Crisis and catalyst:

the impact of COVID-19 on the global state-of-the-art in engineering education

26th April 2023

Dr Ruth Graham

Outline of talk

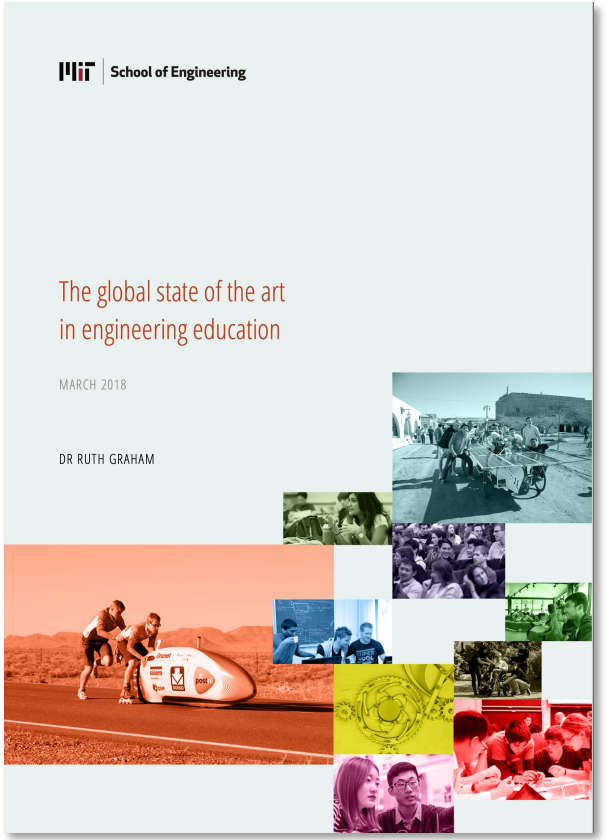
1. Context: what was the art in engineering education prior to March 2020?
2. How has the systemic shock of COVID-19 impacted the direction of travel for engineering education?
3. What are the major challenges facing the engineering education sector?

The global state of the art in engineering education

Commissioned by MIT
to inform the NEET Program

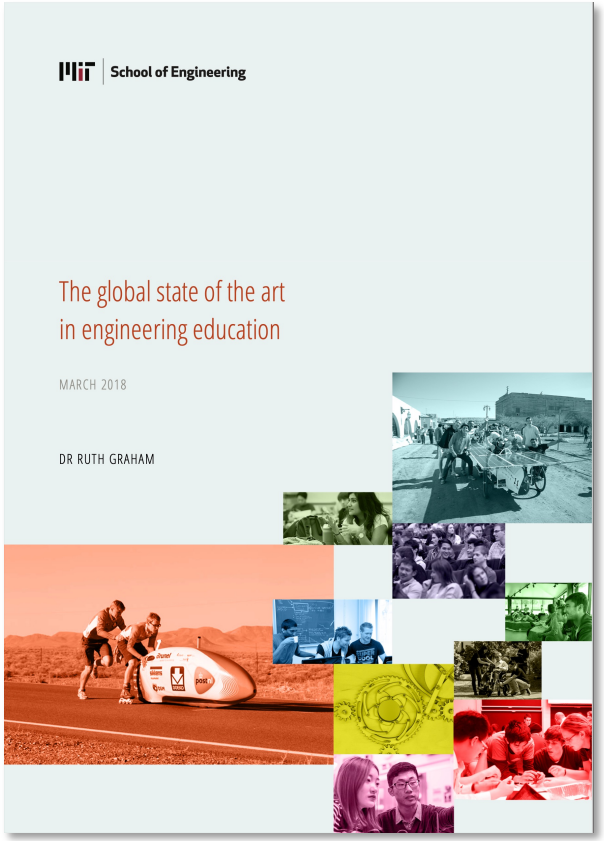
178 interviewees from 18 countries

Published March 2018



After many decades of discussion within the engineering education community, the report highlighted groundswell for change…

“the study feedback suggested that the engineering education sector is entering a period of rapid and fundamental change”



The 10 institutions most frequently identified as **current leaders** in engineering undergraduate education

