COVID-19:
a catalyst for change in global engineering education:

6th July 2022

Dr Ruth Graham

Outline of presentation

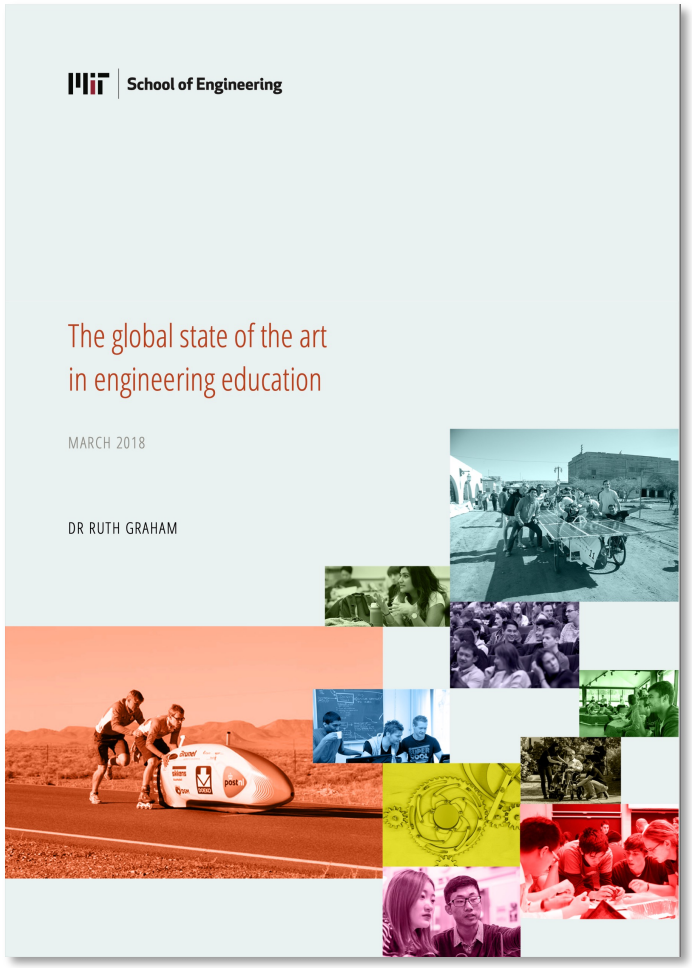
1. Context: what was the state of the art in engineering education prior to March 2020?
2. How will the systemic shock of COVID-19 impact the direction of travel for the engineering education sector?

The global state of the art in engineering education

Commissioned by MIT
to inform the NEET Program

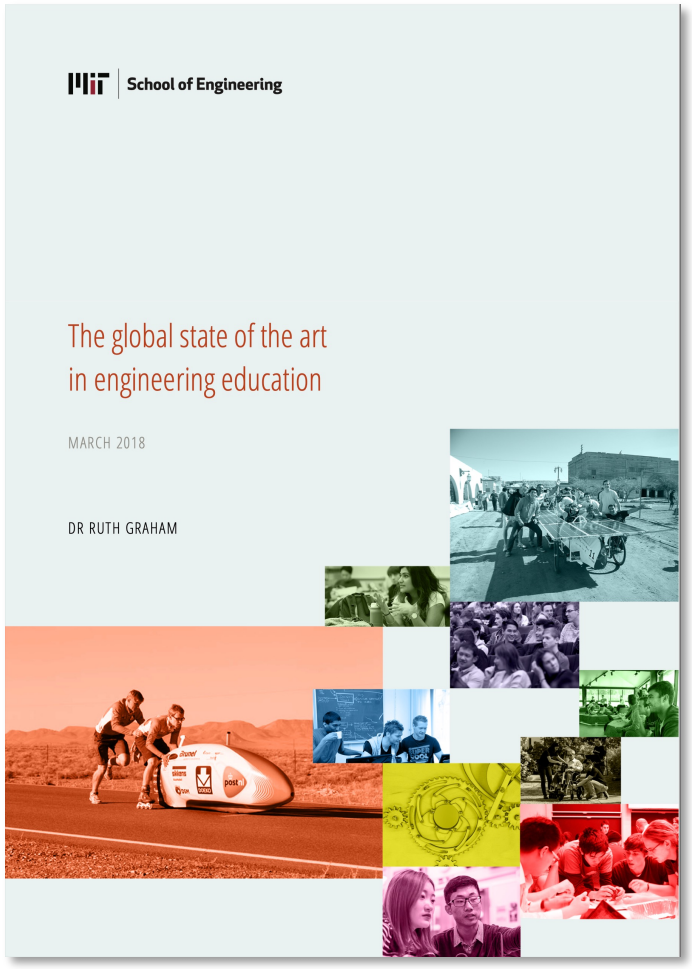
178 interviewees from 18 countries

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)

