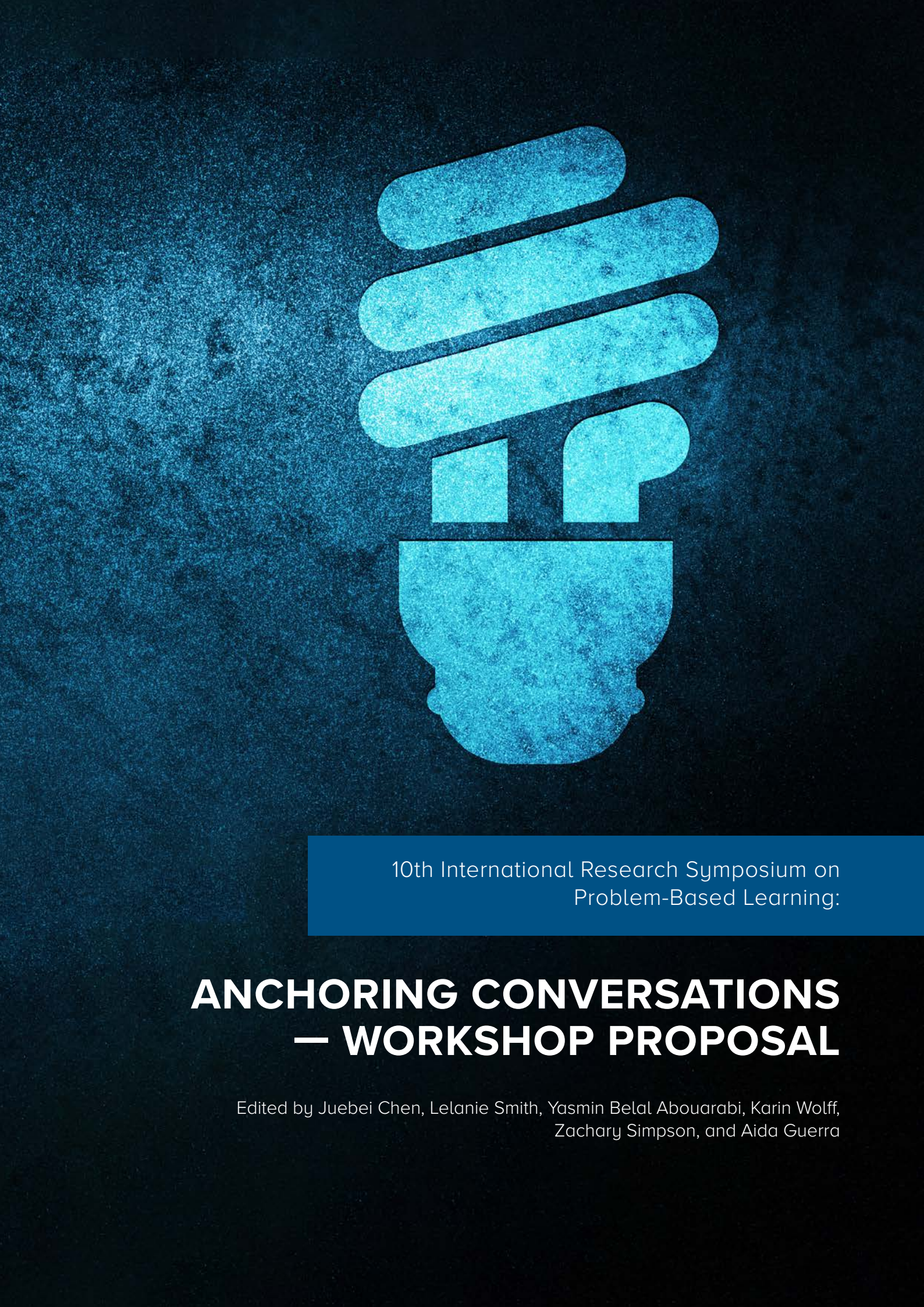

10th International Research Symposium on Problem-Based Learning:

ANCHORING CONVERSATIONS — WORKSHOP PROPOSAL

Edited by Juebei Chen, Lelanie Smith, Yasmin Belal Abouarabi, Karin Wolff, Zachary Simpson, and Aida Guerra

ANCHORING CONVERSATIONS

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Workshop proposal

unesco Centre Under the auspices of UNESCO
AALBORG UNIVERSITY Centre for Problem-Based Learning in Engineering Science and Sustainability
FUTURE NATION SCHOOLS
UNIVERSITEIT VAN PRETORIA UNIVERSITY OF PRETORIA YUNIBESITHI YA PRETORIA
SASEE
SOTL IN THE SOUTH Scholarship of Teaching and Learning in the South

Co-learning in the innovation hub: a way to improve transdisciplinary partnerships

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Abstract

Challenge-based learning (CBL) emphasizes active stakeholder engagement and real-world, open-ended challenges. Unlike other active learning models, CBL involves students, educators, and stakeholders as co-learners (van den Beemt et al., 2023; Doulougeri et al., 2024). Typically, challenges are introduced by a single stakeholder, often from industry, which may limit alignment with broader societal issues requiring multi-stakeholder collaboration (van den Beemt & McCleod, 2021).
To foster inter-stakeholder collaboration and co-learning, TU/e innovation Space developed Thematic Challenges, centered on broad societal themes such as Regenerative Resources and Responsible Mobility. These challenges create communities where students collaborate with diverse stakeholders, learning to navigate complex societal issues.
To support this transition, we developed the "Co-Learning in the Innovation Hub" workshop, which immerses participants in stakeholder roles to explore tensions and align interests in a CBL framework, based on the following structure:

- 20 min: Welcome, Deep Democracy check-in.
- 20 min: Introduction to thematic challenges, Q&A.
- 45 min: Interactive role-playing on systemic constellations.
- 25 min: Reflection and discussion.
- 10 min: Deep Democracy check-out.

Designed for educational designers and teachers, this workshop provides concrete tools to enhance multi-stakeholder collaboration in education, requiring no prior knowledge.

Keywords: learning ecosystem, transdisciplinarity, collaborative learning, grand challenges

1 Introduction

Challenge-based learning (CBL) distinguishes itself through active stakeholder engagement and its focus on tackling real-world, open-ended challenges. Unlike other active learning models, CBL involves students, educators, and stakeholders as co-learners (van den Beemt et al. 2023; Doulougeri et al., 2024). Typically, challenges are presented by a single stakeholder, often from industry, which can narrow the focus and limit alignment with broader, societally impactful problems that involve multiple stakeholders (van den Beemt & McCleod, 2021).

To create more inter-stakeholder collaboration and co-learning, TU/e innovation Space started to develop Thematic challenges. Thematic challenges revolve around broad, societally relevant themes, such as Regenerative Resources and Responsible Mobility. The ambition is that stakeholders from various sectors come together within the ecosystem of a given grand challenge. Students join this thematic community within a larger ecosystem to work on the challenges and engage with the diverse stakeholders involved.

This thematic approach provides valuable learning opportunities to students, particularly in navigating complex multi-stakeholder relationships. It also prompts stakeholders to reflect on their roles, challenging their organizational agendas and impact on society and the ecosystem. However, shifting to thematic challenges requires external partners to engage in co-learning toward addressing a broad societal challenge, which is a significant mindset change from the more profit mindset most industry partners have. We developed the "Co-Learning in the Innovation Hub" workshop to support this transition.

2 Workshop design

The “Co-learning in the Innovation Hub” workshop simulates the transition to multi-stakeholder, thematic challenges. Participants will immerse themselves in various stakeholder roles, navigating tensions and aligning interests within a CBL framework. The workshop is structured as follows:

- 20 minutes: a welcome moment in plenary, where participants follow the Deep Democracy’s check-in protocol to introduce themselves and share what they bring into the room.
- 20 min: introduction to the thematic, grand challenges approach with multiple stakeholders, with examples from TU/e curricular education where this has been applied and sharing of key insights. This will include a Q&A moment for the attendees to ask questions.
- 45 min: interactive session where attendees engage in the “Co-Learning in the Innovation Hub” workshop through role playing. The attendees are divided into small groups and within those groups they choose a stakeholder they want to impersonate for the workshop (e.g. industry partner, government, citizen, non-profit organization, educational organization, etc.). They are then assigned a thematic challenge (e.g. Regenerative resources, Smart Mobility, etc.) and they are facilitated through the creation of a systemic constellation around the given challenge. During the discussion, they are encouraged to share their stakes in the thematic challenge, from the perspective of the stakeholder they are representing. By doing so, conflicting interests and perspectives will emerge, and the facilitator will support them to find a common ground.
- 25 min: A reflection moment, facilitated in plenary, where all attendees discuss their experiences, share key takeaways and give feedback on the approach.
- 10 min: A closing moment, before concluding the workshop, following the Deep Democracy’s check-out approach, where all participants share how they are leaving the workshop.

3 Educational impact

The workshop is aimed at educational designers and teachers interested in (multi-) stakeholder challenges in CBL, yet IRSPBL, SoTL in the South, SASEE, and other interested visitors are also welcome to participate. The workshop requires no prior knowledge. Participants will be equipped with concrete tools to start or improve collaboration with external stakeholders in education.

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Beyond Borders: International Fellowships as Your Research Launchpad

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Abstract

In an increasingly interconnected global landscape, international fellowships serve as powerful catalysts for connection, collaboration, and co-creation in engineering education research (EER). This transformative tutorial workshop is designed to empower educators and researchers to bridge geographical boundaries, foster meaningful international partnerships, and advance equitable learning environments. Through interactive and participatory approaches, participants will explore prominent fellowship opportunities (including Marie Curie, EU-funded, and Fulbright programs), develop strategies for crafting compelling applications, and learn to leverage global networks to amplify their research impact. The ultimate objective is to equip participants with the tools to secure funding that enables cross-cultural dialogue, innovative research collaborations, and meaningful contributions to the future of engineering education.

The facilitators have previously delivered versions of this workshop at CREE in Cape Town, REES in India, LACCEI in Costa Rico, and SEFI in Switzerland. We now hope to share it with the IRSPBL audience in Pretoria.

Keywords: International Fellowships, Research Funding, Engineering Education Research, Equity and Inclusion, Global Collaboration, Cross-Cultural Research Networks

1 Introduction

This tutorial workshop embodies the conference theme of "Anchoring Conversations" by providing a comprehensive approach to building international research connections. We will examine how fellowship opportunities serve as crucial mechanisms for promoting global dialogue, collaborative knowledge production, and innovative research methodologies in engineering education.

Securing research funding in a competitive global environment requires strategic navigation of complex international research landscapes. Key steps include:

- Identifying funding sources that align with collaborative research goals
- Carefully studying funders' guidelines and priorities
- Developing clear, compelling research proposals that demonstrate global impact

- Building robust, diverse research teams
- Crafting meticulous applications
- Seeking expert feedback to refine proposals

The workshop recognizes that successful fellowship applications are more than financial transactions—they are opportunities for meaningful cross-cultural exchange and collaborative knowledge creation. Applicants must demonstrate outstanding academic achievements, comprehensive research vision, potential for global impact, clear implementation strategies, and alignment with the funder's and host organization's strategic objectives.

During this workshop, through practical demonstrations and interactive exercises, participants will:

- Navigate international research databases
- Identify fellowship opportunities
- Learn to strategically align their research interests with funding priorities
- Develop skills for cross-cultural research collaboration

2 Target audience

This workshop is geared toward educators at all stages of their careers seeking to enhance their research capabilities, explore new areas of inquiry, and expand their professional networks through collaborations with colleagues from institutions beyond their national borders.

3 Workshop Format

Utilizing online databases, participants will explore fellowship opportunities within the European Union, the United States, and their current countries of residence. The hands-on approach involves:

- **Fellowship Exploration:** Investigating leading international fellowships (Fulbright, Erasmus+, Marie Curie) with insights into eligibility criteria, application processes, and timelines
- **Networking for Impact:** Building international research networks to promote inclusive and accessible engineering education

4 Key Learning Objectives

1) Understand the fundamental processes of obtaining international research fellowships
2) Explore fellowship programs across different regions
3) Navigate research databases to identify funding opportunities
4) Develop networking strategies for international research collaborations
5) Gain insights into crafting competitive fellowship proposals

5 Expected Outcomes

By the end of this 90-minute workshop, participants will:

- Identify three international fellowship opportunities aligned with their research interests
- Develop an initial fellowship application concept, including:
    - Preliminary research topic

- Potential host institutions
- Understanding of at least one funder's key priorities

- Create a personal action plan for pursuing international fellowship opportunities
- Begin building a network of peers interested in international research collaborations

6 Conclusion

International fellowships represent more than mere funding opportunities; they can be transformative experiences that bridge cultural divides, foster global understanding, and advance engineering education research. This workshop provides a critical starting point for researchers seeking to expand their professional horizons, develop cross-cultural competencies, and contribute to a more inclusive global research landscape.