1	Olin College (US)
2	MIT (US)
3	Stanford Uni (US)
4	Aalborg Uni (Denmark)
5	TU Delft (Netherlands)
6	UCL (UK)
7	Purdue Uni (US)
8	NUS (Singapore)
9	Uni of Cambridge (UK)
10	Chalmers Uni (Sweden)

The 10 institutions most frequently identified as **emerging leaders** in engineering undergraduate education

1	SUTD (Singapore)
2	Olin College (US)
3	UCL (UK)
4	PUC (Chile)
5	Iron Range (US)
6	NUS (Singapore)
7	TU Delft (Netherlands)
8	Charles Sturt (Australia)
9	Tsinghua (China)
10	Arizona State (US)

The locations of **current** and **emerging** leaders:

Hallmarks of future leaders:

Student choice, flexibility and work-based learning

Fostering skills and mindsets, such as critical thinking and team-working

The roles, responsibilities and ethics of engineers in society

Multi-disciplinary and global learning experience

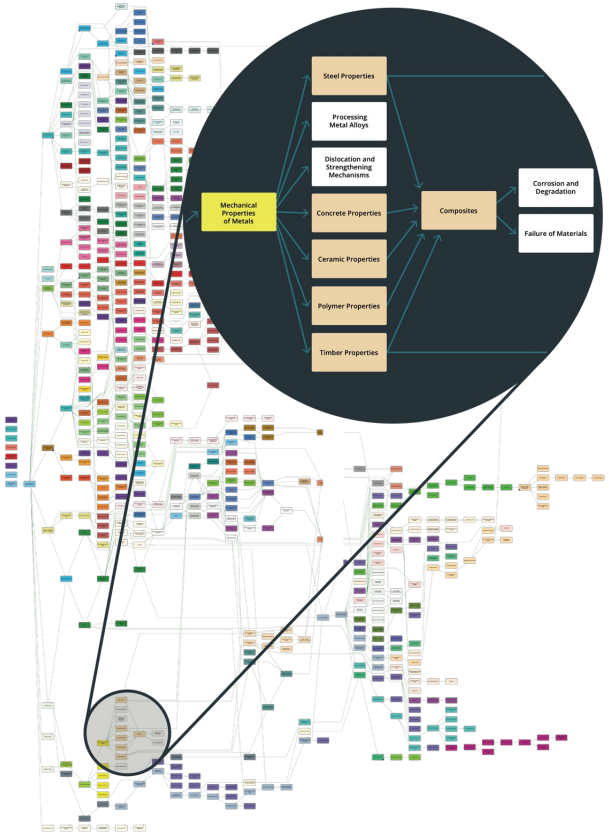
Systemic/unified educational approach with connectivity across the curriculum

Systemic/unified approach – CSU (Australia)

CSU (AU)

CSU topic tree

- core engineering concepts and skills are disaggregated into discrete three-hour topics and accessed independently online by students
- the topic tree offers a visual map of the relationships and dependencies between topics and branches of engineering
- students complete 240 topics before their work placement and 600 topics by graduation



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1 Context: what was the art in engineering education prior to March 2020?

2 **How has the systemic shock of COVID-19 impacted the direction of travel for engineering education?**

3 What are the major challenges facing the engineering education sector?

March 2018:

study anticipated systemic educational change in engineering schools worldwide

March 2020:

almost all universities worldwide pivoted online to emergency teaching due to COVID-19

Context: what was the state of the art in engineering education prior to March 2020?

What have we learnt from this period of emergency teaching and how will it impact engineering education for the future?

