGES AND STRATEGIES

Common Engineering Programme

	Civil, Geomatic & Environmental Engineering		Mechanical Engineering		Chemical Engineering		Biochemical Engineering		Electronic & Electrical Engineering		Biomedical Engineering		Computer Science		Management & Innovation		
	MEng	BEng	MEng	BEng	MEng	BEng	MEng	BEng	MEng	BEng	MEng	BEng	MEng	BEng	MEng	BEng	MEn
Y4, S2	Advanced Masters Package Individual Research Project		Advanced Masters Package Individual Research Project		Advanced Masters Package Individual Research Project		Advanced Masters Package Individual Research Project		Advanced Masters Package Individual Research Project		Medical Image Computing package Individual Research Project		Advanced Masters Package Individual Research Project		Advanced Masters Package Individual Research Project		Advanced Packa Individual Proj
Y4, S1	Advanced Masters Package Individual Research Project		Advanced Masters Package Individual Research Project		Advanced Masters Package Individual Research Project		Advanced Masters Package Individual Research Project		Advanced Masters Package Individual Research Project		Biomaterials, Biomechanics, Tissue Engineering Individual Research Project		Advanced Masters Package Individual Research Project		Advanced Masters Package Individual Research Project		Interdisci Packa Individual Proj
Y3, S2	Specialist Track Package Research Methods	Specialist Track Package Individual Research Project	Specialist Track Package Research Methods	Mechanics of Fluids Thermal Power & Environment Design II Individual Research Project	Specialist Track Package Research Methods	Process Dynamics & Control Chemical Reaction Engineering Transport Processes Individual Research Project	Specialist Track Package Research Methods	Specialist Track Package Individual Research Project	Specialist Track Package Research Methods	Optoelectronics Fields & Waves Digital Design Individual Research Project	Specialist Track Package Research Methods	Medical Imaging - I Medical Imaging - II Ionising Treatment Individual Research Project	AI & Neural Computing Interaction Design Functional Programming Research Methods	Database & Information Management Systems Interaction Design Functional Programming Individual Research Project	New Technology Ventures Operations & Technology Mgt Innovation Management Research Methods	Financial Modelling Fixed Income & Equity Investment Mgt Mergers & Acquisitions Individual Research Project	Specialist Tra Research M
	Team Design Project																
	Ethics, Law & Professional Practice																
Y3, S1	Mathematics II Specialist Core Module Interdisciplinary Package	Individual Research Project Fluids & Engineering Analysis Interdisciplinary Package	Mathematics II Specialist Core Module Interdisciplinary Package	Individual Research Project Modelling & Analysis Interdisciplinary Package	Mathematics II Specialist Core Module Interdisciplinary Package	Individual Research Project Design & Experimentation Interdisciplinary Package	Mathematics II Specialist Core Module Interdisciplinary Package	Individual Research Project Specialist Core Module Interdisciplinary Package	Mathematics II Specialist Core Module Interdisciplinary Package	Individual Research Project Electronic Circuits II Interdisciplinary Package	Mathematics II Specialist Core Module Interdisciplinary Package	Individual Research Project Physics of Human Body Interdisciplinary Package	Mathematics II Specialist Core Module Interdisciplinary Package	Individual Research Project Networks & Graphics Interdisciplinary Package	Mathematics II Specialist Core Module Interdisciplinary Package	Individual Research Project Corporate Strategy Interdisciplinary Package	Mathem Specialist Co Interdisci Packa
Y2, S2	Specialist Core Package	Design II Environment II Mechanisms I	Specialist Core Package	Applied Electricity Design I Stress Analysis	Specialist Core Package	Process Engineering Process Heat Transfer Process Mass Transfer	Specialist Core Package	Specialist Core Package	Specialist Core Package	Communication Systems Electronics Design Semiconductors	Specialist Core Package	Electromagnetism Electronics Biophysics	Specialist Core Package	Concurrent Programming Software Engineering & Interaction Design Compilers	Specialist Core Package	Managerial Economics Finance Strategy	Specialist Co
Y2, S1	Specialist Core Package	Design I Environment I Mechanisms I Tools II	Specialist Core Package	Fluids Thermodynamics Materials & Manufacturing Mechanics	Specialist Core Package	Chemical Engineering Physical Chemistry Thermodynamics Transport Processes	Specialist Core Package	Specialist Core Package	Specialist Core Package	Electronics Circuits I Electromagnetics Circuit Analysis Digital Electronics	Specialist Core Package	Fluids Thermodynamics Introduction to Medical Imaging Mechanics	Specialist Core Package	Cognitive Systems & Intelligent Technologies Program a Robot Discrete Mathematics Object-Oriented Programming	Specialist Core Package	Economics Accounting Marketing Organisational Behaviour	Specialist Co
	Systems & Project Management / Business & Financial Awareness																
	Critical Thinking & Effective Communication																
	Design Studio																
	Systems & Modelling																
Y1, S1	Mathematics I																