Distinguishing programmatic features of the emerging leaders

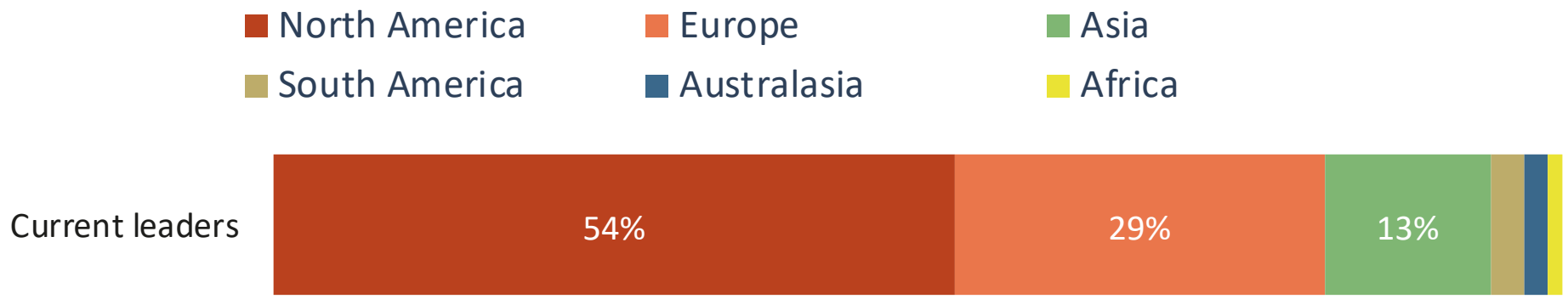
CURRENT LEADERS

Largely US and Europe based

EMERGING LEADERS

Global spread of institutions

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



Distinguishing programmatic features of the emerging leaders

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Non-traditional practice confined to 'pockets' with course often taught in isolation

EMERGING LEADERS

Global spread of institutions

Systemic/unified approach with connectivity across the curriculum

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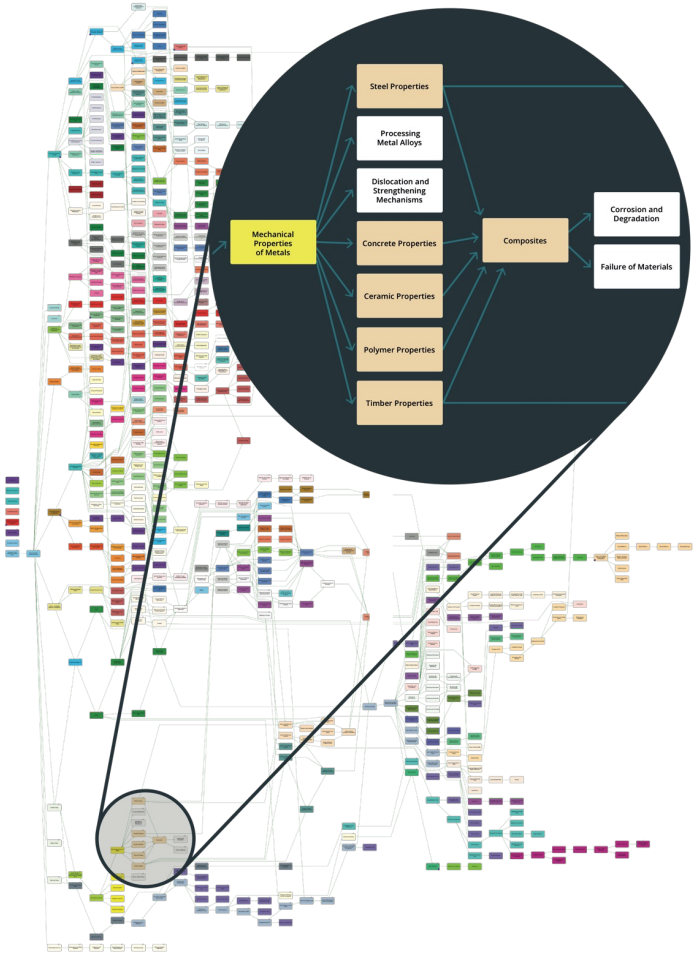
Systemic/unified approach – CSU (Australia)

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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Teacher-centred approach with limited external connectivity

EMERGING LEADERS

Global spread of institutions

Systemic/unified approach with connectivity across the curriculum

Culture of student empowerment and cross-community collaboration

Distinguishing programmatic features of the emerging leaders

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Development shaped by variety of drivers, with much of curriculum unchanged for decades

EMERGING LEADERS

Global spread of institutions

Systemic/unified approach with connectivity across the curriculum

Culture of student empowerment and cross-community collaboration

Development is typically shaped by regional needs or priorities, enabling a more visionary approach

Investment by the Chilean Ministry for Finance

CORFO

Established in 2014, the Chilean government's National Agency for Innovation and Development (CORFO) launch Engineering 2030.