Crisis and catalyst:

the impact of COVID-19 on global practice in engineering education

Sponsored by university consortium

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SUTD Singapore University of Technology and Design
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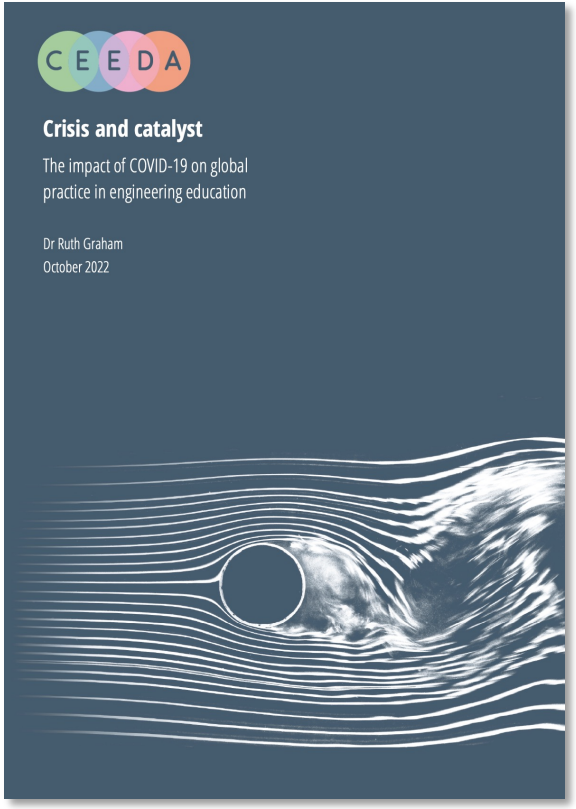


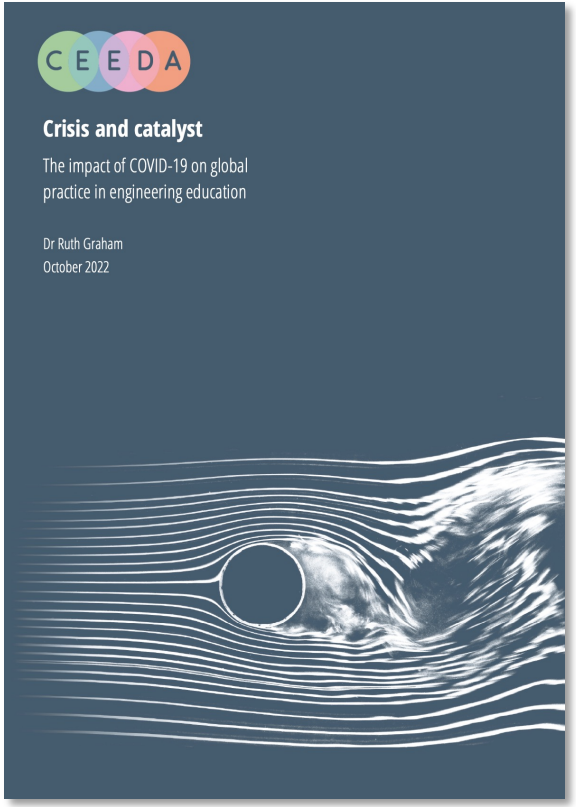
Informed by one-to-one interviews with 226 individuals from 36 countries

Crisis and catalyst:

the impact of COVID-19 on global practice in engineering education

1. Experiences of the engineering education community during ‘emergency teaching’

2. The impact of ‘emergency teaching’ on global practices in engineering education



Two particular effects of COVID-19 and emergency teaching on cutting-edge programmes:

A. accelerated and enhanced some of the innovations already in train

B. precipitated new practices and priorities that may not previously have emerged but for the 'systemic shock' of COVID-19

Hallmarks of future leaders (MIT report 2018):