By demystifying the fellowship application process, participants are empowered to see beyond institutional and national boundaries. The collaborative approach encourages researchers to view their work as part of a broader, interconnected global dialogue. While a 90-minute workshop cannot guarantee fellowship success, it equips participants with essential tools, strategies, and confidence to pursue international research opportunities.

The ultimate impact extends beyond individual career development. Each successful fellowship represents a step toward more diverse, collaborative, and innovative engineering education research. By supporting researchers in navigating these opportunities, we contribute to the development of more robust, inclusive, and globally connected academic communities.

As participants move forward, we encourage them to continue networking, refining their research goals, and remaining persistent in pursuing international research collaborations. The journey of securing an international fellowship is itself a valuable process of professional growth and global engagement.

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Mapping Research Terrain: Navigating Systematic Literature Reviews

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Abstract

In the rapidly evolving field of Engineering Education Research (EER), systematic literature reviews (SLRs) have emerged as powerful tools for synthesising knowledge and identifying gaps in the research landscape. Whether you are a novice researcher or an experienced academic, conducting thorough and unbiased literature reviews is crucial for advancing scholarship and ensuring impactful contributions to the field. This 90-minute workshop introduces participants to the process and methodologies behind SLRs, equipping them with the skills to conduct robust and reproducible reviews.

Through interactive presentations, hands-on analysis of published reviews, and collaborative discussions, participants will develop essential skills in identifying appropriate review types, formulating research questions, establishing inclusion/exclusion criteria, and understanding database selection strategies. Expected outcomes include enhanced critical evaluation skills, improved understanding of systematic review methodologies, and practical knowledge for conducting future literature reviews in engineering education contexts. This workshop addresses a crucial gap in research training for early career researchers who must navigate an increasingly complex landscape of review methodologies while maintaining scientific rigor and transparency.

Keywords: Engineering Education Research; Research Methodology; Literature Review; Systematic Mapping; Systematic Review; Systematic Literature Review; Inclusion and Exclusion Criteria

1 Introduction

Literature reviews serve as the foundation of scholarly research, providing comprehensive examinations of existing knowledge within specific domains. However, not all literature reviews are created equal, and understanding the distinction between different review approaches is crucial for early career researchers in Engineering Education Research (EER).

Traditional narrative reviews, while valuable for providing broad overviews, often lack the systematic rigor necessary for evidence-based research. Grant and Booth (2009) identified fourteen distinct review types, each with specific methodologies, strengths, and applications. Among these, systematic literature reviews (SLRs) have emerged as the gold standard for synthesizing research evidence due to their explicit, reproducible methodologies and comprehensive search strategies.

Systematic literature reviews differ from narrative reviews in several key aspects: they employ predefined search strategies, utilize explicit inclusion and exclusion criteria, conduct systematic quality assessments, and follow transparent reporting guidelines (Booth, Papaioannou, & Sutton, 2012; Cochrane Collaboration, 2011; Petticrew & Roberts, 2006) – including the currently accepyed formats for research/reviews: Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Moher et al., 2009) (see figure 1).

This methodological rigor makes SLRs particularly valuable in engineering education research (Borrego, Foster, & Froyed, 2014; Philips et al., 2024; Saunders-Smits & Leandro Cruz, 2020), where evidence-based practice is increasingly important for informing curriculum development, pedagogical innovations, and policy decisions.

For new researchers entering the field of engineering education, mastering systematic review methodologies provides several advantages: enhanced critical evaluation skills, improved understanding of research

synthesis techniques, and the ability to contribute meaningfully to evidence-based practice in engineering education. Furthermore, conducting systematic reviews helps researchers identify gaps in existing literature, understand methodological trends, and develop expertise in specific research domains.

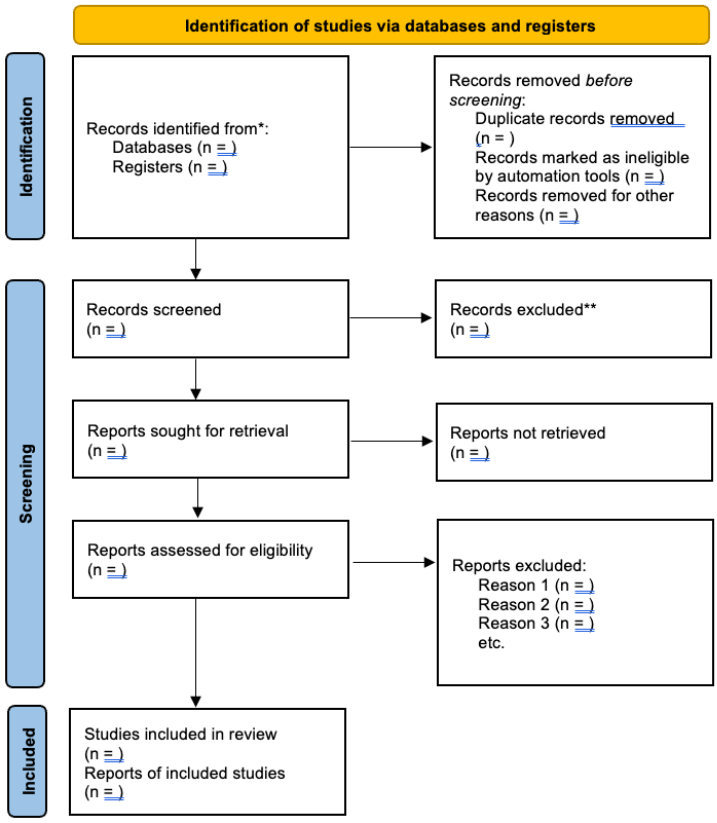

Figure 1. PRISMA 2020 flow diagram for new systematic reviews

(retrieved from: https://www.prisma-statement.org/prisma-2020-flow-diagram)

2 Objectives

By the conclusion of this workshop, participants will be able to to:

1. Identify and articulate multiple reasons and motivations for conducting literature reviews in the context of engineering education research, including theory development, gap identification, methodology assessment, and evidence synthesis for practice improvement.
2. Differentiate between various review types, purposes and methodologies with particular focus on distinguishing systematic reviews from narrative reviews, scoping reviews, and meta-analyses in terms of methodology, scope, and appropriate applications.
3. Identify and assess databases used in precedent systematic literature review studies, including understanding the rationale for database selection, coverage limitations, and the importance of comprehensive search strategies across multiple databases.
4. Identify and evaluate research questions in published systematic literature review studies using the PICOS and/or SPIDER frameworks (e.g. Methley et al., 2014), demonstrating understanding of how research questions drive methodology selection, search strategy development, and inclusion/exclusion criteria formulation.

5. Describe and apply inclusion/exclusion criteria used in systematic literature reviews, understanding how these criteria relate to research questions, ensure study quality, and maintain review scope while minimizing bias.
6. Evaluate the quality and completeness of systematic literature review reports using established guidelines and frameworks (PRISMA), including assessment of search strategy transparency, selection criteria clarity, and synthesis methodology appropriateness.
7. Develop preliminary plans for conducting systematic literature reviews in their own research areas, including research question formulation, database selection strategy, and inclusion/exclusion criteria development.

3 Target audience

The workshop has been developed with PhD students and early career researchers in mind. However, anyone interested in learning more about the different types of literature reviews, and associated methodologies, are welcome to participate.

4 Format

Expected participants: 12-20 participants to ensure effective pair work and meaningful group discussions

Pair organisation work: Participants will be paired strategically based on research interests and experience levels when possible.

The session structure, for 90 minutes, is:

1. Introduction & Overview (20 minutes)

Participants will be introduced to various types of literature reviews, with a particular focus on the SLR, highlighting their significance in EER.

2. Hands-On Activity (45 minutes)

Participants work in pairs to analyze assigned systematic literature reviews from EER. Each pair receives a different published systematic review and a structured set of prompts designed to assist them in locating various components of the document and assessing the rationale behind each part. Key focus areas will include:

- Topic and scope analysis
- Research questions evaluation
- Database and search strategy assessment
- Inclusion/exclusion criteria analysis
- PRISMA flow chart examination
- Key findings and synthesis

3. Group Presentations & Discussion (20 minutes)

Each pair presents 2-3 minutes on their assigned review, with a focus on one particularly interesting or challenging aspect of their analysis and/or insights.

4. Wrap-Up (5 minutes)

The workshop will conclude with a summary of key takeaways followed by an opportunity for participants to address remaining questions and seek further clarifications.

5 Activities

- Interactive presentation on literature review typologies and SLR methodology.
- Tutorial on interpreting and evaluating published SLR reports.
- Structured pair analysis of published systematic literature reviews.
- Collaborative Discussion

If time permits, participants will begin developing preliminary plans for systematic literature reviews in their own research areas, applying workshop learning to their specific contexts.

6 Expected Outcomes

This workshop provides participants with essential foundations in systematic literature review methodology, drawing from established frameworks while addressing the specific needs and contexts of EER. Through hands-on analysis of published systematic reviews, participants develop both theoretical understanding and practical skills. The emphasis on interactive learning, peer collaboration, and practical application ensures that participants leave the workshop with immediately applicable knowledge and a clear understanding of how systematic approaches to literature review can enhance their research quality and impact.

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Ethics in Action: Transforming Engineering Classrooms Together

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Abstract

Are you ready to energize your students' learning of engineering ethics? Join us for a high-energy, interactive workshop where we will unlock the power of *The Routledge International Handbook of Engineering Ethics Education (RIHEEE)*—an open-source treasure trove of cutting-edge knowledge and active learning strategies! This active learning workshop session is designed for educators who want to incorporate innovative, discipline-specific ethics learning methods into their courses. Through creative brainstorming and collaborative problem-solving, **specifically through an engaging "Engineering Ethics Education Bingo" activity**, you'll walk away with practical strategies for integrating ethics into any engineering course.

Keywords: Engineering Education, Ethics, Teaching Methods, Active Learning, Curriculum Development

1 Introduction

This workshop explores the integration of active learning methods into engineering ethics education, aligning with the conference's focus on connection, collaboration, and co-creation for the future. Facilitated by editors and authors of *The Routledge International Handbook of Engineering Ethics Education*, this session will introduce participants to diverse student-centred approaches for teaching ethics, including case studies (Herzog et al., 2025), project-based learning (PBL) (Routhe et al., 2025), value-sensitive design (VSD) (Gammon et al., 2025), service learning (Daniel et al., 2025), arts-based methods (Hitt et al., 2025), and reflective practices (Marin et al., 2025). During the workshop, participants will discuss practical, actionable strategies for embedding ethics into their engineering programs, **primarily through an interactive "Engineering Ethics Education Bingo" game designed for collaborative problem-solving**. They will gain insight into using active learning methods and will network with peers interested in ethics education.

This workshop offers a cutting-edge opportunity for engineering and technology educators to integrate ethics into their teaching. We view ethics as a crucial topic that needs to be incorporated into our teaching in various ways, utilizing different learning speeds (such as reflection, deliberation, and quick response). We will practice all these during the workshop.

2 Target audience

This workshop is designed for educators seeking to energise their classrooms with active learning approaches, infusing course lessons and assignments with meaningful and ethically oriented discussions and activities. We aim to familiarise participants with the ethics handbook, promote its utility for educators, and provide a platform for understanding and applying concepts from its chapters. Participants will collaborate to identify ethical issues and apply chosen methods to engineering modules, thereby fostering critical discussion and planning for the ethical integration of these methods. The intended audience is any educator who teaches an engineering subject or leads/manages an engineering course, including professors, lecturers, teaching assistants, and curriculum developers keen to integrate ethics innovatively into their pedagogical practices. The collaborative activities, such as the Bingo game, are designed to accommodate diverse participants, fostering rich discussion and idea exchange.