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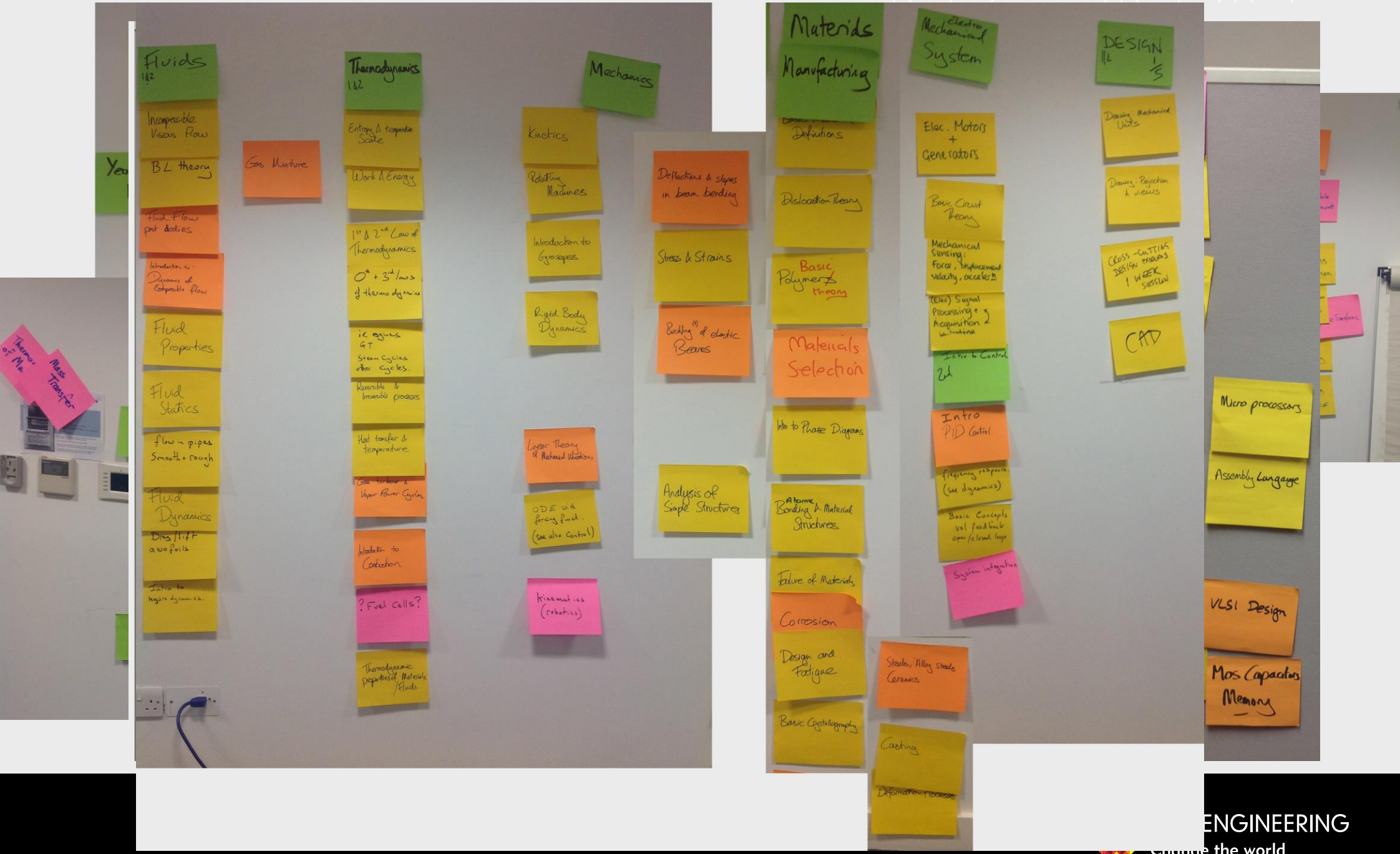