Student choice, flexibility and work-based learning

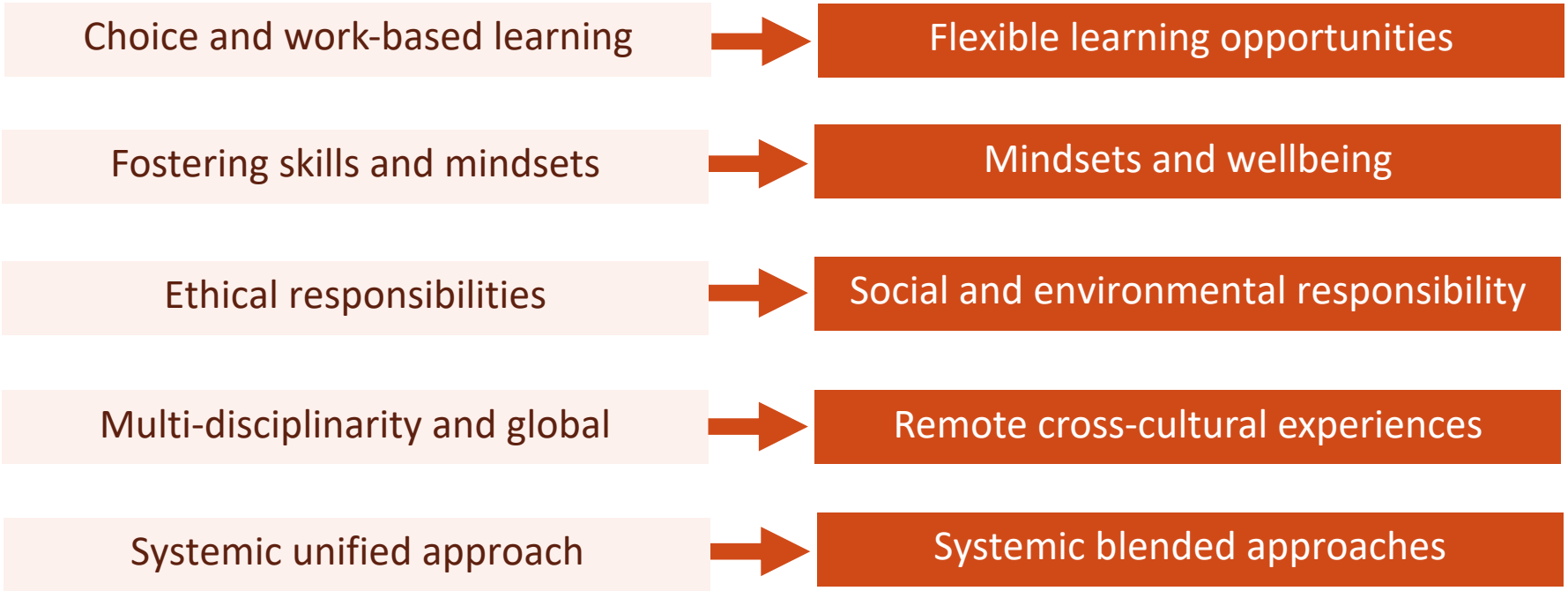
Fostering skills and mindsets, often through authentic, hands-on problem-solving