3 Workshop Format

The workshop begins with a whole-group discussion to define ethics in the context of engineering education. Then, the facilitators introduce the handbook and selected teaching methods featured in it. We subsequently break into small groups for a high-energy, collaborative problem-solving activity: **Engineering Ethics Education Bingo**. Conducted in small groups of 2-3 participants, each team receives a unique Bingo card (Chance et al., 2025) designed to connect ethics education with various engineering disciplines through active learning methods. The challenge is to align a row of boxes on their card by proposing and presenting innovative ideas for integrating ethics. The first team to achieve this will be crowned "Ethics Bingo Champions!"

This engaging game explores a diverse range of active learning pedagogies outlined in the handbook, including dilemmas and case studies, project- and challenge-based learning, value-sensitive design, service- and humanitarian-learning, arts-based methods, and reflective and dialogical approaches. Participants will actively consider how to apply these techniques across various engineering disciplines, including mechanical and aerospace engineering, civil engineering, chemical engineering, electronic and electrical engineering, and software engineering.

Following the Bingo game, a whole-group recap will synthesize learning and gather recommendations for improvement. This will lead into a focused, deliberative activity where groups develop a specific idea—generated during or following the Bingo game—into a concrete implementation plan for their own courses (e.g., foundational classes on electrotechnology, physics, calculus, design, chemistry).

4 Expected Outcomes

At the end of this workshop, participants will have a clear understanding of active learning methods for ethics education, practical plans for applying ethics in engineering modules, and an enhanced ability to evaluate and refine ethics-related teaching practices critically.

More specifically, by the end of this workshop, participants will be able to:

- articulate what ethics means in the context of engineering education,
- identify a range of issues relevant to engineering ethics education,
- describe the ethics handbook and name some of the topics covered in it,
- identify several active learning methods used to teach ethics in engineering, **as explored through the Engineering Ethics Education Bingo game**,

- articulate a plan for using one of the recommended teaching methods to integrate a new/additional aspect of ethics into one of the modules they teach, **derived from the Bingo activity and subsequent idea development**, and
- critically evaluate and discuss activities proposed by others for integrating ethics using active learning methods.

Furthermore, attendees will **collaborate effectively in small groups**, forging meaningful connections between diverse assignment and activity ideas, core ethics concepts, specific engineering discipline areas, and various active learning pedagogical strategies. They will also **generate innovative and actionable approaches** for integrating ethics topics, discipline-specific challenges, and effective teaching methods directly into their instructional practices and curriculum design.

5 Schedule

A 90-minute session is recommended for comprehensive engagement. This workshop fosters a highly interactive and collaborative environment, with participants actively engaging in group discussions and hands-on activities.

- **Introduction to the Handbook (10 minutes):** A comprehensive introduction to *The Routledge International Handbook of Engineering Ethics Education*, identifying its six sections/thematic areas and highlighting specific active teaching methods and engineering disciplines featured within.
- **Engineering Ethics Education Bingo Activity (50 minutes):** A fast-paced, collaborative gaming activity conducted in small groups of 2-3 participants, utilizing the "Engineering Ethics Education Bingo" cards (Chance et al., 2025).
- **Bingo Game Recap and Improvement (10 minutes):** A whole-group discussion to synthesize learnings from the Bingo game and collect recommendations for further improvement.
- **Idea Development and Planning (15 minutes):** A focused, deliberative activity where groups develop one specific idea—generated during or following the Bingo game—into a concrete implementation plan for their own courses (e.g., foundational classes on electrotechnology, physics, calculus, design, chemistry).
- **Wrap-up Synthesizing Discussion (5 minutes):** A final discussion to consolidate insights and prepare participants for applying their new knowledge.

6 Conclusion

This "Integrating Active Learning Methods into Engineering Ethics Education: A Hands-on Workshop" serves as a crucial opportunity for engineering and technology educators to transform their classrooms. By leveraging open-source resources like *The Routledge International Handbook of Engineering Ethics Education* and engaging in interactive methods such as the "Engineering Ethics Education Bingo", participants are empowered to identify a range of issues relevant to engineering ethics education and develop concrete implementation plans for their own courses. Ultimately, this collaborative and high-energy session aims to enhance participants' ability to evaluate and refine ethics-related teaching practices, fostering innovative and actionable approaches for integrating ethics directly into instructional practices and curriculum design across various engineering disciplines.

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From matters of fact to meta-affect: Exploring emotional support in teaching and learning on wicked sustainability challenges in engineering education

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Abstract

Traditional engineering education prioritizes rational-analytical learning processes, focusing on 'matters of fact' and overlooking the role of emotions and dealing with 'matterns of concern' – which often are at stake when dealing with wicked sustainability issues. We are in this workshop interested in teaching and learning processes that elicit stronger epistemic emotions among engineering students with respect to wicked issues, namely open-ended exploration, collective experimentation, value clashes, ambiguity, and uncertainty.

This workshop explores the significance of *meta-affect*—the capacity to recognize, articulate, reframe, and regulate emotions in complex problem-solving. The aim is to deepen our collective understanding of productive meta-affect and how it can help improve engineering education pedagogy and practice in a spirit of care.

Earlier research has shown that it is important to help students navigate difficult emotions, for example, by validating their emotional experiences. While affective scaffolding and collective emotional regulation support this, approaches that foster students' self-directed emotional regulation are limited. This is the core of *productive meta-affect.* Strengthening students' ability to recognize and handle emotions productively offers a key opportunity to strengthening engineering education for sustainability. In the workshop we build on participants' experiences and develop strategies and tools to enhance our teaching practices, establish connections, and identify opportunities for future research.

Keywords: meta-affect, engineering education, sustainability, emotion, learning

1 Background and rationale

Caring Pedagogies and Sustainable Education: workshop

Engineering education traditionally prioritizes analytical approaches, overlooking the emotional aspects of learning. Wicked issues, such as sustainability challenges, characterized by uncertainty, complexity and value dispute, highlight the need for students to develop productive meta-affect skills— how to identify, manage, and contextualize emotions in ways that may also challenge or transform deeply held beliefs about what it means to learn and become engineers (Holmén & Lönngren, 2025; Lönngren et al., 2024).

Enhancing emotional competencies can transform engineering pedagogy, enabling students to engage more deeply with complex issues. The workshop addresses key interests of IRSPBL 2025 by promoting interactive pedagogical development and reflection, focussing on wicked problem-solving drawing on recent research and participants' knowledge and experiences. By emphasising distributed, interactive, and self-guided emotional regulation methods through a lens of meta-affect, we will explore how these empower students to handle uncertainty and ambiguity in learning to address wicked sustainability issues.

Meta-affect can be approached as a *process*, that is, focussing on what students (can, could or should) do and in what sequence in e.g. accepting, avoiding, reframing or regulating emotions (Goldin, 2002; Radoff et al., 2019). It can also be understood as a *skill*, focussing on what students are able to do with respect to regulating or handling emotions, or; as a *perspective* inviting students and teachers to approach learning differently. Based on these complementary ways of understanding meta-affect, we can also distinguish between understandings of emotions as deficits-to-be-controlled (i.e. through avoiding or regulating), or as assets-to-be-nurtured (i.e. through accepting or reframing). With respect to zones of proximal development and learning with wicked issues, active and productive engagement with emotions may be of particular importance, i.e. working towards reframing and regulating rather than acceptance or avoidance.

Research on affect has shown the ways in which meta-affect can shift or redirect students affective pathways (Goldin, 2000). Mathematics and engineering researchers have examined the sequences of emotions, or affective pathways, that students experience when solving problems (Goldin, 2000; Gómez-Chacón, 2015; Treadway et al., 2022, 2023) and how repeated pathways over time can contribute to a student's overall feelings about a discipline. Engineering education researchers have created a tool to measure affective pathways students experience during problem solving that will be shared during the workshop (Treadway et al., 2022, 2023).

The organisers of the workshop have extensive research and practice experience from working with emotions in engineering education (Holmén & Lönngren, 2025; Lönngren et al., 2023, 2024; Swenson et al., 2024), both on a level of the individual and in social interaction. Interestingly, despite different philosophical, theoretical or pedagogical starting points and empirical contexts, results and experiences are strikingly similar in terms of identified actions and strategies for how students regulate or engage productively with emotions given the various challenges they come across. Based on this realisation, the workshop will further explore the assumption whether more generic patterns and mechanisms can be identified and general strategic guidelines be developed to enhance the research with and practice in various educational settings and contexts to productively deal with emotions in wicked issues.

2 Workshop plan

The workshop will start with a brief introduction of meta-affect and emotional dimensions in engineering education with complex challenges such as wicked sustainability issues. The participants will then explore dimensions and approaches for emotional regulation, emphasising productive emotional regulation methods and affective scaffolding. Finally, questions and strategies to enhance self-directed emotional regulation will be developed based on participants' experiences and education contexts.

To support the workshop, we will bring an overview of recent empirical research on the role of emotional support on student learning in engineering education with complex issues. This will be underpinned by basic theories and literatures on epistemic emotions, affective scaffolding and meta-affect. To invite and initiate conversation among participants, they will early on be divided in smaller groups and asked to briefly share their own education practices and their relation to meta-affect.

The target audience for this workshop is engineering educators, researchers and practitioners with experience from and interest in innovative educational practices on emotions in engineering education for sustainability and complex issues. The maximum number of participants is 35 to ensure active engagement and meaningful interaction.

2.1 Objectives

The objectives for the workshop are the following:

(1) Understand the concept of meta-affect and its relevance to engineering education.
(2) Explore methods for surfacing and productively handling emotions in learning environments dealing with wicked problems.
(3) Develop plans or strategies for scaffolding or an intervention to enhance emotional support in education, teaching and learning practices.

distributed support/learning environment in the activities. I.e., we're not only planning to develop individual interventions, but also changes to the overall learning environment.

2.2 Activities

The workshop time is 90 minutes, and will combine plenum presentation, paired conversation, group discussion, concept formation and whole group reflection.

1. **Introduction (15 min):** Brief presentation of meta-affect and its relevance in engineering education for sustainability and complex issues, including empirical examples and theoretical underpinning.
2. **Conversation in groups of 2-3 (10 min):** Participants share personal experiences and observations about emotional challenges encountered in their teaching or learning environments or research.
3. **Group Activities (40 min):** In groups of 4-5, participants collaboratively identify specific emotional challenges in their teaching contexts and apply concepts of meta-affect to reason around possible ways of deepening emotional awareness and learning. This block will be supported by a simple conceptual model based on the theories presented earlier, including affective pathways.
4. **Strategy Development (15 min):** Groups share strategies developed, receiving feedback and refining ideas collectively. Strategies may include simpler interventions or more comprehensive concepts enhancing distributed support and changes to wider learning environments.
5. **Wrap-up and Reflection, future research and practice avenues (10 min):** Synthesize key learnings, outline actionable steps participants can implement, and discuss potential areas for future research.

2.3 Expected outcomes

The workshop is expected to arrive at the following outcomes:

- Enhanced understanding of emotional dimensions in engineering education.
- Practical strategies and tools for noticing emotions within the classroom and integrating meta-affect in teaching practices.
- New connections and collaborations for future research.

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Exploring Understandings of Technological Literacy in K-12 Science Education

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Abstract

This workshop aims to explore various perspectives on technology education and technological literacy in K-12 science education. Results from a Q-study on Danish teacher educators' perspectives on technological literacy in science education is presented, after which participants will engage in a Q-sort activity themselves, reflecting on predefined statements related to technological literacy to capture diverse perspectives on the topic. This is followed by group discussions to further explore these viewpoints, aiming to identify subjective opinions and innovative practices related to technological literacy in teaching. By the end of the workshop, participants will have gained valuable insights into different understandings of meaningful teaching approaches to developing technological literacy in K-12 science education. Additionally, they will have experience with using Q-methodology to reflect on their own practices and explore others' perspectives on technological literacy in K-12 science education.

Keywords: Technology education, Technological literacy, K-12, Science education, Q-methodology

1 Introduction

There is growing recognition that rapid technological development increases the complexity of the world. Therefore, it is necessary to develop education that fosters technological literacy, with a broad understanding of technology and its role in society (e.g., UVM, 2018; 2022; National Research Council, 2013; ITEEA 2021). Technology education, although often overlooked in the formal school curriculum, plays a crucial role in equipping students with essential skills and knowledge for critical thinking and decision-making (Avsec & Jamsek, 2015). Historically, however, technology has often been viewed as secondary to science or merely as its practical application, leading to a limited understanding of effective technology teaching methods (Kim & Roth, 2015). Consequently, important aspects of technological literacy risk being overlooked or neglected (de Vries, 2012).