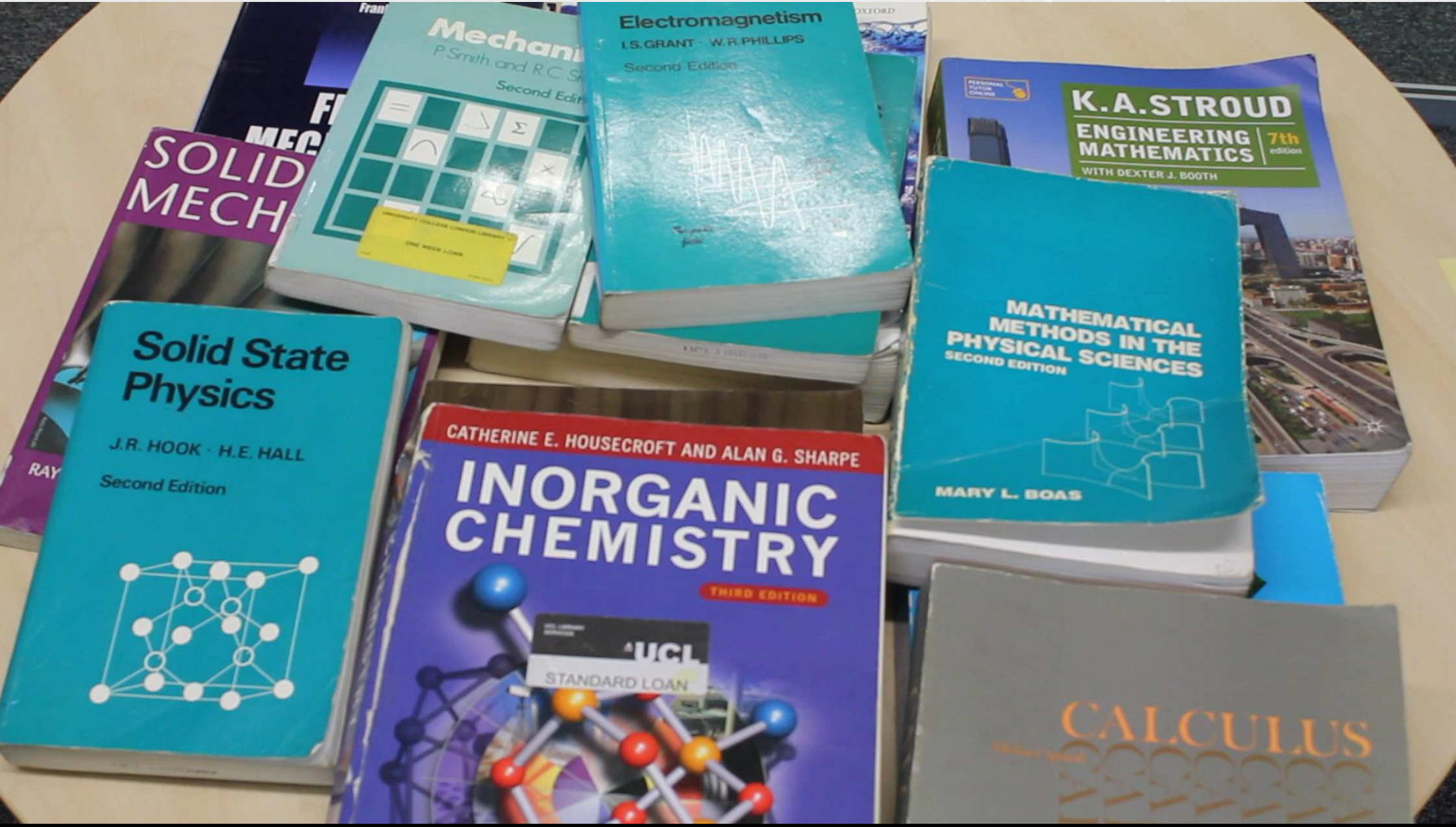
Curriculum Design