Aiming to drive economic growth through technology innovation, the initiative targets Chilean engineering schools as an incubator for this talent. Over $200m (US) has already been invested, must of which is focused on educational reform.

2030 ENGINEERING STRATEGY

Case study – PUC (Chile)

PUC (Chile)

Hallmarks of future leaders:

Experiential, open-ended problem solving rooted in authentic challenges

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

Student choice, flexibility and work-based learning

March 2018:

study captured sector-wide views on the direction of travel for engineering education

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?

How will the systemic shock of COVID-19 impact the direction of travel for the engineering education sector?

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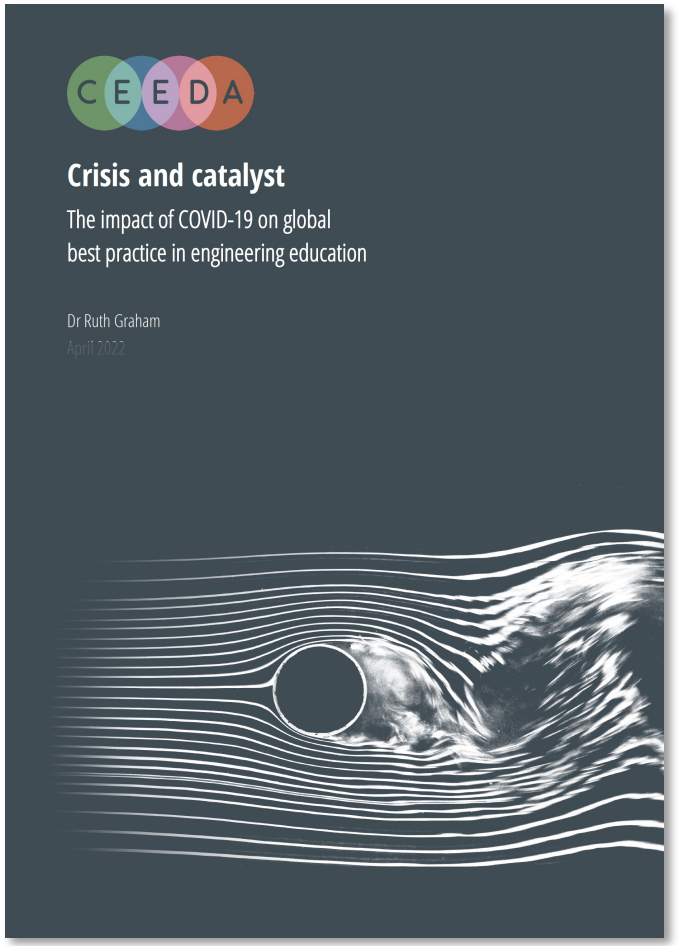
Crisis and catalyst:

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

Sponsored by university consortium

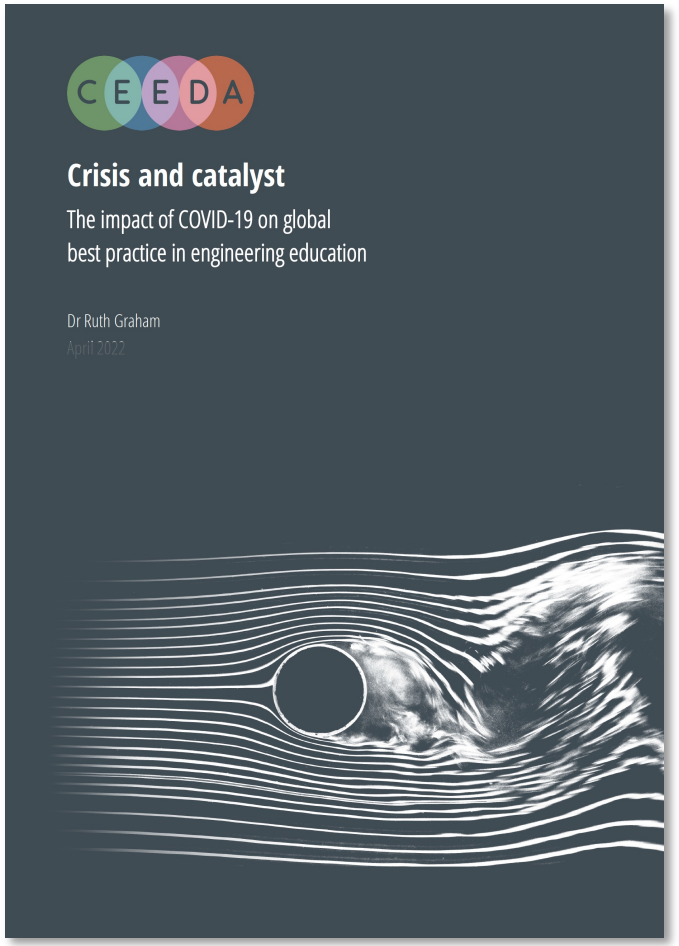
Informed by one-to-one interviews with 226 individuals from 36 countries