The roles, responsibilities and ethics of engineers in society

Multi-disciplinary and global learning experience

Systemic/unified educational approach with connectivity across the curriculum

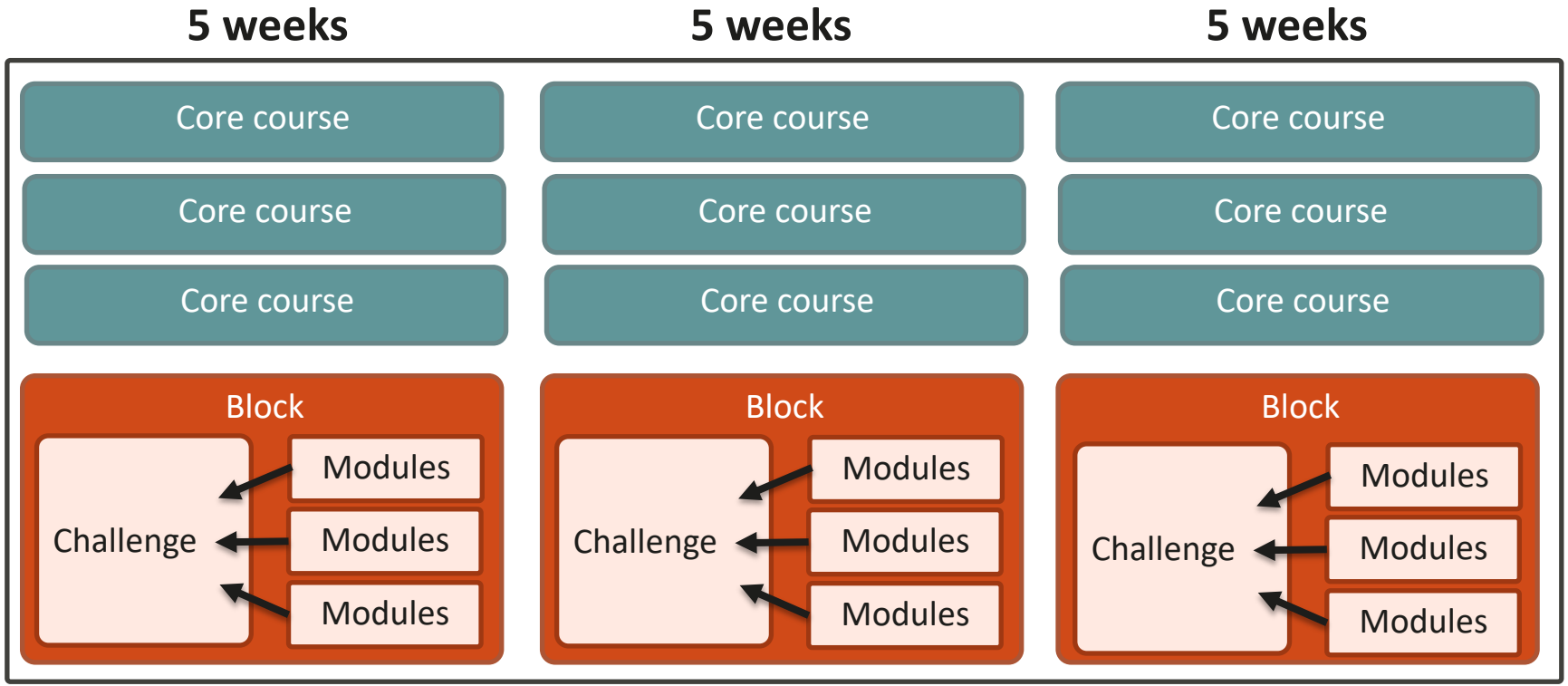
A. Acceleration and enhancement of trends already in train



Example – Tec de Monterrey (Mexico)

Tec de Monterrey (Mexico)

Sample semester of the Tec21 curriculum:

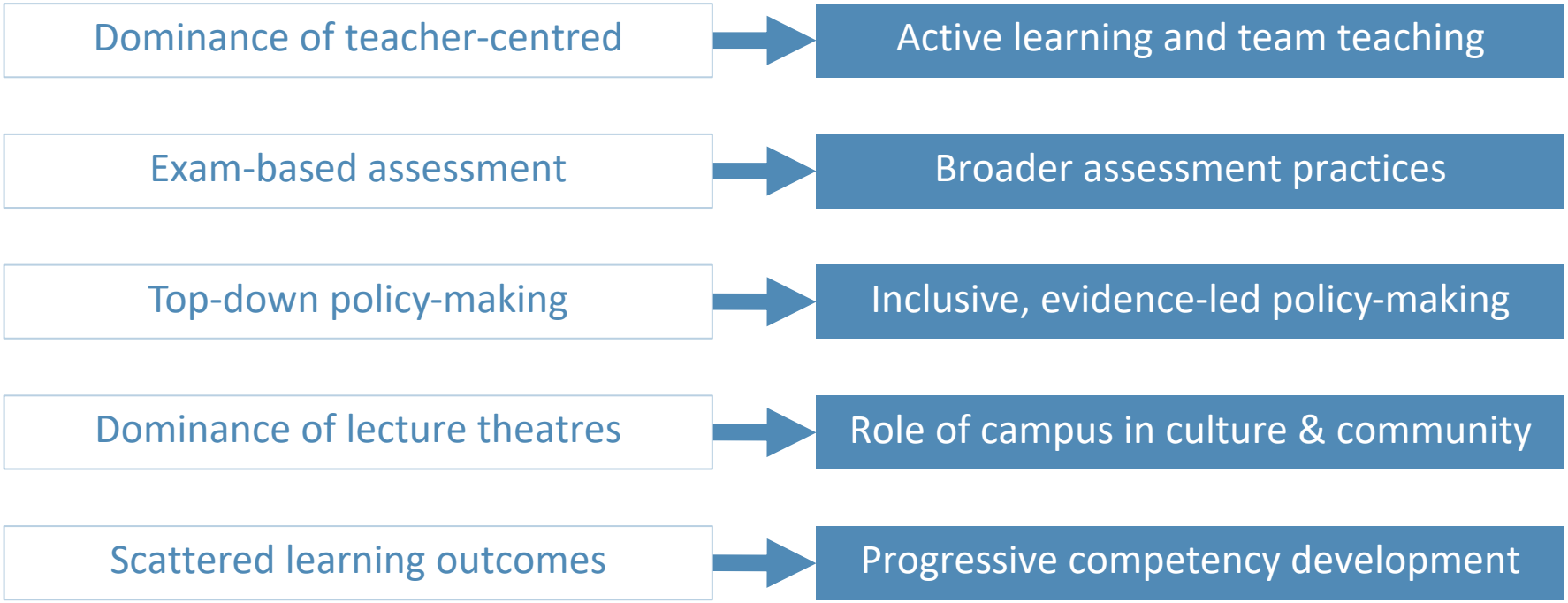


Two particular effects of COVID-19 and emergency teaching on cutting-edge programmes:

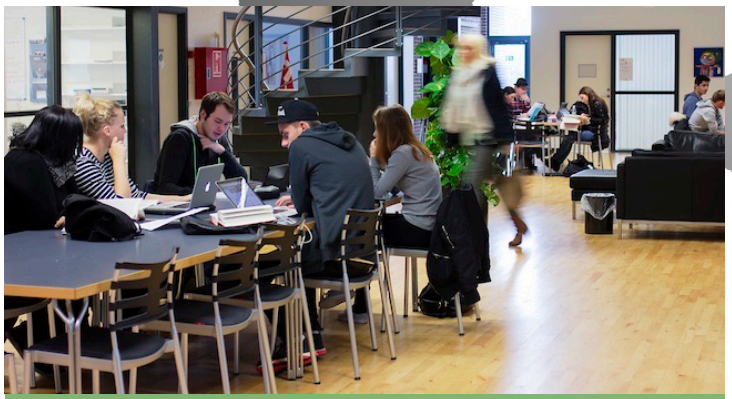
A. accelerated and enhanced some of the innovations already in train

B. precipitated new practices and priorities that may not previously have emerged but for the 'systemic shock' of COVID-19

2. New practices and priorities enabled by systemic shock



Example – Aalborg University (Denmark)



Aalborg University (Denmark)

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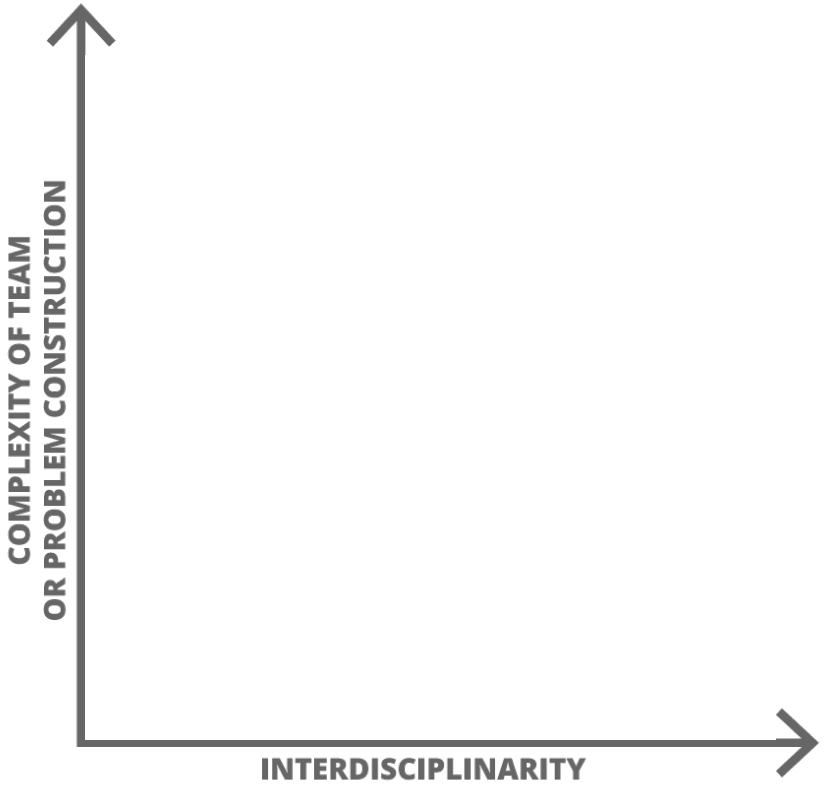