In the Netherlands (Ardies & de Vries, 2022), Finland (Niiranen, 2022), Japan, and the USA (Moye, 2020), a larger collaborative project is being conducted focusing on the identification of current and future trends and challenges in technology education. In the Netherlands, Finland and USA countries, the project involved consulting teachers, researchers, and other relevant stakeholders through a Delphi process. The backgrounds and results of the surveys in the three countries were very different, but all emphasized the need for a clearer definition of technology and its role in STEM education. Japan is yet to publish their results.

In Denmark, there has been a growing emphasis on digital literacy in primary education, with experiments conducted between 2018 and 2021 to introduce "technological understanding" both as a standalone subject and integrated into existing subjects (*Teknologiforståelse*, n.d.). These experiments primarily focused on the design, construction, and critical reflection on digital artifacts (i.e., informatics) and their impact on individuals and society (UVM, 2018). In 2023, a 'Knowledge Center for Digital Technological Understanding' was established to develop a Danish approach and knowledge base for a common discipline in digital technological understanding in primary and secondary education. Currently, digital technological understanding' is offered as an elective subject on an experimental basis. However, it remains uncertain how this subject will ultimately be integrated into primary education and, consequently, into teacher education.

Thus, there is a need to conceptualize what technology education within science education should or can look like, both in terms of content and didactics.

This is the focus of this workshop, in which various perspectives on technology education and technological literacy in K-12 science education are presented based on a Q-study in the context of science teacher education in Denmark. In the workshop, participants themselves will engage in a Q-sort activity, reflecting

on predefined statements to capture diverse perspectives on technological literacy in science education. This is followed by group discussions to further explore these viewpoints, aiming to identify subjective opinions, practices and innovative ideas related to technological literacy in science teaching.

2 Background and rationale

The Danish national program Naturfagsakademiet (NAFA - Natural Science Academy) (*OM NAFA - NAFA*, 2023), was established in collaboration with all six teacher education institutions in Denmark, four co-applicant universities, and The National Centre for Science Education (Astra), running from 2021 to 2028. NAFA is funded by the Villum Foundation and the Novo Nordisk Foundation. Its aim is to promote motivating and beneficial science education in primary and secondary schools (K-10) in Denmark by strengthening the training of future and current science teachers.

NAFA is thematically organized to ensure cohesion between three initiatives: Teacher education, school development initiatives, and science education research. Each academic year, development and research activities are launched under an overarching thematic framework, providing direction for all activities. These themes are developed through a co-creation process involving didactic experts and NAFA's development groups. Each NAFA theme generally spans one academic year (two years for the school initiatives).

In 2024-2025, the theme was "technological literacy in science education." At the start of this theme, a kick-off day was held, attended by teacher educators, university researchers, program partners, school principals, and other stakeholders. As part of the day, a workshop was conducted on perspectives and practices for technological literacy in science education.

Since technological literacy in science education is not a well-established field in Denmark, while the broader field of technological literacy is significant internationally, we were interested in investigating the existing practices among science teacher educators. Q-methodology was applied as an exploratory method to understand the field's different perspectives and practices (Watts & Stenner, 2005). The aim was to identify science teacher educators' subjective opinions regarding their practices related to technological literacy in pre-service science teacher education.

The Q-method combines qualitative and quantitative methods, empirically examining subjective perspectives and lived experiences of its participants (Ramlo, 2016). The purpose of using Q is to empirically group individuals based on their similar views (ibid.). To do so, participants conduct a reflective ranking of predefined statements related to the research question, enabling the researcher to explore the importance of the statements for each participant (Ramlo, 2016; Du et al., 2021). The key steps for a Q-study include: 1) development of a concourse, 2) construction of the Q set, 3) participation of individuals in the Q sorting, 4) post-sorting activities, 5) Q factor analysis, and 6) factor interpretation.

The Q-study was used as a focal point for the kick-off workshop. At the beginning of the day, all participants at the kick-off were asked to individually sort the statements. Afterwards, a factor analysis was conducted on-site while the participants took part in other practice-oriented workshops. At the end of the day, participants were placed in their factor groups to discuss and reflect on their own sorting.

Q-data was collected from a total of 58 teacher educators-nearly all science teacher educators at Danish teacher colleges. Five different perspectives on technological literacy in K-12 science education emerged from the Q-sorting process, after which by post-sorting activities included focus group discussions based on the Q analysis results.

Through this study, we gained valuable insights into how Danish teachers and teacher educators understand meaningful technological literacy in K-12 science education. This workshop aims to expand on this insight by extending the conversation about various perspectives on technology education and technological literacy in K-12 science education internationally. Through reflection and sharing perspectives on technological

literacy in K-12 science education, this workshop aims to explore the Q-sorting process as a tool for individual and collaborative continuous professional development.

3 Workshop

The following session will describe the details surrounding the workshop.

3.1 Workshop details

This workshop will be around 120 minutes. The primary target audience is K-12 science in-service teachers, pre-service teachers and teacher educators. The secondary audience will be other stakeholders around K-12, including school leaders, supervisors, other educational staff, as well as educational researchers in K-12, who are interested in technology education and technological literacy in science education. We expect a maximum of 50 participants, who will engage in reflection and conversation about how technological literacy can be integrated in K-12 science teaching practices through a Q-sorting process and follow-up discussions. No prerequisites are required as the workshop will cater to participants at all skill levels and experience with and around technology education and technological literacy in science education.

3.2 Workshop Agenda

Provide a detailed outline of the workshop agenda, including the topics to be covered, the activities planned, and the time allocated for each segment.

Schedule:

1. **Introduction to Workshop Instructors, Agenda, and Learning Goals** (10 minutes)
    - Welcome and introduction of the presenters
    - Overview of the workshop agenda and learning objectives
2. **Individual Q-Sorting with Instruction Time** (30 minutes)
    - Explanation of Q-sorting methodology
    - Participants engage in individual Q-sorting activity
3. **Debriefing with Peer on Q-Sorting and Plenary** (30 minutes)
    - Participants discuss their Q-sorting results in pairs
    - Plenary discussion to share insights
4. **Presentation on Q-Study from Teacher Educators in Denmark** (15 minutes)
    - Overview of the Q-study findings
    - Presentation of the five perspectives on technological literacy
5. **Guided Discussions in groups on 'How' and 'Why' participants integrate technological literacy into their practice** (20 minutes)
    - Group discussions to explore integration of technological literacy
    - Focus on practical applications and rationale
6. **'World café': Sharing of ideas across perspectives** (20 minutes)
    - The World Café method is utilized to facilitate sharing of group discussions
    - Facilitated conversation to synthesize insights and further develop ideas
7. **Questions and Wrap Up** (5-10 minutes)

- Open floor for questions
- Summary and closing remarks

3.3 Workshop Learning Objectives

At the end of this workshop, participants will:

- Have gained knowledge about five different perspectives on technological literacy in K-12 science education
- Be able to reflect on and articulate their own teaching practices in relation to technological literacy.
- Have developed and shared practical ideas and approaches to integrating technological literacy in their teaching.
- Be able to apply the Q-sorting process to facilitate reflection on local educational practices related to technology literacy in K-12.

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How to enact transformative change for global responsibility in engineering education

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Abstract
The people who deliver and shape the learning journeys of the next generation of engineers are at the heart of the entire ecosystem of engineering, and therefore they have great power to enact transformative change (Purcell and Fraser-Haddock, 2023). However, many engineering educators have limited exposure to sustainability learning themselves or are required to deliver topics outside of their disciplinary expertise. Through small group activities, individual and group reflection, and mapping exercises, this interactive workshop will:

1. Engage with participants to critically reflect on the challenges, gaps and opportunities for preparing future engineers to be globally responsible.
2. Enable participants to identify what tools and support is available to help them with “what" to teach but also on the “why” and “how” of educating globally responsible engineers, and how they could be implemented in their own educational contexts.
3. Identify what evolving teaching means for the roles educators play, and the competencies and capabilities required, in conjunction with caring pedagogies.

We intend to initiate a broader conversation about the continuous professional development of educator competencies and commitment to teaching global responsibility and connect participants with a growing network of support from others who are working towards systems change.

Keywords: global responsibility, keeping curriculum relevant, navigating change, engineers as changemakers

1 Purpose

How and what we teach engineering students in South Africa and globally has profound implications for development trajectories, and the role engineers will play in addressing societal challenges and our collective future. Our graduates will be required to engage with challenges of unprecedented complexity while acting sustainably, ethically, and equitably —particularly within the South African context of resource constraints, historical inequities, and urgent infrastructure needs, which offers valuable lessons for engineering education

worldwide. Indeed, scholars, industry, and advocacy organizations all recognize that engineering education needs radical transformation to meet the needs of the 21st century and beyond (Lavrysh, 2018; Engineers Without Borders UK, 2022; Royal Academy of Engineering, 2024).

But how ready and equipped are engineering educators—both in South Africa and internationally—to enact the transformation our students need while addressing specific challenges like energy security, water scarcity, infrastructure development, and socioeconomic inequality? These challenges, while acute in South Africa, reflect global concerns that all engineering educators must be prepared to address with their students.

Transformation necessitates change, and change is hard because of systemic boundary constraints found in institutions and processes. Change is also an emotional and cultural journey for communities and individuals alike. Yet a change toward globally responsible engineering education that embeds sustainability, ethics, and justice —while remaining contextually relevant to diverse realities— is an imperative at all levels of the engineering education system–from individual classes to degree programs, to colleges, to accreditors, and into professional practice. This workshop will equip participants with tools to identify, understand, navigate, and lead this change within their respective engineering education contexts, with particular attention to applications in South Africa.

After all, the people who shape and deliver the learning journeys of the next generation of engineers are at the heart of the entire ecosystem of engineering, and therefore they have great power to enact transformative change. But navigating the complexities of educating the next generation of engineers is no easy feat - educators are after all influenced by what they know, if they are able to incorporate innovative pedagogies, and what their attitude and mindsets are about what they can do.

Engineers Without Borders UK and South Africa are part of a global movement advocating for globally responsible engineering that embeds sustainability, ethics, and justice at all levels. Through our experience developing context-appropriate interventions across institutions internationally and in South Africa, we recognise that collective and collaborative approaches are key to enact change at pace and scale (Truslove et al. 2024). Our in-curriculum Engineering for People Design Challenge, delivers project-based learning through a real community-based brief to upskill students in global responsibility in a safe and supportive environment. It has reached over 87,000 students across 47 universities in five countries since 2011 (Engineers Without Borders UK, 2024).

2 Expected Audience

The workshop will appeal to individuals who are interested in, passionate about, or responsible for the changes needed within engineering education so that our graduates can respond to challenges of unprecedented complexity while acting sustainably, ethically, and equitably. This is likely to include people who must enact changes (i.e. by aligning programs with ABET requirements) such as department heads or chairs and course coordinators, but also individuals who feel a personal commitment to reimagining engineering education. Ideally, attendees will be representative of the entire system: whether that is teaching, designing degrees, overseeing strategy, accrediting, and even hiring graduates. The workshop is particularly meant to appeal to those who feel stuck or unable to create change yet have ideas or hope for meaningful reform, in order to provide the reflective space, tools, confidence and connections to turn those ideas into action that can support a better future for people and planet.

3 Session Outline

Navigating the complexity of change requires taking people on a journey and providing space to explore without feeling overwhelmed. Because many engineering educators have not been exposed to sustainability learning themselves or are required to deliver topics related to global responsibility that may lie outside of their disciplinary expertise, these activities are designed around how to build knowledge, change habits and approaches, and contextualize what we do as engineering educators. This 90-minute interactive workshop

will deepen attendees' understanding of *why* sustainability, ethics and inclusion must be embedded in engineering education, and *how* they could be implemented in their own educational contexts.

1. (10 minutes) Introductory activities: who are we, why are we here, where are we going?: An introduction to the facilitators and overview of the workshop.
2. (30 minutes) Shaping systems for change: Using activities within EWB UK's Reimagined Degree Map, participants will gain a wider perspective on systems that influence engineering education, and how to respond to these in their own contexts.
3. (30 minutes) Developing anticipatory competence: Using the Three Horizons Model framework, participants will be guided to discuss the future, the future of engineering and the roles of engineers, where we are now, and what matters most in education.
4. (20 minutes) Reflection and continuing the connection: Besides a personal and group reflection on the activities of the workshop, participants will be provided with a suite of tools and resources that can support their work and connect them with a community of changemakers, and opportunities for collaborating through adopting these resources for driving change within engineering curricula.