What gives?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K.A.STROUD
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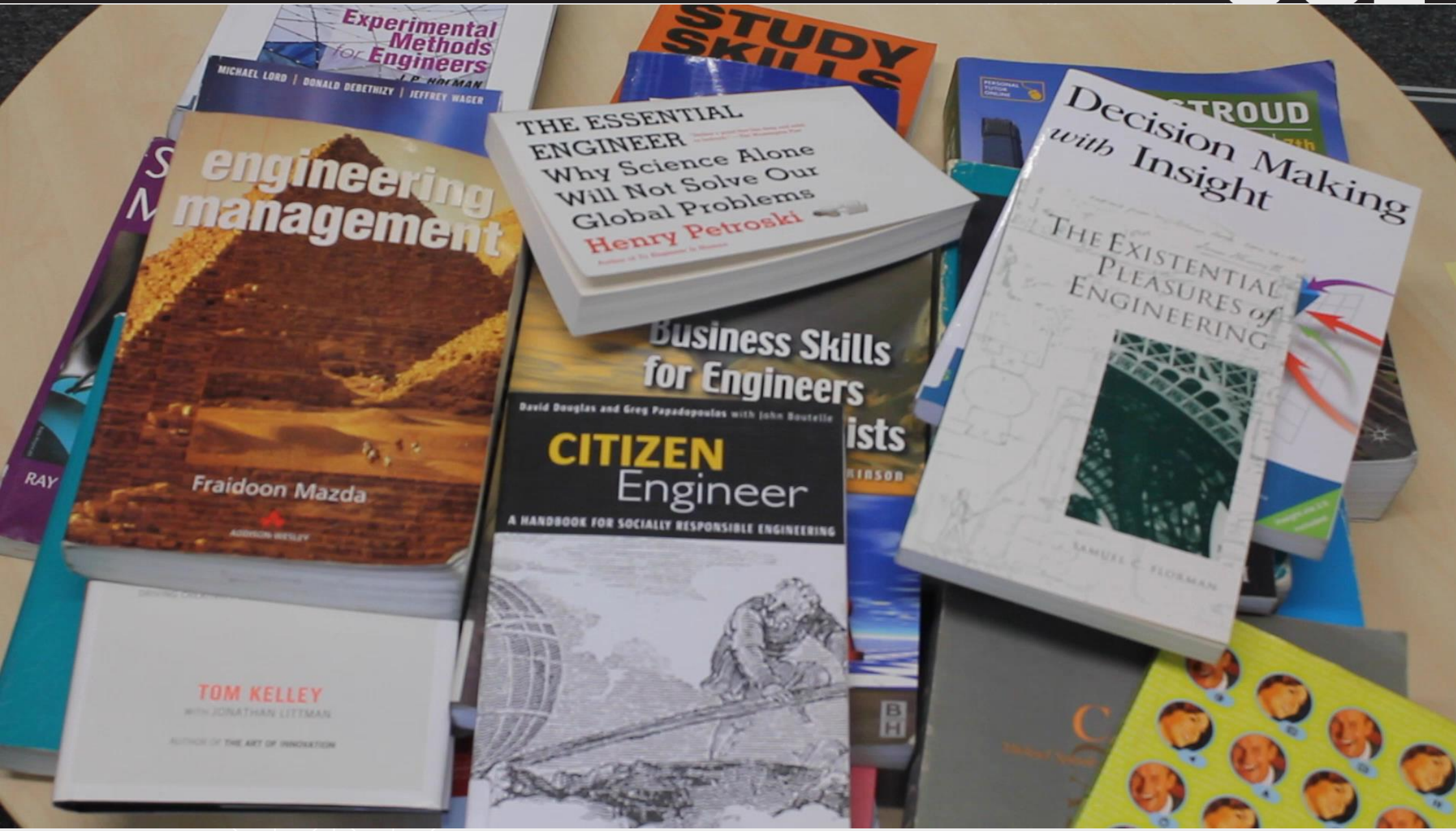
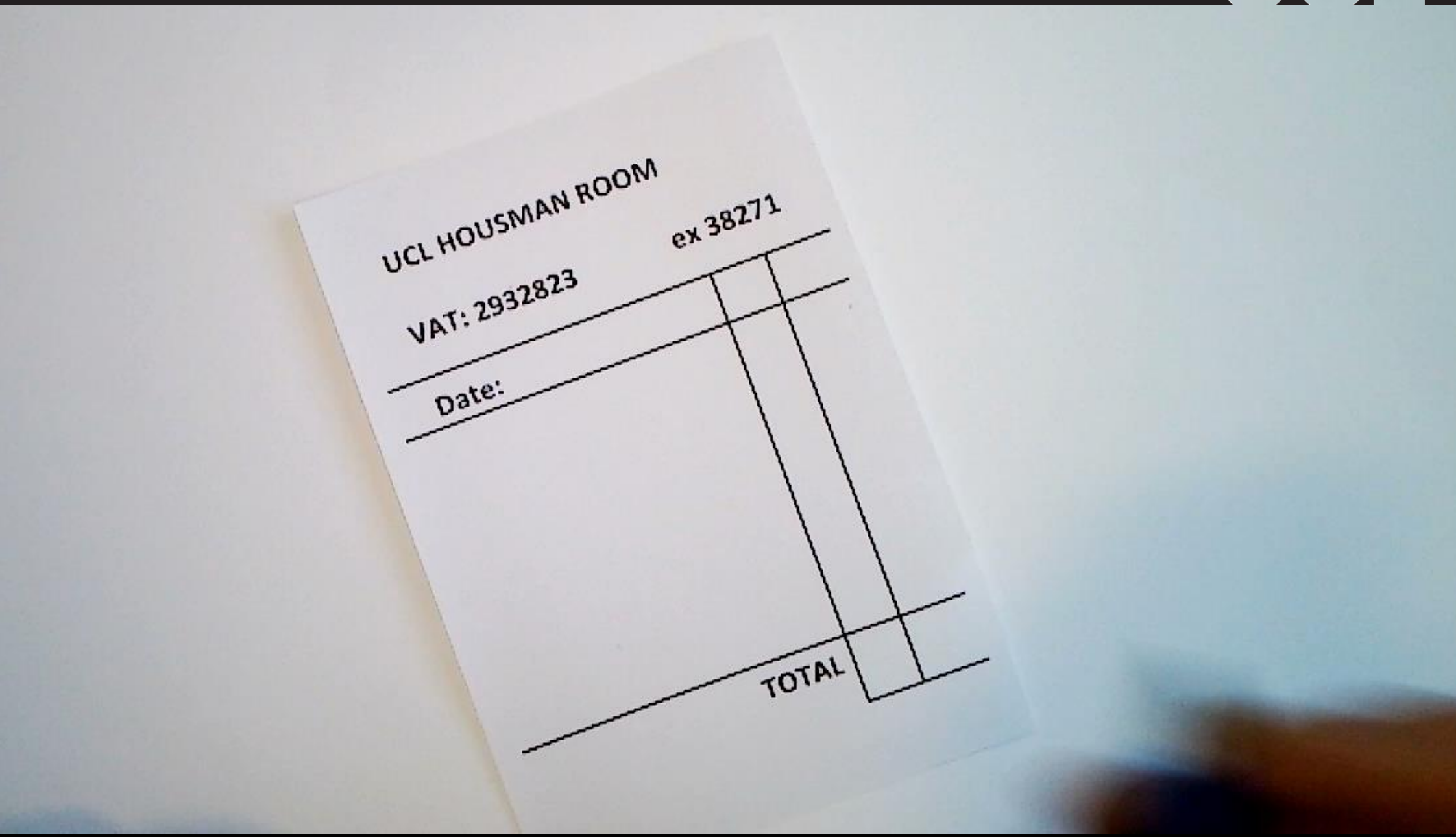

