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J A Griffiths, Y Jalali, A Kálmán, Klara Kövesi, G Langie, J Lönngren, J Mitchell, M Polmear

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# FUTURE PERSPECTIVES OF CAPACITY BUILDING IN ENGINEERING EDUCATION

**J.A Griffiths**<sup>1</sup>

University College London  
United Kingdom

**Y. Jalali**

EPFL  
Switzerland

**A. Kálmán**

Budapest University of Technology and Economics  
Hungary

**K. Kövesi**

ENSTA Bretagne  
France

**G. Langie**

KU Leuven  
Belgium

**J. Lönngren**

Umeå University  
Sweden

**J. Mitchell**

University College London  
United Kingdom

**M. Polmear**

King's College London  
United Kingdom

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<sup>1</sup> J A Griffiths

[j.griffiths@ucl.ac.uk](mailto:j.griffiths@ucl.ac.uk)

## 1 MOTIVATION

This workshop aimed to encourage sharing of Capacity Building practices in Engineering Education across the SEFI community and open dialogue to shape how SEFI can support the community and their practices through the Capacity Building Special Interest Group. Participants also had the opportunity to discuss their own experiences of Capacity Building, also known as pedagogical training or professional development, and compared and contrasted this to others' experiences. They considered where Capacity Building has been beneficial for themselves and their colleagues. Participants were also asked to consider areas that will require Capacity Building in the future, feeding into ideas for pan-European support that SEFI might provide, including consideration of the environmental facilitators and barriers for Capacity Building.

The aim was for participants to develop an understanding of the wide variety of ways in which Capacity Building can be organised in Higher Education institutions across Europe, which might provide inspiration for improving current practices within their own institutions. It was also intended for the workshop to support the building of a Community of Practice of educators who are involved with and/or lead Capacity Building activities in their own institutions or within the broader SEFI network.

## 2 BACKGROUND AND RATIONALE

Capacity Building is also known as *pedagogical training or professional development in education*.

Engineering educators understand that the world is changing quickly and the engineers of the future need to ethically balance technology, sustainability and the demands of growing populations in a world where large-scale projects are becoming the new normal, communication is often instant and cultures are mixing more widely. Engineers require new competencies, especially with the growing importance of engaging with the Sustainable Development Goals (SDGs) (Diaz Lantada 2020, 1814, Beagon et. al 2023,1). These include dealing with conflicting values; decision-making using incomplete complex data; transdisciplinary collaboration; and increasing competition for resources.

But how do we make sure that we, as educators, build our capacity to support the development of future engineers? How do we ensure engineering educators at all stages of their career have the appropriate pedagogical skills and knowledge to shape education sustainably and successfully?

Capacity Building is considered important for engineering educators (Chen et al. 2021, 900), but activities are governed and delivered in many different ways (Kövesi et al. 2022, 379). Moreover, an individual's access to Capacity Building may be limited by pre-existing structural factors, job role, the time available for personal development, and employers' recognition of its importance (Perez Foguet and Lazzarini, 2019, 772). Finally, educators who have participated in pedagogical development often face structural challenges that may hinder them implementing

new pedagogical approaches in their practice - which can lead to reduced motivation to engage in further development opportunities.

(Chen et al. 2021) and (Hebles et al. 2021) indicate that Capacity Building is most successful when participants have opportunities to reflect, interact, rehearse and try out pedagogical practices. This workshop asked participants to share their experiences related to these opportunities, discussing how we can build a SEFI community of practice that supports the Capacity Building needs of engineering educators and educational institutions. We examined differences in local practices, exploring whether and how a pan-European approach could add value, shaping future direction of European Engineering Education Capacity Building, and providing inspiration for participants to take back to their own institutions.

### **3 WORKSHOP DESIGN**

The workshop began with introductions and a short questionnaire to find out more about the participants' backgrounds. Of the 20 participants who responded, 2 were early career researchers, 2 new academics, 1 in an administrative or strategy role, 11 were experienced academics, and 4 did not fit into any of these categories.

A second question enquired about disciplinary identification, and they could select more than one answer: 10 considered themselves to be engineering education researchers, 5 'engineering' discipline-specific researchers, 16 educators or practitioners, and 7 have industrial experience.

An overview of Capacity Building practices was then provided (Kövesi et al. 2022), and participants spent a few minutes reflecting on Capacity Building activities that they have experienced. They then moved into small groups of between 4 and 6 people to discuss and identify aspects of Capacity Building that they consider to have worked well, those that have had little effect, and where they see future challenges and opportunities in Capacity Building. The workshop concluded with short summaries of the group discussions which were collected on a white board and in Mentimeter.

### **4 RESULTS OF THE WORKSHOP**

The small discussion groups shared what they have observed worked well for Capacity Building and when it had added value. They generally observed that Capacity Building activities tend to focus on early career staff, with less support for more senior staff.

#### **4.1 What works well**

The groups observed that Capacity Building has worked well for them when:

- There are opportunities for hands on practice.
- There is encouragement and clear support from leadership.
- There is space to include a student role in the activities, creating a bottom up approach.

- Activities are inclusive and include a mix of sharing (dialogue) and teacher delivery (didactic) methods.
- It is 'just in time' and relevant to educators' needs.

It was additionally observed that spending time in industry can be very enriching for academic staff, and that 'food works well'(!) in terms of gaining engagement.