4 Expected Outcomes

The workshop aims to enhance participants' knowledge, skills, and mindsets around values, systems, futures, strategy, and collaboration: all competency areas that have been documented and called for as essential to education for sustainability (Arizona State University, 2018; Rieckmann, 2018; The Lemelson Foundation, 2022). This workshop will give participants the tools to identify, understand, navigate, and lead this change within engineering education. The activities support people to make change at different levels of the engineering education system in four key ways:

1. Identify and respond to levers of influence for systemic change and transformation in engineering education.
2. Understand how to develop the competencies needed to deliver globally responsible engineering education.
3. Deploy existing techniques and resources in their own contexts in a way that contributes to institutional and cultural transformation.
4. Connect with a network of support and others who are working toward change.

Ultimately, this workshop helps participants overcome inertia and barriers to change by providing constructive space to grow confidence and willingness of a broader community across universities and continents. Participants will gain access to:

- Reimagined Degree Map resources from Engineers Without Borders UK
- Activities for immediate application (Ethics and Sustainability Toolkits from Engineering Professors Council and Engineering for One Planet resources)
- Global Responsibility Competency Compass resources from Engineers Without Borders UK
- Invitation to join the Engineering for People Design Challenge and BambaSonke Design Challenge.
- Access for students to join student chapters.
- Community network contacts

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Exploring Interpretative Phenomenological Analysis: A Hands-on Workshop for Engineering Education Researchers

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Abstract

This interactive workshop introduces participants to the practical application of Interpretative Phenomenological Analysis (IPA) in engineering education research. Through guided hands-on activities, attendees will develop essential skills for conducting IPA studies, from initial coding to theme development. The workshop combines expert demonstration with collaborative analysis exercises, allowing participants to work in small groups to analyze authentic interview transcripts from engineering education contexts. Activities will include practical coding exercises using real engineering student interview data, collaborative theme development, guided discussions on analytical challenges and solutions, and the development of strategies to ensure research quality. Facilitated by both an IPA expert and a clinical psychologist with expertise in engineering education, this workshop offers a unique dual perspective that bridges methodological rigor with practical application. Participants will leave with concrete tools, templates, and strategies for conducting their own IPA studies in engineering education. It is designed for both experienced qualitative researchers looking to expand their methodological toolkit and newcomers to qualitative research.

Keywords: Interpretative Phenomenological Analysis (IPA), Research Methodology, Experiential Learning, Psychological Inquiry, Engineering Education

1 Overall Description

In this pre-conference workshop, we guide participants to use intentional techniques for interpreting psychological experiences in engineering education through interpretative phenomenological analysis (IPA). Researchers increasingly use IPA to explore identity (Huff et al., 2019; Ross et al., 2019), emotion (Huff et al., 2021), well-being (Stefl, 2020), and cognition (Barlow & Brown, 2020; Kirn & Benson, 2018) in engineering education (Kirn et al., 2019). We adapted this workshop from a highly attended workshop offered at the 2022 Frontiers in Education Conference (Huff & Brooks, 2022). In the workshop, we help participants delve into the nuanced and implicit processes of conducting high-quality interviews and analysing transcripts using IPA (Huff et al., 2014; Smith et al., 2022). One facilitator (James) brings extensive experience in practicing and mentoring others in IPA, while the other facilitator (Curwyn) has advanced a psychological research agenda with dual affiliations in the field of clinical psychology and engineering education.

2 Description of Session Content

The proposed session focuses on three specific areas, which are described as follows.

2.1 Psychological Experience

The session will use psychological experiences as a lens to uncover under-explored phenomena in the participants' own environments, such as the psychological journeys of identity and emotion in engineering education. After participants deeply analyze a shared experience of shame from an interview transcript excerpt, we will encourage them to reflect on psychological experiences that are often overlooked in their own institutional settings.

2.2 Interpretative Phenomenological Analysis

The session will introduce participants to IPA as a methodology dedicated to understanding the lived experiences of specific phenomena, such as becoming an engineer, while acknowledging the researcher's interpretive role in creating this understanding. Throughout the session, participants will learn how to conduct IPA to systematically interpret a transcript through multiple iterations of text analysis. They will start with an initial reading for superficial comprehension and conclude by linking the transcript to experiential and psychological patterns.

2.3 Conducting Quality Research

The session will provide a space for participants to think through how they actually analyze text from a common interview transcript. To foster this development for researchers, we will share an excerpt from a transcript in a recent investigation related to how students experience professional shame in the context of engineering education research. Using this common source of data, we will guide participants through multiple layers of interpretation of this text. Toward the conclusion of the session, we will demonstrate how our exercise relates to the assurance of quality in interpretive research (Huff et al., 2020; Walther et al., 2013, 2017).

3 Format of the Special Session

In the workshop, we plan for participants to form small groups of 4 - 6 people. The workshop will include a mix of activities for individuals, small groups, and the entire assembly. As facilitators, we will move among the groups to offer guidance as needed during the structured tasks. While we will provide a detailed itinerary below, we will generally immerse participants in conducting detailed transcript analysis on an actual interview excerpt and then guide them through an interactive process to trace in-depth analysis to producing experiential knowledge claims.

4 Itinerary

The itinerary for this workshop follows the same structure of a prior workshop offered by Huff and Brooks (2022).

4.1 Welcome and Group Introductions

(00:00 – 00:15): We will welcome everyone and review the learning goals. We will then organize the participants into small groups and facilitate introductions within these groups. During this time, we will also hand out all materials related to the session.

4.2 Defining Terms: Psychological Experience and Interpretative Phenomenological Analysis

We provide a brief explanation of these terms but then quickly immerse them into *doing* IPA to examine psychological experience. This activity corresponds to the steps of analysis detailed in Huff et al. (2014). The intent here is to foster learning among the participants in IPA through shared experience before considering theoretical features of these terms. Throughout the activity, we will wander the room to provide feedback on the various stages of interpretation.

4.3 IPA Activity: Reading an Interview Excerpt

(00:25 – 00:35): We will begin by having the facilitator and a participant acting out a portion of a real interview transcript from a study on identity development. The particular transcript is an authentic account of a student's experience of shame in the context of engineering education. We begin by reading the transcript to discuss how the transcript is a representation of a real event, both for the researcher and the participant.

4.4 IPA Activity: Individual Reflection of the Transcript

(00:35 – 00:45): After the interview is read, the excerpt will have certainly elicited some personal connections from the workshop participants. We will use this time to allow participants to *bracket* off these personal responses by reflectively, writing them down, and then forgetting about them—for the time being.

4.5 IPA Activity: Descriptive Comments

(00:45 – 00:55): We will give participants the opportunity to individually *describe* what they see in individual copies of transcript. What are significant features of the transcript? What is the play-by-play among the text? Each participant will do so in a designated color of ink in the wide right-hand margin.

4.6 IPA Activity: Linguistic Comments

(00:55 – 01:05)*:* We then will give participants the opportunity to document how the participant is using *language*. Each participant will do so in a different color of ink in the righthand margin of the paper.

4.7 IPA Activity: Conceptual Comments

(01:05 – 01:15): Having considered the description and linguistics of the transcript, the participants will now *ask conceptual questions* of the transcript. This prepares the analysts to consider how the transcript might relate to broader psychological themes from literature.

4.8 IPA Activity: Connecting to Broader Patterns of Experience

(01:15 – 01:25): We will close this portion of the session by guiding participants to connect sections of the transcript to broader psychological patterns of experience. Participants will note these in the left-hand margin.

4.9 Break

(01:25 – 01:40): Break for participants.

4.10 Group Reflection on Activity

(01:40 – 01:55): After individuals have completed the analysis activity, we will discuss their reflections of the common activity in two layers: first among small groups and then among the entire assembly.

4.11 How Does Analysis Relate to Knowledge Claims?

(01:55 – 02:05): Following the activity, we will give an overview of how we would use IPA to compare particular findings in the excerpt from the particular interview to psychological themes in other interviews. Specifically, we will examine how such detailed analysis can result in relevant knowledge claims through peer reviewed publications.

4.12 Thinking Through Quality

(02:05 – 02:25): Using the shared analysis activity as a guide, we will walk the participants through the Q3 Framework as a general form of considering quality in their own investigations.

4.13 Relevance of Psychological Experience

(02:25 – 02:35): We will close the session by inviting participant to consider questions of *psychological experience* that may be relevant investigations in their own institutions. Responses will be written down and shared.

4.14 Final Group Discussion

(02:35 – 02:50): The session will close with a brief group discussion with the group identifying how they can apply what they have learned into their own investigations.

5 Anticipated Audience

We expect an audience of individuals interested in qualitative research within engineering education and other problem-based learning settings, particularly Ph.D. students and faculty researchers who conduct or

oversee qualitative studies. This audience will likely include both newcomers to qualitative research and experienced qualitative researchers seeking to refine their skills or connect with others who share similar interests. Additionally, we anticipate that this session will attract those interested in exploring the *experiential* aspects of engineering education from a psychological viewpoint.

6 Learning Goals

The primary learning goal of this session is for participants to develop a robust foundation to investigate psychological experience using IPA (Huff & Brooks, 2022). We anticipate that this session will clarify aspects of interpretive analysis that are rarely made explicit, boosting participants' confidence to delve deeper into understanding IPA or other qualitative methods. Additionally, participants will identify valuable textual resources to support their exploration of IPA and find a community to continue developing as interpretive researchers after the conference ends.

7 About the Presenters

Dr. James Huff is Associate Professor of Engineering Education at the University of Georgia and Senior Research Associate at the University of Johannesburg (South Africa). He conducts transdisciplinary research on identity that lies at the nexus of applied psychology and engineering education. A winner of the NSF CAREER award (No. 2045392), Dr. Huff has mentored numerous undergraduate students, doctoral students, and academic professionals from more than 10 academic disciplines in using interpretative phenomenological analysis (IPA) as a qualitative research method to examine identity in a variety of contexts. Additionally, he has offered multiple workshops in using IPA and regularly consults other investigators in how they apply the methodology.

Dr. Curwyn Mapaling is an Associate Professor of Psychology, clinical psychologist, and researcher in Optentia's Strengths-based Studies and Interventions sub-programme at North-West University (South Africa). Holding a PhD in Education, his work bridges mental health, wellbeing, and pedagogy, with a focus on resilience, identity, and inclusive approaches to psychological wellbeing in engineering education and higher education. As co-editor of the *Scholarship of Teaching and Learning (SOTL) in the South* journal, he applies his expertise in psychology and education to identity, learning and wellbeing in these contexts.

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Workshop: Empathy and Ethics in Engineering Education: A Paradigm Shift for a Human-centered Future

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Abstract

Challenges of the 21st century demand that engineers transcend technical competence and human-centered approaches to problem-solving. This workshop aims to inspire and equip engineering educators with the tools and strategies to integrate empathy and ethics into engineering curricula, fostering the development of socially responsible engineers. Participants will explore the intersection of empathy and ethics in engineering, engaging in topics such as empathic design, professional ethics, discipline-based applicability and practical integration. Participants will engage in hands-on activities, such as role-playing scenarios and

ethical decision-making exercises, to experience firsthand the challenges and opportunities of teaching these concepts. Case studies from a variety of engineering disciplines will highlight the real-world impact of empathy and ethics on design and innovation. Additionally, the workshop will provide resources and best practices for assessment and evaluation, enabling educators to measure the effectiveness of these initiatives in their own context. This workshop is designed for engineering educators, curriculum developers, and academic leaders committed to transforming engineering education. Together, we will redefine the role of engineering education in shaping not just problem-solvers, but professionals, ready to co-create solutions for a human-centered future.

Keywords: professional ethics, empathic design, human-centered design, engineering education, workshop

1 Introduction

The complex challenges of the 21st century demand that engineers move beyond technical proficiency to embrace human-centered approaches to problem-solving. The workshop "Empathy and Ethics in Engineering Education: A Paradigm Shift for a Human-centered Future" aims to equip engineering educators with the strategies and tools necessary to integrate empathy and ethics into their curricula, fostering a new generation of socially responsible engineers.

Empathy, the ability to understand and share the feelings of others (Barbot et al., 2020) and ethics, the principles guiding moral decision-making (Bucciarelli,2008) are critical in addressing the multifaceted issues engineers face today. Whether designing accessible infrastructure or tackling global sustainability challenges, engineers must account for diverse perspectives and the societal implications of their work (ABET 2023, National Academy of Engineering, 2009). This workshop provides a structured framework for embedding these essential values into engineering education, emphasizing their role in shaping ethical, collaborative, and innovative professionals.