Experimental Methods for Engineers
MICHAEL LORD | DONALD DEBETHIZY | JEFFREY WAGER
STUDY SKILLS
engineering management
Fraidoon Mazda
THE ESSENTIAL ENGINEER
Why Science Alone Will Not Solve Our Global Problems
Henry Petroski
Business Skills for Engineers
David Douglas and Greg Papadopoulos with John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

How is change achieved?

Talk to lots of people


UCL HOUSMAN ROOM
ex 38271
VAT: 2932823
Date:
TOTAL

Censored

But be careful who you listen to…

Accreditation won't allow that!

You won't get staff do that!

UCL Regulations won't allow that!

That will take years!

You won't get the space to do that!

What do you need to make change happen?

Our chief weapon is

UCL

Fear

Surprise and Fear

Our three weapons are

Fear, Surprise and an almost fanatical devotion to the Dean

Amongst our weaponry are such diverse elements as

Fear, Surprise,

an almost fanatical devotion to the Dean,

and nice orange and grey branding….

IEP – Scaling of Existing Innovations

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

…. is our secret shared amongst the IEP Team

Meaning… everything implemented within the IEP had existed somewhere at UCL

Remember the students

- Students can be conservative too
- To be exposed to research, design and problem-solving is not what they are expecting,

but *most* enjoy it!

"Engineering should be science and hard sums"

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

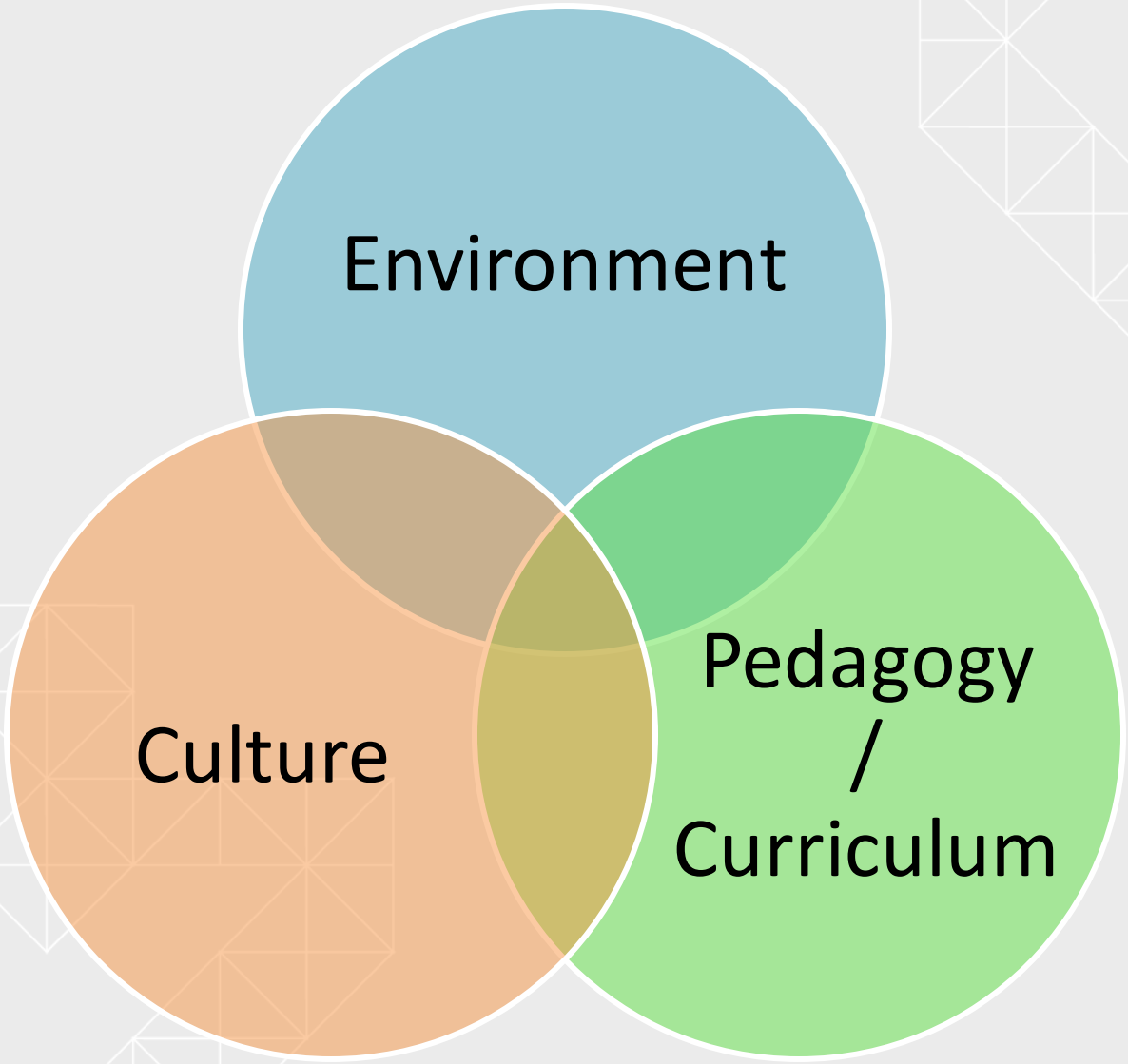
What the students think?