## 4.2 Barriers

A number of barriers to successful engagement with Capacity Building were highlighted:

- Staff require incentives to participate, which could include financial incentives, promotion or tenure.
- Value needs to be perceived in order for staff to participate.
- Staff need to perceive that they are learning 'real' skills and competences.

The analogy of carrots and sticks was used, with carrots being senior leadership actively showing value and appreciation of staff who engage in Capacity Building. This may be in the form of allocation and protection of time for staff to engage through structured opportunities for personal development.

## 4.3 The Future

Participants were asked to consider what Capacity Building activities they would like to see in future. This could include the skills that needed to be covered or the format that activities could take. Comments included:

- There needs to be credibility of the staff delivering – showing by example
- There could be more sharing between institutions
- Universities in the future could value teaching as much as research!
- There could be a culture change bringing increased recognition of Capacity Building activities
- Skills that it would be useful to have more Capacity Building in include:
  - Applying action research in the classroom
  - Equality, Diversity and Inclusion
  - Sustainability
- Educational Research support

## 4.4 Suggestions for SEFI Support

The following points were discussed regarding where SEFI could be impactful:

- The Capacity Building SIG could conduct research on the skills educators will need for the future, and the needs of educators in Higher Education.
- Creating of a European network that could support senior and experienced staff
- Help for trailblazers in institutions
- Following the Japanese Society for Engineering Education and creating a credentialed course for teaching (theirs is around PBL and actives learning)
- Creating an evidence base for the development of Capacity Building activities and of their impact.

Nevertheless, it was also raised that contextualisation to local practices will lead to the most successful and most relevant Capacity Building.

## **5 CONCLUSIONS**

The discussions in the workshop often congregated around the common theme of the value of Capacity Building – it needs to be seen as important and relevant by both those taking part and by senior leadership, who should recognise activities through reward and by enabling participation. Social incentives were seen as key in creating an environment that is supportive of Capacity Building. This fits with many models of behaviour change where a suite of interventions around training, structural changes and incentivisation must be addressed for change to be successful.

It was noted that participants felt there were fewer opportunities for useful and meaningful engagement as they progressed in their careers, but the workshop time did not allow investigation of the specific types of support that senior individuals might find most useful.

## **6 SIGNIFICANCE FOR ENGINEERING EDUCATION**

Connecting to SEFI2023's theme, it is increasingly apparent that we cannot educate future engineers with fluency in the SDGs without tackling competence development. Few engineering educators are comfortable teaching SDGs due to few being experts; there are tensions that occur when educating students for an unknown future requiring different types of knowledge and competencies than those traditionally taught in engineering (Beagon et al 2023, 1). High quality sustainability education requires new approaches such as active learning, project-based learning, and stakeholder collaboration, creating an urgency to build educators' capacity to deliver in these ways. There is a need for pedagogical support to build confidence in numerous emerging, and often fast growing, areas such as AI, sustainability, transdisciplinary education, open and online education and stakeholder collaboration.

Nevertheless, although growing, there remains a scarcity of literature on this important topic and opportunities for discussion with peers are limited. As a result, opportunities for interactions among individuals interested in the field are essential to build a community of practice centred around sharing experiences and learning (Wenger, 2000).

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## **REFERENCES**

Beagon, Una, Kövesi, Klara, Tabas, Brad, Norgaard, Bente, Lehtinen, Riita, Bowe, Brian, Gilet, Christiane and Monrad Spliid, Claus. 2023. "Preparing engineering

students for the challenges of the SDGs: what competences are required?"  
European Journal of Engineering Education 48, no.1, 1-23.

Chen, Jubei, Kolmos, Anette, Pereiria De Carvalho Guerra, Aida Olivia and Chungfang Zhou. 2021. "Academic Staff's Motivation, Outcomes and Challenges in a Pedagogical Training Programme of PBL." International Journal of Engineering Education 37, no.4, 900-14.

Diaz Lantada, Andres. 2020. "Engineering Education 5.0: Continuously Evolving Engineering Education." International Journal of Engineering Education 36, no.6: 1814-32.

Hebles, Melany, Yániz-Alvare-de-Eulate, Concepción, Alonso-Dos-Santos, Manuel. and Villardón-Gallego, Lourdes. 2021. "Towards a cooperative Learning Environment in Universities through In-Service Training." Sustainability 13, no.3 (January). 1112. <https://doi.org/10.3390/su13031112>

Kövesi, Klara, Langie, Greet, Gardner, Anne, Griffiths, Jennifer, Kálmán, Anikó, Lönngren, Johanna, and Ruth-Polmear, Madeline. 2022. "International practice of CB in engineering education: a comparative case study", Proceedings of the 2022 SEFI Conference, 379-90 <https://doi.org/10.5821/conference-9788412322262.1279>

Pérez-Foguet, Agustí, and Lazzarini, Boris, 2019. "Continuing professional education in engineering faculties: Transversal integration of sustainable human development in basic engineering sciences courses." Journal of Cleaner Production 218, no.1 (May), 772–81. <https://doi.org/10.1016/j.jclepro.2019.02.054>

Wenger, Etienne. 2000." Communities of Practice and Social Learning Systems." Organization , no. 2, 225-46, <https://doi.org/10.1177/135050840072002>