Crisis and catalyst:

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

- Experiences of the engineering education community during ‘emergency teaching’
- The impact of ‘emergency teaching’ on global practices in engineering education



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'
- **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
- **Attitudes to teaching and learning**: including education experts and team teaching
- **Faculty-student connectivity**: by forming closer, less hierarchical relationships

How will best practices in engineering education change in the future?

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:

Experiential, open-ended problem solving rooted in authentic challenges

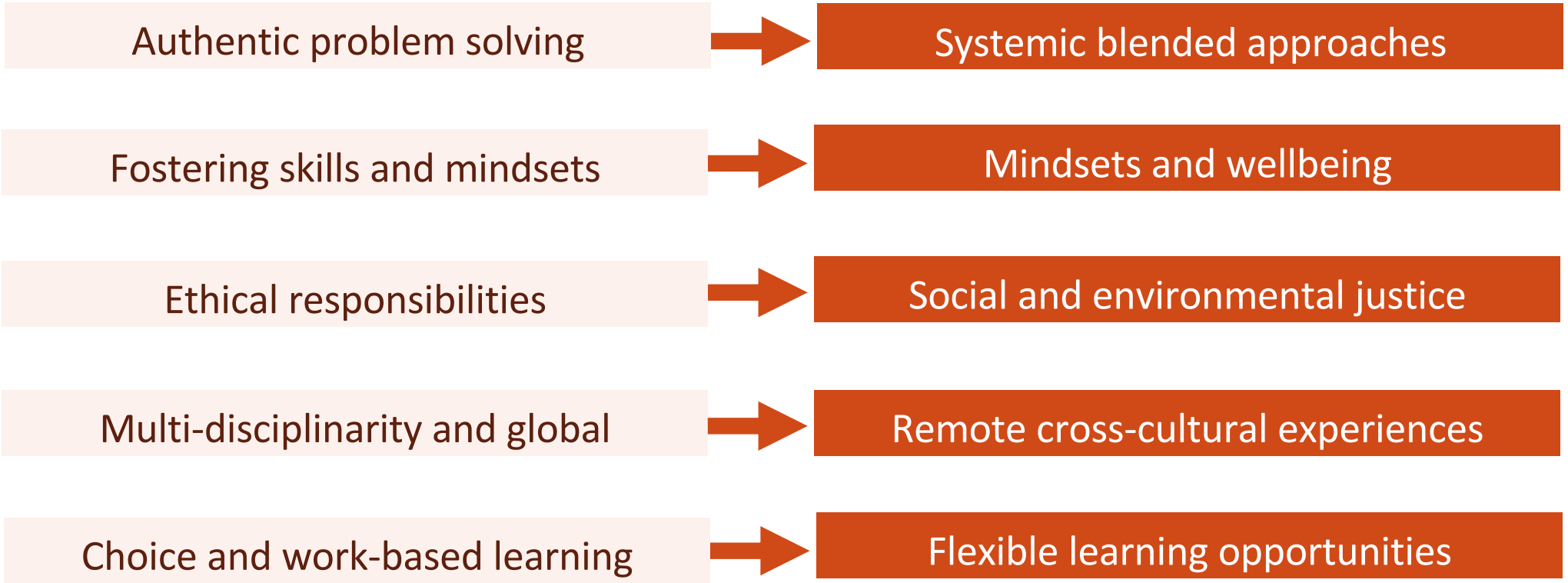
Fostering skills and mindsets, such as critical thinking and team-working