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

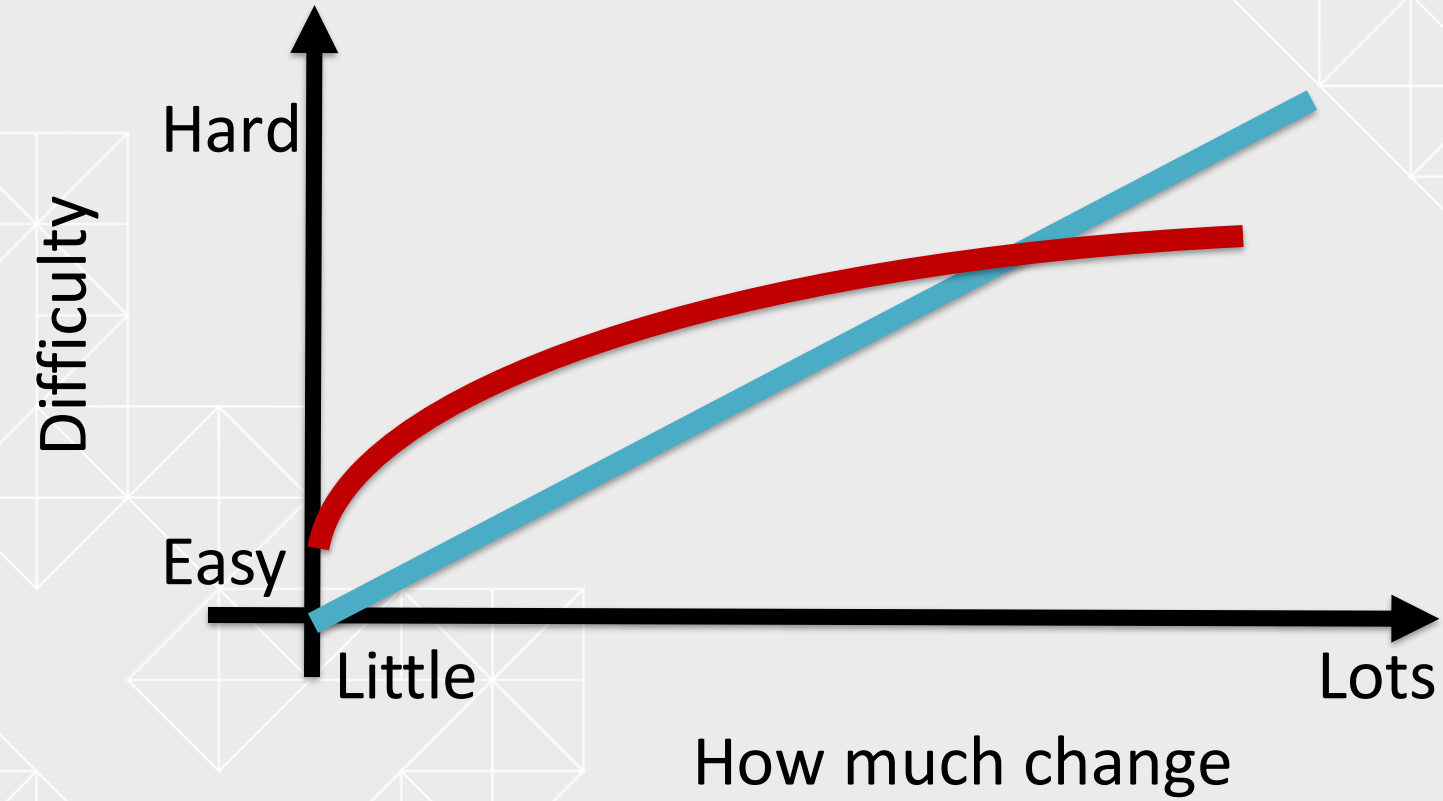
To me, the IEP is a platform where one can learn, understand and appreciate the various content from other engineering fields.

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

Leasons Learned



Change is hard!



Cultural Change

The IEP is now an advocate for the departments because.... we are more influential as a faculty body

Current Aim:

- Embrace flexibility so that the IEP becomes the departmental cultural norm, it is not uniform
- Put people and systems (financial, operational, etc.) in place so that it is harder to go back to the old way of working than is it to continue on!

UCL Centre for Engineering Education

The UCL Centre for Engineering Education is a leading innovator in the field of Engineering Education and is paving the way with research into change management, inclusivity and diversity and leadership.

- Support and training for staff
- Educational research
- Collaboration with other universities to develop curriculum
- Join between UCL Institute of education and UCL Engineering