Through interactive sessions and collaborative discussions, participants will explore key themes, including:

- Empathy in Design – Applying human-centered and empathic design principles to engineering solutions.
- Ethics in Decision-Making – Navigating ethical dilemmas using frameworks rooted in moral psychology and global citizenship.
- Cultural Contexts – Understanding how cultural differences influence empathy and ethical considerations in global engineering projects.
- Practical Integration – Developing strategies for embedding empathy and ethics into engineering curricula through project-based learning, reflective exercises, and interdisciplinary collaboration.

Participants will engage in hands-on activities, such as empathy mapping, role-playing scenarios and ethical decision-making exercises, to experience firsthand the challenges and opportunities of teaching these concepts. Case studies from diverse engineering disciplines will illustrate the real-world impact of empathy and ethics on design and innovation. Participants will be assigned to the case studies by the workshop facilitators.

Additionally, the workshop will provide practical resources for assessment and evaluation, enabling educators to measure the effectiveness of these initiatives in their own teaching contexts.

Designed for engineering educators, curriculum developers, and academic leaders, this workshop offers a platform to rethink and reshape engineering education. By fostering empathy and ethical reasoning in students, participants will help prepare future engineers to navigate an increasingly complex world with integrity, social consciousness, and compassion.

As facilitators, we will guide participants in exploring how empathy can drive ethical practice in engineering education and how we can better prepare students to be not only technically skilled but also socially responsible professionals.

2 The Interconnection of Empathy and Ethics in Engineering Education

Empathy and ethics are inseparable in engineering education. Our collective experiences as design engineers and educators have consistently reinforced a human-centered mindset, aligning with the core principles of design thinking (Brown, 2009, Cross, 2011, Liedtka & Ogilvie, 2011). This methodology begins with empathizing, deeply understanding the user's needs, challenges, and lived experiences (Dorst, 2011; Brown & Katz, 2019). Through this lens, we have embraced empathic design (Buchanan, 1992; Kimbell, 2011), a practice that not only informs engineering solutions but also fosters ethical responsibility.

Beyond design, our teaching and research in ethics education have been firmly grounded in moral psychology (Vargas & Doris, 2010), further solidifying the intrinsic link between empathy and ethical decision-making. Ethics, in its most impactful form, is not merely about following established rules or professional codes; it is about recognizing and valuing the human impact of engineering decisions (Herkert, 2001). When engineers understand the experiences and perspectives of those affected by their work, they are better equipped to make ethically sound choices (Hess et al., 2017).

Through this workshop, we aim to demonstrate that empathy is not just a component of ethics, it is the foundation upon which ethical reasoning is built. Without the ability to step into another's shoes, ethical frameworks become abstract guidelines rather than meaningful principles that guide responsible engineering practice (Newberry, 2004, Whitbeck, 2011).

By the end of this workshop, participants will recognize empathy not as a 'soft skill' but as an essential element of effective engineering problem-solving. In an era where engineers are tackling increasingly complex global challenges, empathy-driven ethical practices are critical for developing solutions that are not only technically sound but also socially just.

This perspective challenges the traditional boundaries of engineering education, urging educators to integrate empathy explicitly into their teaching. By doing so, we can cultivate a generation of engineers who approach their work with both technical rigor and social consciousness, ensuring that their innovations serve diverse communities ethically and responsibly.

3 Exploring Ethics and Empathy in Engineering Education

In the workshop, participants will engage with foundational concepts that highlight the critical role of ethics and empathy in engineering. Through guided discussions, we will explore fundamental questions such as: *Why are ethics and empathy important in engineering?*; *How do these principles shape engineering decisions?*, and *What does it look like when they are intentionally integrated into the classroom?*

These discussions will set the stage for deeper exploration, helping participants reflect on the broader societal impact of engineering work. By examining real-world examples (Harris, 2019) we will illustrate how

ethical dilemmas often require not just technical expertise but also an understanding of human experiences, values, and cultural contexts (IDEO, 2009; d.school).

3.1 Group Activity: Empathy Mapping

To translate these concepts into practice, participants will engage in a hands-on Empathy Mapping (Gray, 2017) exercise**,** a tool designed to help engineers and educators adopt a user-centered perspective. This activity encourages participants to step into the shoes of those directly impacted by engineering projects, fostering a deeper understanding of their experiences, emotions, and challenges. We share the activity instructions below:

1. Form Groups – Participants will be divided into small groups of 4-5.
2. Assign Engineering Challenges – Each group will work on a specific engineering project or challenge, such as:
    - Designing accessible transportation systems for individuals with disabilities.
    - Developing a sustainable water solution for a rural community.
    - Creating disaster-resilient housing in an area prone to natural disasters.
3. Distribute Empathy Mapping Templates – Each group will receive a template divided into four key sections:
    - Think – What are the concerns and priorities of the affected individuals?
    - Feel – What emotions might they experience regarding this engineering solution?
    - Say – How do they express their thoughts and frustrations?
    - Do – What actions do they take as a result of their experiences?
4. Facilitate Discussion – As groups work through the exercise, facilitators will walk around, observe discussions, and prompt deeper thinking with guiding questions:
    - *How might this design impact users emotionally?*
    - *What ethical considerations emerge from this project?*
    - *How do cultural backgrounds influence user needs and expectations?*

This activity will not only help participants grasp the importance of empathy in engineering but also provide practical strategies for incorporating these insights into their teaching. By experiencing empathy-driven design firsthand, educators can more effectively guide students toward ethical, socially responsible engineering practices.

3.2 Navigating Ethical Dilemmas in Engineering

In the second part of the workshop, we will explore how ethical dilemmas arise in engineering practice and discuss strategies for preparing students to navigate these complexities. Engineers frequently face challenging decisions where technical, ethical, and societal considerations intersect. By analyzing real-world case studies, participants will examine how empathy influences ethical decision-making and how these principles can be effectively integrated into engineering education. Below we present a Case Study Discussion Activity.

Participants will be divided into small groups and assigned one of the following case studies, each presenting a complex ethical challenge in engineering:

1. Privacy and AI – A tech company develops an AI-powered facial recognition system for public safety, but concerns arise over privacy violations and potential biases in the algorithm.

2. Environmental Impact of Infrastructure – A proposed highway expansion would improve transportation efficiency but requires deforestation and displacement of local communities.
3. Autonomous Vehicle Safety – A self-driving car must make split-second decisions in an unavoidable accident scenario—should it prioritize passenger safety or pedestrian welfare?

4. Biomedical Engineering and Accessibility – A life-saving medical device is developed but remains inaccessible to lower-income populations due to high costs.
5. Cybersecurity in Smart Cities – A city's new smart infrastructure system collects massive amounts of data for optimization but raises concerns about data security and potential misuse.

Each group will discuss their assigned case study and consider the following questions: What are the ethical issues involved?; How might empathy influence the decision-making process?; How can educators prepare students to navigate such dilemmas in their future careers?

After 10-15 minutes of discussion, groups will share key takeaways with the larger group. A facilitator will synthesize these insights, emphasizing the critical intersection of empathy and ethics in real-world engineering scenarios.

3.3 Reflection and Closing

As we conclude the workshop, we will invite participants to take a few moments for personal reflection. The following questions will guide the participants' reflection: *What is one key takeaway from today's workshop that you will apply in your teaching or curriculum?; How can you foster empathy in your students while teaching technical content?; What ethical frameworks or empathy-building exercises might you integrate into your existing courses?*

To close, we will invite a few volunteers to share their reflections before summarizing the key themes from the workshop.

Empathy is not just an add-on but a fundamental driver of ethical decision-making in engineering. Ethical dilemmas in engineering require an understanding of human impact, not just technical solutions. Engineering educators play a crucial role in shaping socially responsible engineers who are prepared to navigate these challenges.

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APPENDIX 1- Workshop materials

1. Empathy Mapping Template - we will provide a blank empathy map that participants can use during the group activity. Instructions or guiding questions on how to fill out the sections (e.g., "What does the user think/feel? What are their goals?") will be included.

2. Case Studies on Ethical Dilemmas - we will print out short summaries of the ethical dilemmas that participants will use during the group discussion. There will be included a few prompts for analysis (e.g., "What are the ethical considerations? How could empathy change the outcome?").

3. Empathy and Ethics in Engineering Summary - we will create a one-page handout summarizing the key points from our presentation on the intersection of empathy and ethics. The handout will include definitions of both concepts, their connection, and examples from real-world engineering challenges.

4. Reflection Prompts - we will provide a sheet with reflection questions (those we will use during the closing section) so participants can jot down their thoughts during the session.

5. Recommended Readings or Resources - compile a list of recommended articles, books, or online resources related to ethics, empathy, and engineering education. This list will help participants continue exploring the topics on their own.

6. Practical Tools for Incorporating Empathy in Education - we will offer some practical strategies or exercises that educators can use to teach empathy in their own courses. Thiswill include activities like role-playing, design challenges, or reflection exercises.

7. Workshop Agenda - To help participants follow along and manage their expectations for each section of the workshop, we will provide a handout with the outline of the workshop, timing, and key activities.

*All materials will be available online.

APPENDIX II – ADITIONAL CASE STUDIES

1. Safety vs. Cost in Infrastructure Projects
An engineering team is tasked with designing a bridge, and they discover that implementing certain safety features would significantly increase costs and extend the project timeline. The ethical dilemma arises between prioritizing safety for future users and adhering to budget constraints set by stakeholders.
Empathetic Approach: Engineers can engage with the community that will use the bridge to understand their concerns and values regarding safety. By gathering input from local residents about their perceptions of safety and the importance of the bridge in their daily lives, the engineering team can advocate for necessary safety features to stakeholders. This empathetic engagement helps ensure that the design reflects the community's needs and emphasizes the importance of user safety over purely financial considerations.
2. Sustainability vs. Project Requirements
An engineering firm is developing a new product that could provide significant benefits to consumers but at the expense of environmentally sustainable practices. The team must decide whether to prioritize short-term performance gains and cost savings or invest in sustainable materials and processes that may be more expensive and time-consuming.
Empathetic Approach: By considering the long-term implications for the environment and future generations, engineers can engage with environmental advocates, community members, and end-users to understand their concerns about sustainability. This dialogue can foster a shared understanding of the importance of sustainability and lead to innovative solutions that meet both performance and environmental goals. The empathetic perspective ensures that the product development process aligns with broader societal values, prioritizing the well-being of the planet alongside business interests.
3. Technology Development and User Privacy
An engineering team is developing a smart home device that collects user data to enhance functionality. However, they face an ethical dilemma regarding how much data to collect and how to ensure user privacy. The team knows that collecting more data could improve user experience but could also lead to significant privacy concerns.

Empathetic Approach: Engineers can conduct user research to understand the concerns and expectations of potential users regarding privacy. By actively listening to users' fears about data security and privacy invasion, the team can design the product with stronger privacy protections, such as user-controlled data sharing options. This empathetic approach not only helps build trust with users but also aligns the product development with ethical standards that prioritize user autonomy and security.

4. Disparities in Engineering Solutions

An engineering firm is working on a water purification project for a rural community. However, they face an ethical dilemma about whether to use a technology that is less effective but cheaper, or a more effective technology that is beyond the community's budget.

Empathetic Approach: By engaging with the community to understand their specific needs, resources, and cultural context, the engineering team can explore solutions that are both effective and financially viable. They might collaborate with local stakeholders to seek funding or support for the more effective solution, demonstrating a commitment to addressing the community's long-term health and well-being rather than just the project's immediate constraints.

University of the Future: an open discussion on the implementation

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Abstract

In today's volatile technological and global climate, higher engineering education institutes are key in driving responsible innovation and sustainable development (Ernst & Young, 2018; Habbal et al., 2024). They are evolving from traditional knowledge creators into dynamic, transdisciplinary hubs (Giesenbauer & Mueller-Christ, 2020). But how will universities fulfil this role, and what structures would best support this?

These questions were central to the University of the Future (UotF) project, where we envisioned and concretized an ideal university (Reymen, 2021). Recognizing regional expertise and challenges, we designed the future University of Technology Eindhoven, co-created with various stakeholders from the ecosystem, bridging academia, industry, and communities.