The roles, responsibilities and ethics of engineers in society

Multi-disciplinary and global learning experience

Student choice, flexibility and work-based learning

A. Acceleration and enhancement of trends already in train



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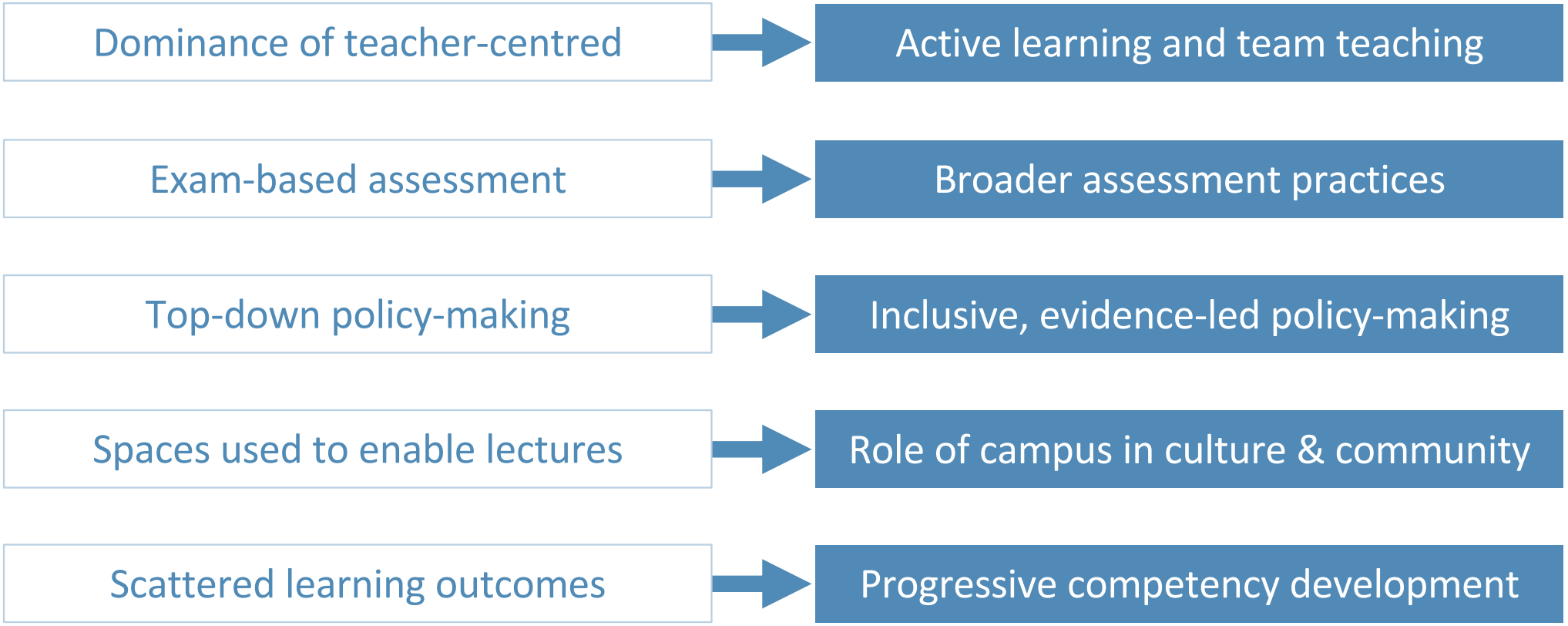
2. New practices and priorities enabled by systemic shock



What does this look like in practice?

Example – Aalborg University (Denmark)