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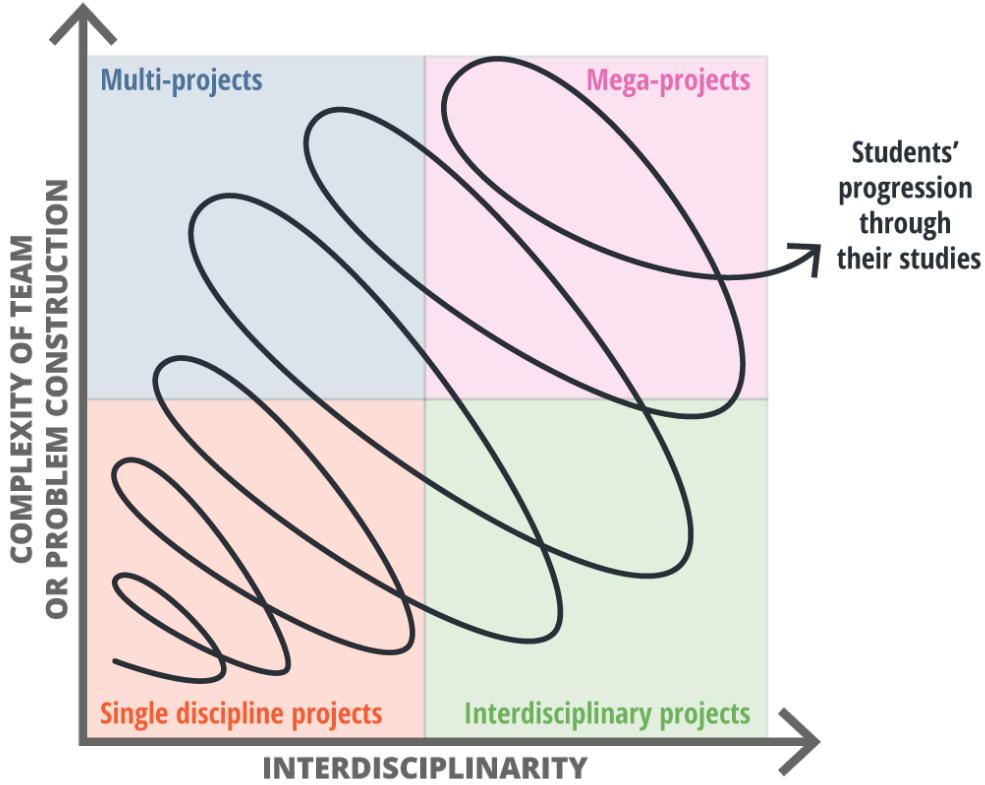

Increasing project complexity

Building in complexity – technical, societal and inter-disciplinary – as students progress. Culminating in 'mega-projects' in final years of study.

Mindset development

Nurturing and tracking progressive learning outcomes (*PBL Competencies*), guided by structured self- and peer-reflection sessions.

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Challenges and risks facing the sector

- **Exacerbation of inequalities:** that inequalities amongst students and instructors, and across institutions, may be exacerbated by COVID-19
- **Legacies of emergency teaching:** the experience has left many across the sector exhausted with acute concerns about mental health
- **Scaling-up good practice:** the challenges faced by large publicly-funded institutions to deliver student-centered, active learning at scale
- **Reward and recognition:** the extent to which faculty impact and achievement in teaching and learning is rewarded by their university

Advancing Teaching

Global initiative to improve the recognition, reward and evaluation of university teaching

1

Supporting change to academic career pathways at institutional and national levels

2

Resources to support change, including Career Framework to inform new institutional policies