At the 9th IRSPBL, we gathered valuable input in an interactive workshop (Reymen et al., 2022). Now at the project's final phase, we will present the design and facilitate a fish-bowl discussion on the implementation, focusing on inclusivity, diversity, and cultural perspectives. The workshop structure will be as follows:

- 15 min: Welcome and introduction University of the Future
- 45 min: Fishbowl discussion on implementation
- 20 min: Reflection
- 10 min: Closing and next steps

The session aims to provide an engaging platform for sharing innovative practices, refining strategies, and guiding the next steps in this transformative journey.

Keywords: Future of education, Responsible innovation, Transdisciplinary learning, Community engagement, Cultural perspectives

1 Introduction

As we navigate through the 21st century, we face increasingly complex global challenges, such as the escalating impacts of climate change, growing socio-economic inequality, and persistent political instability, that shape society (Fletcher et al., 2024). At the same time, the accelerating complexity and reach of technological advancements offer both transformative opportunities and pose significant societal risks (Wolff, 2021). The interconnectedness, scale and scope of these socio-technical challenges call for a progressive and systematic approach. Higher engineering education institutes are stepping up to respond to this call, emerging as key actors in driving responsible innovation and sustainable development (Ernst & Young, 2018; Habbal et al., 2024). These institutes are evolving from traditional knowledge creators into dynamic, transdisciplinary hubs that engage with various stakeholders, promoting co-creative collaboration and systemic development, while developing excellence in education and research for a more sustainable world (Giesenbauer & Mueller-Christ, 2020).

Literature, including studies on the Quintuple Helix model, highlights universities' crucial role in facilitating both knowledge creation and circulation across academia, industry, government, civil society, and the environment to address global challenges (Carayannis et al., 2012). As universities adapt to these evolving responsibilities, critical questions emerge: How can the university best fulfil this role? What structures best support this mission? What will the ideal future university actually look like in detail? The University of the Future (UotF) project was established to find answers to these questions and develop a concrete design (Reymen, 2021).

Recognizing the unique expertise and challenges of each region, we focused on designing the future University of Technology Eindhoven (TU/e). Eindhoven's strong history of collaboration within its high-tech Brainport region laid a solid foundation for partnerships with industry. Through a series of open co-creation sessions with the TU/e ecosystem, iterative scenario developments, and focused expert sessions, the ideal TU/e gradually took shape. Although the design is focused on the context of TU/e, it can serve as a blueprint for any engineering university.

At the 9th IRSPBL, we gathered valuable input on our design of the UotF in an interactive workshop (Reymen et al., 2022). At the 10th IRSPBL, we will share outcomes of our design efforts and facilitate a discussion on implementation. This discussion is crucial as it will not only address the practical aspects of bringing the design to life, but it will focus on inclusivity, diversity, and cultural perspectives in advancing higher engineering education and its role in addressing global challenges. The workshop will provide an engaging and interactive platform for this essential dialogue.

2 Workshop design

The primary objective of this workshop is to engage participants in a meaningful open discussion on implementing the design of the University of the Future.

The workshop begins with a welcome and introduction to the final design of the University of the Future (15 min). Following the presentation, an interactive discussion on the implementation will be facilitated using the fish-bowl method (45 min). Participants will be organized in an inner and outer circle, with the inner circle representing the fishbowl. Those in the outer circle can enter and exit the fishbowl as they wish. This method encourages dynamic participation and allows for a variety of perspectives to be shared. Participants will bring their unique insights and experiences to the discussion and are encouraged to focus on the aspects of inclusivity, diversity, and cultural perspectives, and how to ensure that diverse voices are heard throughout the implementation. The session aims to provide an engaging platform for sharing innovative practices, refining implementation strategies, and guide the next steps in this transformative journey.

Following the fishbowl discussion, there will be a reflection period (20 mins). Participants will have the opportunity to reflect on the insights gained during the discussion, noting key takeaways and personal reflections. This reflection will also include a discussion on whether we share a common vision for the University of the Future, but also identifying the first steps we can all take, and exploring how we can support each other moving forward.

The workshop will conclude with a brief closing session and next steps (10 mins). This final segment will summarize the main points discussed, outline the next steps, and equip participants with practical tools for transforming higher engineering education.

3 Target audience

The workshop welcomes all participants from IRSPBL, SoTL in the South, SASEE, and other interested visitors, regardless of their role or background. It is designed to be inclusive and beneficial for educators, researchers, learners, education collaborators, and support staff. No prior knowledge is required, making it accessible to anyone interested in discussing the University of the Future and its implementation.

4 Follow-ups

Although the University of the Future project officially comes to an end, we remain committed to the implementation of the University of the Future. Therefore, the outcomes of the session will be shared with participants to keep the community engaged and support each other in this transformative journey. We aim to maintain an active community to help each other further in the implementation process.

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Adopting PBL – Hybrid in resource-constrained settings: Perspectives from Gulu University – Introducing Student-Centered eLearning Implementation Methodology

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Abstract
The PBL-Hybrid project, a collaboration between Gulu University and Aalborg University under the Building Stronger Universities initiative, addresses the urgent need for flexible, student-centred education in fragile contexts. Inspired by the persona of Mr. Okot—a working professional facing long travel times to pursue higher education—the project responds to challenges intensified by the Covid-19 pandemic and the broader socio-economic realities of northern Uganda. The novelty of the project lies in the integration of problem-based learning (PBL), design thinking, and digital technologies to create hybrid learning models that support both academic and community transformation.

Using the Student-Centred eLearning Implementation Methodology (S-C eLIM), the project follows five phases: Envisioning, Preparing, Piloting, Scaling, and Maturing. It has been piloted across three Master's programmes at Gulu University, engaging over 500 students. The methodology promotes sustainable change by empowering students and facilitators to become active agents in their learning environments. Design thinking fosters creativity, interdisciplinary collaboration, and real-world problem solving, while technology enhances flexibility and accessibility.

The results demonstrate significant shifts in teaching and learning practices. Facilitators and students now co-create learning experiences that link theory with practice, address community challenges, and build 21st-century skills. Despite limited material resources, the project showcases the power of human capacity when supported by innovative pedagogical frameworks.

In conclusion, the PBL-Hybrid project exemplifies how higher education can adapt to post-pandemic realities by embracing inclusive, participatory, and technology-enhanced approaches. It offers a replicable model for universities in similar contexts, aiming to transform education into a tool for resilience, empowerment, and sustainable development.

Keywords: Problem and project-based learning, PBL-hybrid, resource constraint, Higher Education, Student-Centered eLearning Implementation Methodology.

Introduction

PBL Hybrid Learning - Beyond Covid-19

"Mr. Okot is a Community Development Officer in Arua, Uganda. He has experience working in the field with the community but feels tired after work due to frequent travels. He is now pursuing a Master's in Public Administration programme at Gulu University. He travels approximately 464 km/12 hours in travel time to pursue his studies every weekend (staying over in Gulu Friday-Sunday). He wishes his study program was flexible enough to allow him to balance his studies, work, and family life. "The covid-19 pandemic has helped me to avoid my travels now……." (Persona developed by David Pakono, GU, 2021).

Background

The workshop is based on the long-standing partnership between Gulu University and Aalborg University, which has been in place since 2011 as part of the Building Stronger Universities initiative and is supported by the Danish Ministry of Foreign Affairs (MFA). Within this framework, the focus has been on transforming education from teacher-centred to student-centred methodologies, such as problem- and project-based learning (PBL). The PBL-Hybrid project (2022–2025), supported by the MFA, has enabled more systematic work on integrating PBL, design thinking, and technology.

Gulu University, established in 2002, is located in northern Uganda. Due to the unrest and human consequences of armed conflict from the 1980s to 2007, the region still faces challenges. This includes damage to infrastructure and the institutions that provide education, as well as the long-term damage to people's assets, livelihoods, and physical, emotional, and spiritual well-being (Atim et al., 2019). Gulu University plays an important role in 'reparation', as expressed in the university's motto, 'For Community Transformation'.

PURPOSE OR GOAL

The PBL-Hybrid project is novel in its integration of PBL, design thinking and technology in order to innovate teaching practices and engage with fragile communities where education and innovation are lacking. (Dirckinck-Holmfeld et al., 2024). The project contributes to capacity development and the development of new hybrid learning models at university level in response to the 'new normal' beyond the era of the pandemic.

Gulu University has been exploring PBL since 2015 (Tabo, 2020; Awacorach et al., 2021; Tabo et al., 2021; Tabo et al., 2022; Jensen and Lassen, 2020; Dirckinck-Holmfeld et al., 2025). The PBL-Hybrid project (2022–2025), supported by the MFA, has enabled us to work more systematically with the integration of PBL, design thinking, and technology. Design thinking is considered a practical approach to implementing PBL, encouraging creativity, innovation, interdisciplinary collaboration, and community engagement (Van der Westhuizen, 2020; Ku & Lupton, 2019; Lorusso et al., 2021; Camacho et al., 2023). Technology enables the programme to be more flexible in terms of time and space, builds IT literacy competencies, and supports PBL and design thinking (Dirckinck-Holmfeld et al., 2024).

APPROACH OR METHODOLOGY/METHODS

The project is based on the Student-Centred eLearning Implementation Methodology (S-C eLIM), which focuses on achieving sustainable change (Camacho et al., 2023; Pakono et al., this conference). The methodology comprises five phases: Envisioning, Preparing, Piloting, Scaling, and Maturing. This workshop builds on the results of the first three phases as applied to three Master's programmes within the Faculty of Business and Development Studies at Gulu University: Public Administration and Management (MPAM), Development Studies (MDS) and Monitoring and Evaluation (MME). A variety of design workshops and quantitative and qualitative methods were employed. More than 500 students participated in the pilot schemes.

ACTUAL OR EXPECTED RESULTS

The results reflect the changes in the practices of teachers and students, as well as the methodology. S-C eLIM has empowered participants to become change agents, and they are now ready to scale up the S-C eLIM methodology, as well as the principles and practices of PBL hybrid, which bring real-world problems into focus and prepare students for 21st-century skills.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

The project demonstrates the commitment of the teachers (known as 'facilitators' in Gulu) and the students to developing new pedagogical and participatory approaches. These approaches take real-world problems

as a starting point, link theory and practice, integrate digital tools in a flexible and pragmatic way and use design thinking to creatively bring these different elements together. Despite material resource constraints, the project demonstrates that human resources can be very powerful when given the opportunity to develop.

Workshop Program

Objectives of the workshop

- To be able to reflect critically on PBL and hybrid learning in a resource constraint setting and understand the challenges and opportunities in adopting this in your teaching.
- To get acquainted with the Student-Centered eLearning Implementation Methodology (S-C eLIM), and to be able to use some of the tools in transforming teaching and learning practices.
- To support networking between educators and researchers in South-South-North constellations.

Expected Outcomes of the workshop

- Knowledge on how and why to adopt PBL-Hybrid learning in teaching.
- Knowledge on the Student-Centered eLearning Implementation Methodology, and skills in using some of the tools to adopt PBL-Hybrid.
- Co-constructing and elaborating the concept of PBL-Hybrid in a resource-constrained setting.
- Knowledge exchange and comparative learning based on shared experiences.
- Further collaboration and networking among teachers, researchers, and institutions.

Program

Part 1: Adopting PBL-Hybrid in resource constraint settings – perspectives from Gulu University

- PBL-Hybrid implementation at Gulu University: Theoretical principles and main findings by Geoffrey O. Tabo** and Lone Dickinck-Holmfeld*. Followed by participants posting burning issues on PBL-Hybrid adoption practices.

Part 2: Introducing Student-Centered eLearning Implementation Methodology:

- Short presentations of different perspectives: Design, Practice and Research
- Student centered e-learning methodology – Principles by Heilyn N. Camacho***
- Experiences of teachers with piloting PBL-Hybrid by Vivian P. Drateru**
- Reflections from a research perspective by David Pakono** and Ann Bygholm*

Part 3: Hands-on in groups: Teachers as designers

- Pilot your course for PBL – Hybrid using some of the templates from the methodology
- Future workshop
- Empathy maps
- Course blueprint
- Assessment tool
- IT and digital tools to support the learning process

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Anchoring Conversation on Experiential Learning In African Indigineering Education

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Abstract

Harmonizing experiential learning practices to foster greater coherence and effectiveness in engineering education across Africa, and codifying indigenous knowledge in African engineering education are powerful steps toward fostering a more inclusive and contextually relevant engineering educational framework. By anchoring this conversation, we aim to pave the way to blend traditional knowledge with modern technology, ensuring solutions that are both innovative and rooted in the local context. This holistic approach will help to produce engineers who are not only skilled in their technical knowledge but are also deeply connected to their communities and environments.