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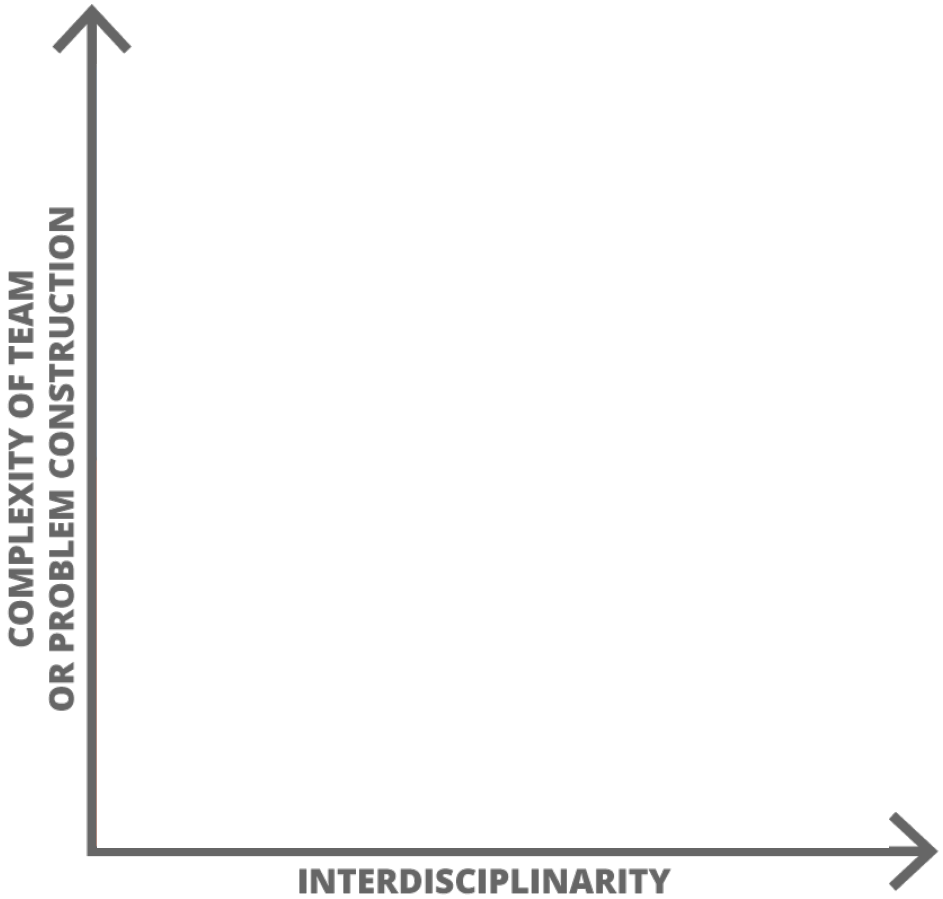
Inclusive, evidence-led policy-making	› Establishment of the *Institute for Advanced Study in PBL* in early 2022
Systemic blended approaches	› Wider adoption of blended learning with more ‘taught courses’ delivered online
Progressive competency development	› PBL Competencies built progressively along with workshops & portfolios
Mindsets and wellbeing	› Focus on mindset development, such as conflict resolution or critical thinking

Example – Aalborg University (Denmark)



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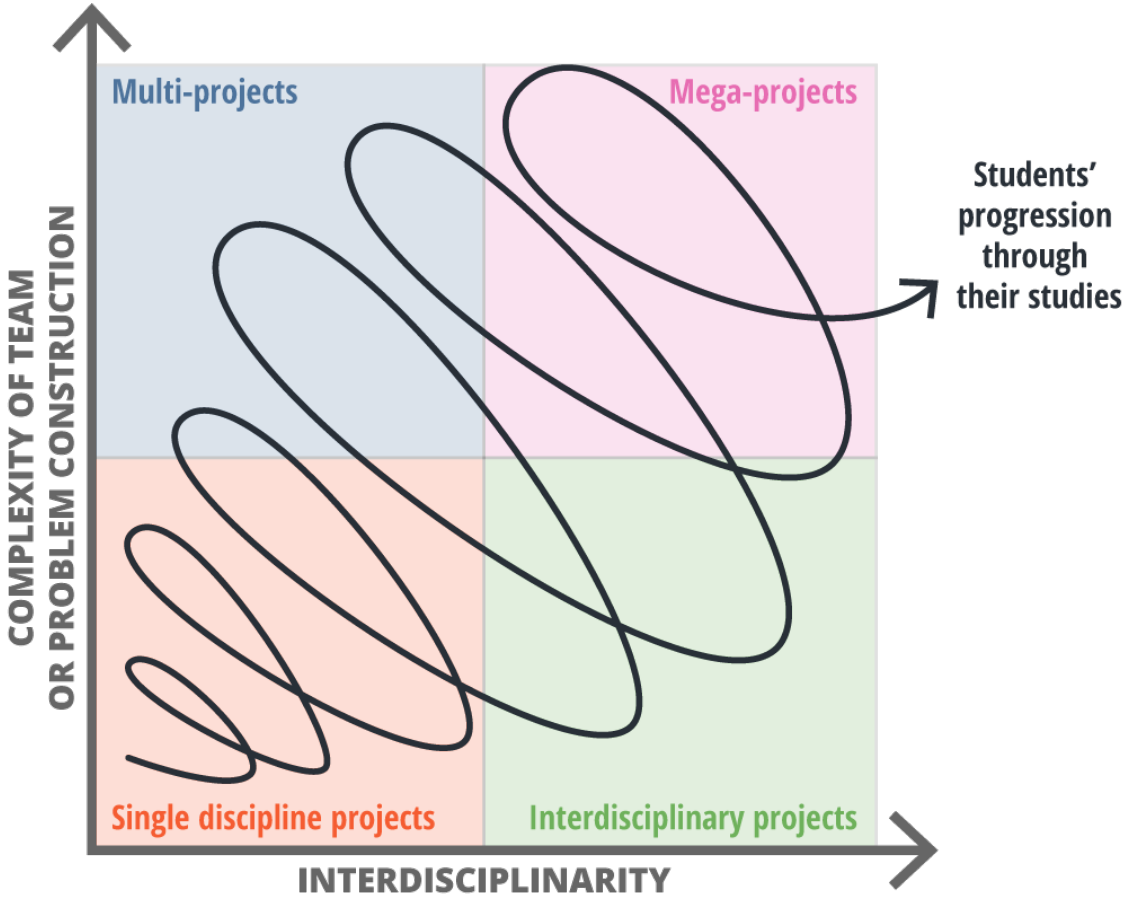

Mega-projects

Building in complexity – technical, societal and inter-disciplinary – as students progress.