3

Survey to track impact of change on academic experiences at over 25 universities worldwide

Annual meeting of university leaders making systemic change

CDIO Seminar, April 2023

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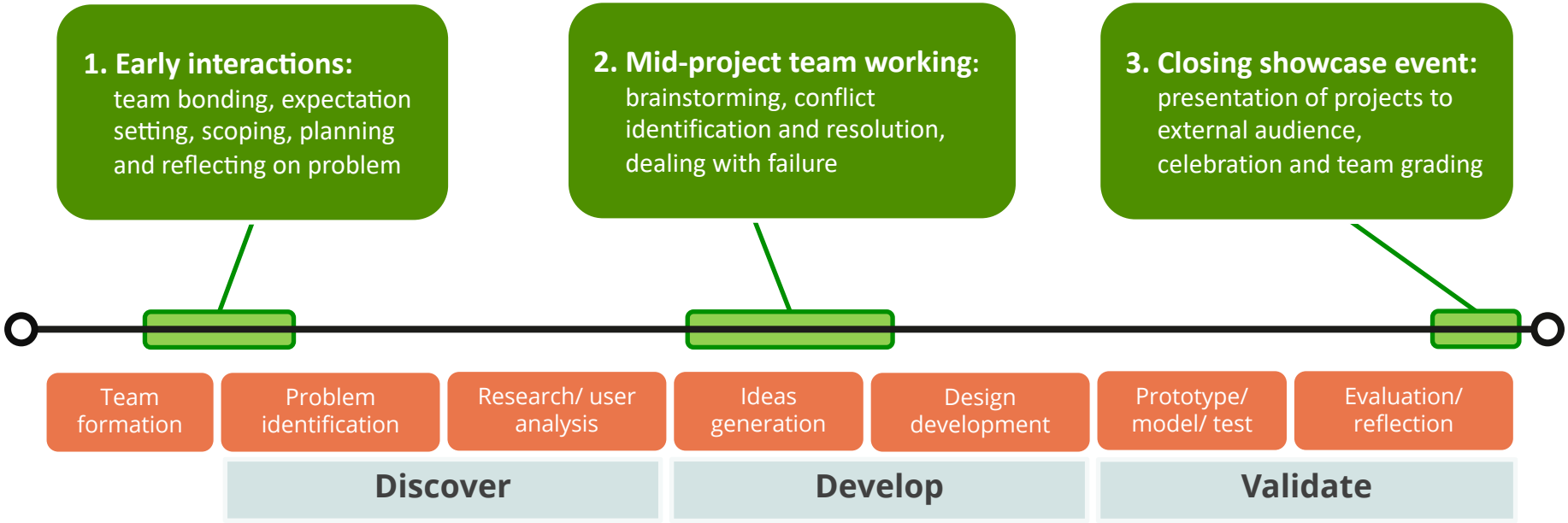
Engineering universities | **General universities** | **Non-university**

CEEDA: Collaborative engineering learning in the digital age

www.ceeda.org

Thank you

What is problematic to deliver online?



Stages in the project- or problem-based learning process

Major challenges faced during emergency teaching

- **Inequality of digital access:** the quality of the institutional IT infrastructure and the capacity of students to access IT devices and reliable internet
- **Student mental wellbeing and isolation:** challenges in three areas:
    1. understanding course expectations and managing workload
    2. building trusting, supportive and collegial relationships with peers
    3. fostering student motivation and combatting anxiety
- **Faculty exhaustion and wellbeing:** the toll taken on instructors and university leaders from prolonged uncertainty and exhaustion during the months and years of emergency teaching

Emerging practices and cultures

- **Engagement with active learning:** beyond the ‘usual suspects’
- **Attitudes to teaching and learning**: including education experts and team teaching
- **Remote hands-on learning**: (i) modelling, simulation, or remote activities; (ii) at home hands-on activities; and (iii) replacement activities
- **Assessment practices**: that balances academic integrity with student wellbeing
- **External connectivity**: new connections with with external stakeholders, as well as regional/global peers
- **Faculty-student connectivity**: by forming closer, less hierarchical relationships