Nurturing flexibility, problem-solving and collaborative thinking.

PBL competencies

Nurturing and tracking progressive learning outcomes.

Example – Tec de Monterrey (Mexico)

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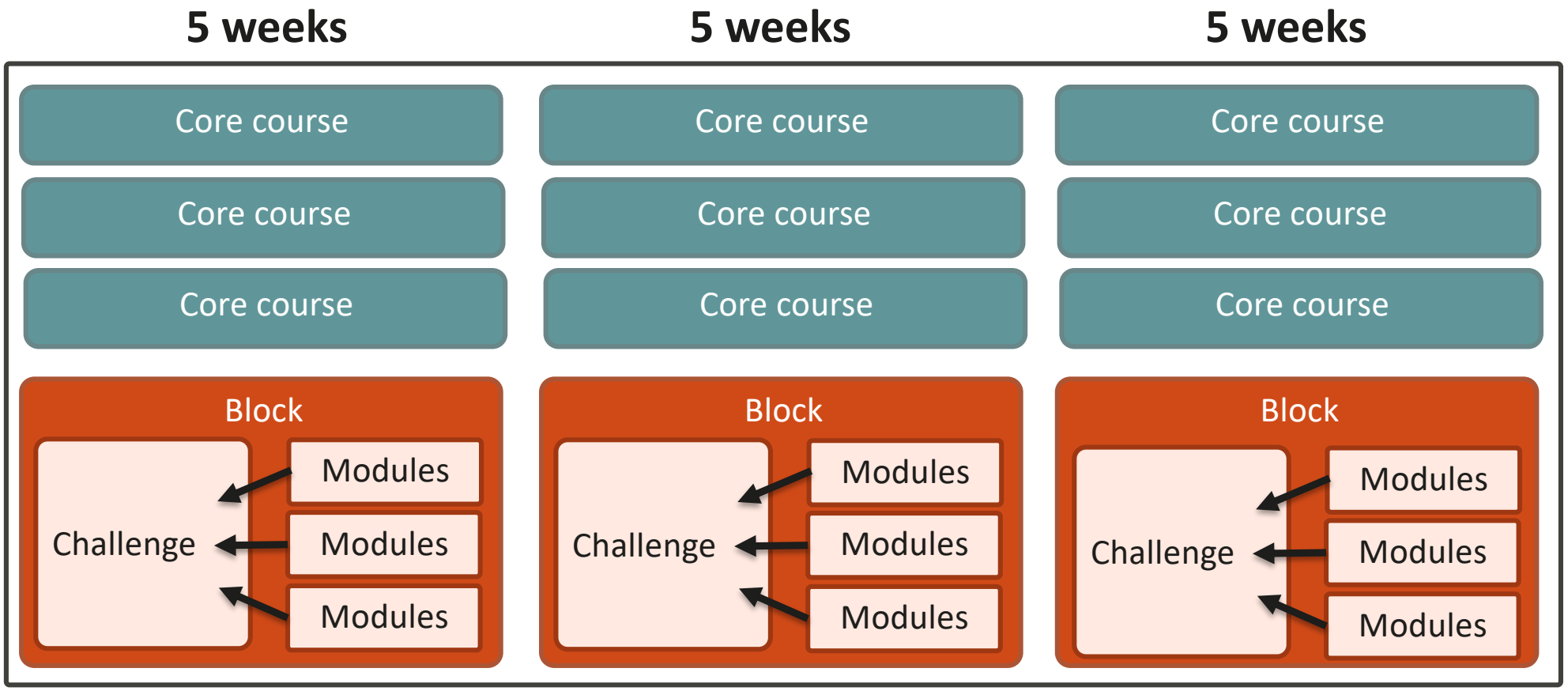
Inclusive, evidence-led policy-making	› Establishment of the *Institute for the Future of Education* in early 2021
Systemic blended approaches	› Tec 21 curriculum, combining in-person projects with online technical courses
Flexible learning opportunities	› Choice embedded throughout Tec21 curriculum
Progressive competency development	› Tec21 embeds 'core competencies' into each semester of study

Sample semester of the Tec21 curriculum:



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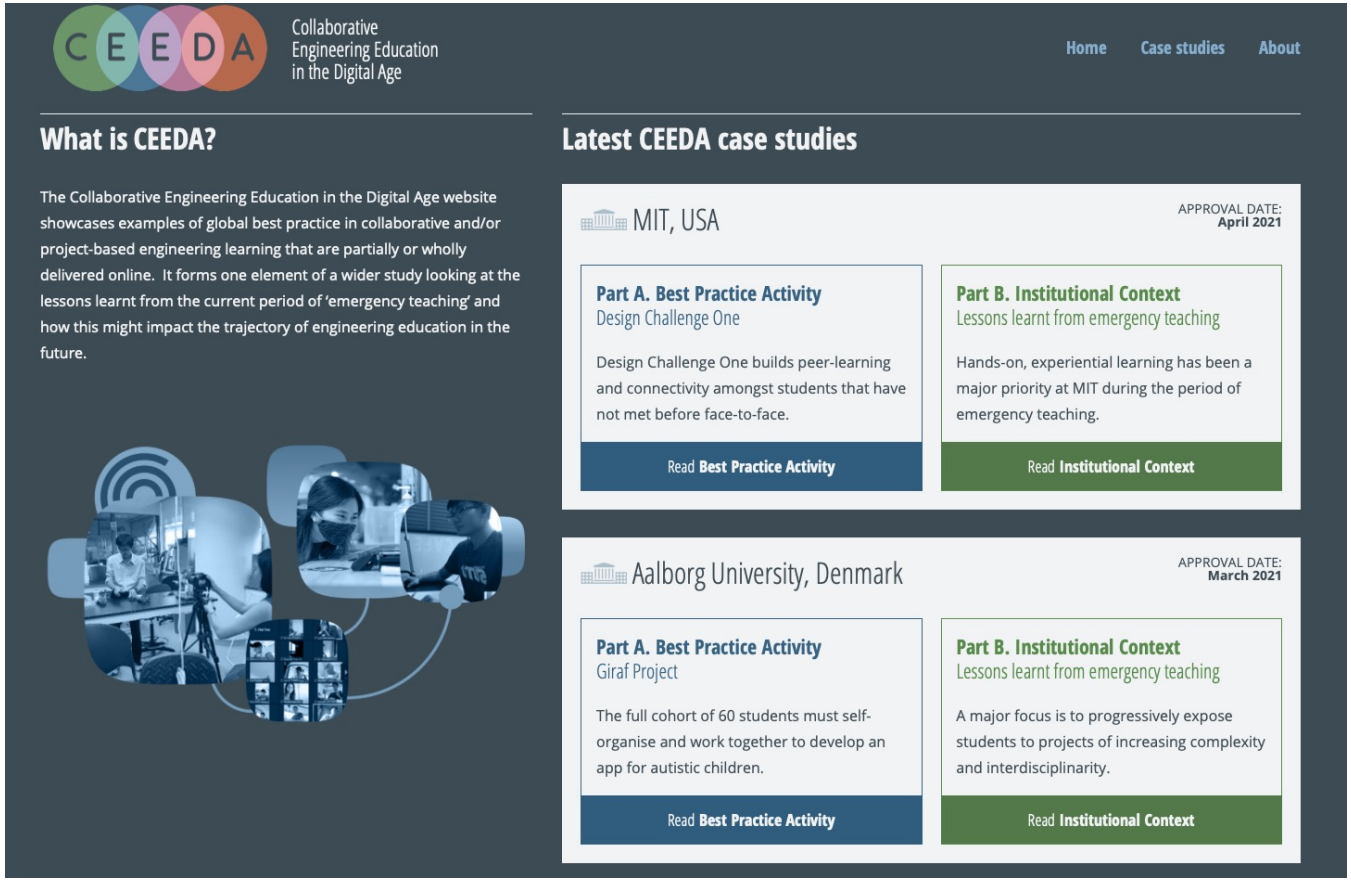
Concerns and risks facing the sector

- **Institutional inflexibility:** that inflexibility will stifle innovation at some institutions
- **Exacerbation of inequalities:** that inequalities amongst students and instructors, and across institutions, may be exacerbated by COVID-19 and ET.
- **Prioritisation of profit over learning:** that emergency teaching may promote a low-cost passive form of online learning that does not prioritise student learning and development
- **Risk of defaulting to the 'status quo':** that lessons will not have been learnt from emergency teaching

CEEDA: Collaborative engineering learning in the digital age



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Thank you