Keywords: Indigineering, Experiential Learning, Africa, Learning Outcome, Transformative Learning.

1. Background and Rationale

1.1 Indigineering

In 100 years of history, there have been five major shifts in engineering education (Froyd et al., 2012): (i) a shift from hands-on and practical emphasis to engineering science and analytical emphasis; (ii) a shift to outcomes-based education and accreditation; (iii) a shift to emphasizing engineering design; (iv) a shift to applying education, learning, and social-behavioral sciences research; (v) a shift to integrating information, computational, and communications technology in education. The first two shifts have already occurred, but they continue to have implications for engineering education. The latter three are still in process, and sustained influences on practice are difficult to forecast. I*ndigineering* could be considered as a sixth shift, or an umbrella to the three latter shift. The *indigineering* word is a combination of Indigenous and engineering (Desjarlais, 2022).

Indeed, indigenous knowledge and Western science represent two different ways of looking at the world around us. Western science tries to understand the natural world by studying individual parts. In contrast, Indigenous knowledge seeks to understand the world in a more holistic way by observing the connections between all of the parts. Because of these differences, Indigenous knowledge has the potential to compliment the system of Western science (The Living Knowledge Project, 2008).

This workshop supports incorporating indigenous virtues, knowledge and practices into engineering by anchoring conversations on experiential learning practices in African “indigineering.”

1.2 Indigineering in Africa

African indigenous traditions have long embodied experiential principles through apprenticeships, storytelling, and community involvement. Learning by doing and oral knowledge transfer are deeply rooted in African cultures (Odendall, 2013; Frimpong et al., 2024). Yet, this raises critical questions: How can African indigenous knowledge systems be meaningfully integrated into formal engineering education? This workshop aims to ignite conversations to support African indigenous knowledge systems in experiential learning.

1.3 Experiential Learning in Africa

Africa is a continent rich with opportunities for experiential learning, leveraging diverse approaches like internships, project-based learning, and field visits. It is important to note that African indigenous education traditions have long embodied experiential principles through apprenticeships, storytelling, and community involvement. Learning by doing and oral knowledge transfer are deeply rooted in African cultures (Odendall, 2013; Frimpong et al., 2024). Across Africa, experiential learning is conceptualized as a transformative pedagogy that makes education more relevant to social needs and student development. Although such experiences may not be systematically documented in mainstream literature, they represent a culturally relevant mode of experiential education, one that warrants deeper exploration in the context of African engineering pedagogy. For example, in Engaging Communities in Sustainable Development: Universities as Active Partners, university students in Lesotho collaborated with local communities through culturally grounded environmental education, drawing on the Botho philosophy and indigenous knowledge to co-develop ecotourism and conservation initiatives (United Nations University, 2018).

While experiential learning in African engineering education faces several challenges, its integration is crucial for developing a workforce capable of meeting the local and international demands of the engineering sector. Efforts to expand and improve experiential learning should continue, with an emphasis on aligning educational outcomes with industry needs and enhancing the overall quality of engineering education. The continent's diverse educational needs and resource limitations highlights the necessity for innovative approaches tailored to local contexts. As such, Africa could serve as a valuable research context to explore how experiential learning can be adapted and optimized to enhance its impact. Indigenous presents an opportunity to reimagine experiential learning in Africa.

1.4 Empirical Research: Codifying Experiential Learning in Africa

In our current study presented for this IRSPBL, participants from Cameroon, Gambia, Ghana, Kenya, South Africa, Uganda, Zimbabwe were recruited from professional and educational engineering institutions across three African regions. These participants self-identify as being familiar with experiential learning, and have used it. Percentage used of experiential learning among participants is shown in Figure 1 (Kwuimy et al., 2025). This finding will guide the selection of experiential learning practices to be used throughout this workshop.

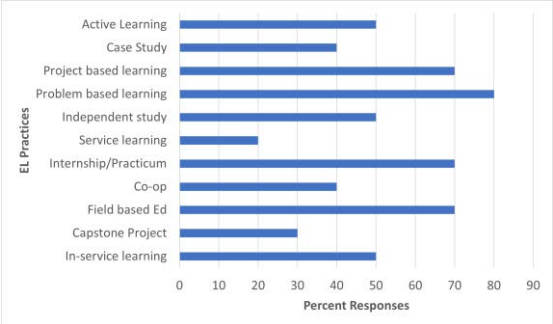

Figure 1: Percentage Used of Experiential Learning Practice

2. Schedule and Framework for the Workshop

2.1 Focus of the Workshop

Building on the pilot study summarized, this workshop will facilitate the harmonizing of experiential learning in Africa, and pave the way to experiential indigineering to achieve learning outcomes identified in the Declarations of Africa Engineering Conference and UNESCO Africa Engineering Week, Cape Town Declaration: enhancement of Practical Skills; Application to Local Needs; Addressing Educational Shortcomings; Broadening the Curriculum; Challenges and Innovations.

The workshop will last for 120 minutes, featuring a mix of interactive team-based and individual activities. It is designed for engineering educators, professionals, and regulatory bodies, with a target audience of 16 to 20 participants. The group will be divided into 4 teams, each consisting of 4 or 5 members, to encourage collaboration and active engagement throughout the session.

2.2 Learning Outcomes

The participants of this session will be able to:

i. **Define experiential learning practices in the context of African engineering education**, through peer discussion and drawing on common practices such as case studies, internships, cooperative education, and project-based learning, and thematic analysis from pilot study.
ii. **Map experiential learning practices with the goals of the Declarations of Africa Engineering Conference, UNESCO Africa Engineering Week**, particularly in enhancing practical skills, addressing educational shortcomings, and broadening the curriculum.
iii. **Design experiential learning activities for indigineering**, ensuring alignment with academic learning outcomes identified in the Declarations of Africa Engineering Conference and UNESCO Africa Engineering Week.
iv. **Identify challenges and opportunities for experiential learning in indigineering** to support engineering programs and educators in Africa.

The workshop is grounded in Transformative Learning Theory (TLT), developed by Mezirow, which emphasizes the importance of reflective dialogue in fostering deeper, transformative learning. This process challenges participants' preconceptions, promoting critical self-reflection and leading to new perspectives. The workshop follows Mezirow's stages of transformation, as outlined by King (2006) in the "Journey of Transformation" (JOT). Key stages include a disorienting dilemma that challenges existing knowledge, self-reflection to critically examine assumptions, experimentation with new ideas, and ultimately applying these revised perspectives to action, particularly through the lens of indigenous practices in Africa, or "indigineering."

3. Structure of the Workshop

Structure of the workshop (120 minutes)

The workshops will provide a platform for engaging educators and promoting reflection on how "indigineering" could leverage African indigenous knowledge to improve the formation of engineering.

The structure of the workshop is given below:

i. **Introduction (10 minutes)**: A brief overview of the workshop's structure and goals and Q&A.
ii. **Icebreaker – Team Formation – Team Bonding (5 minutes): Participants will be asked to state the extent of their familiarity with experiential learning, and** to select from the list of 11 practices of Figure 1, the ones that they have used**. Team of four will be formed to be diverse in familiarity and extent of use of experiential learning.**
iii. **Activities (85 minutes, 3 × 5-minute breaks)**: The session integrates research findings on transformative learning in engineering with interactive exercises framed within Mezirow's stages of transformation.

Time	Activity	Description	Learning Outcome (LO)
10 min	Activity 1 – Disorienting Dilemma	Participants are introduced to "indigineering" examples such as: • Great Mosque of Djenné, Mali – community-led adobe replastering (structural knowledge & sustainability). • Traditional deep wells in Southern Ethiopia & Northern Kenya – integrating hydrology, governance, and resource management. These practices challenge Western-centric views of engineering.	LO1: Critical unsettlement to broaden understanding of engineering.

Time	Activity	Description	Learning Outcome (LO)
		Participants reflect: Were you aware of these? Do they conflict with prior understanding?	
5 min	Break 1	—	—
10 min	Activity 2 – Self-Reflection	Individual & small-group reflection prompts: • What assumptions shape your view of engineering education? • How do these examples broaden perspective? • Have you integrated local knowledge into teaching? Why/why not? Participants map current experiential learning (internships, case studies, etc.) to African Engineering Week & UNESCO goals, identifying gaps (e.g., rural innovation contexts).	LO2: Identify biases, barriers, and opportunities for integrating Indigenous knowledge.
5 min	Break 2	—	—
25 min	Activity 3 – Experimenting	Teams design experiential learning activities rooted in Indigenous engineering contexts. Each design specifies: i. Context (e.g., mud architecture, water management). ii. Experiential method (fieldwork, projects, simulations). iii. Alignment with curricular outcomes (e.g., sustainability, teamwork). iv. Feasibility (resources, duration, integration). Examples: service-learning in rural communities, case studies on ancient metallurgy, artisan internships.	LO3: Develop experiential indigineering activities and adopt facilitator roles.
5 min	Break 3	—	—
25 min	Activity 4 – Acting	Teams pitch their designs, followed by discussion on challenges and opportunities. Common challenges: • Educator preparedness & lack of IK models. • Institutional biases. • Resource/curriculum constraints. • Contextual variability. Solutions: training with local knowledge holders, advocacy, curriculum alignment with UNESCO/FAEO. Each participant drafts an action plan for piloting or publishing their activity.	LO4: Anticipate barriers, propose solutions, and commit to action.
5 min	Break 4	—	—
10 min	Reflection with Peers	Small groups share key insights, barriers, and strategies for advancing experiential indigineering.	Consolidate collective learning and problem-solving.
5 min	Conclusion	Using Boud et al.'s (1985) framework, participants evaluate: (i) what they did, (ii) what it means for their educator role, (iii) how they will apply it. Closing emphasises actionable plans and a broadened view of engineering that values both global and local knowledge.	Ensure transfer of workshop learning into practice.

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Co-creating collaborative and embodied group learning experiences: Entangled stories of emotions, materialities, and the uses of a banana

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Abstract

Is university engineering education detached from emotional and material influences, as dominant discourses and hegemonic practices suggest?

Current research in engineering education shows that providing future-oriented educations towards sustainable worlds requires relational and integrative pedagogies that deepens engagement with socio-material complexities (e.g., Gravett et al., 2024). In this workshop we explore socio-material entanglements as an avenue for fostering equitable and sustainable engineering education.

Rooted in a recorded video sequence of five engineering students discussing the concept of "social pressure", we analyze and experience how students move from abstract theorizations of concepts to embodied conceptual understandings through grapplings with a banana. We introduce key ideas from positioning theory (Davies, 2023) and different interpretations of materiality from Baradian (2007) and Latourian (1993) perspectives to then apply this analytical lens to the sequence through multimodal analysis (Kayı-Aydar, 2019; Lönngren & Berge, 2024) and creative visualizations.

The workshop serves two purposes: first, to investigate how artifacts co-construct meaning with students, transforming abstract ideas into lived experiences; and second, to collaboratively develop pedagogical approaches in engineering education that acknowledge the entanglements of human and non-human entities. We thereby create openings for reimaginations of engineering education as an interconnected, embodied, and contextually rich learning experience.

Keywords: emotions, engineering education, feminist materialities, modernity, positioning theory

1 Introductions and context

University engineering education is often framed as a space for abstract, non-material reasoning and theoretical, unemotional knowledge production (Lönngren et al., 2021). Even in research on engineering education, concepts opposing these discursive norms of rationality and objectivity such as emotions are often unintentionally described as a side phenomenon rather than central to engineering practice or to the education research itself (e.g., Lönngren et al., 2024). But what if we challenge these framings and explicitly acknowledge emotions and even materiality to play a central, a crucial role in any learning process, even in that of engineering students? Inspired by the question, who and what "matters" (Gravett et al., 2024), this workshop provides opportunities to explore and experience how considering emotions and materialities in relational learning situations can offer valuable insights and tools for university educators, particularly in engineering education.

By engaging with multiple ways in which physical objects and embodied knowledges shape learning, we ask: What can we learn from emotions and materialities, and how can such entangled perspectives on learning enhance engineering education?

1.1 Empirical Case: A Banana, Social Pressure, and Learning

This workshop evolved from analyzing a video recording of a group of five university engineering undergraduate students in Sweden who discuss the concept of social pressure in relation to their project on campus sustainability. Initially, their discussions on multiple aspects associated with sustainability remains abstract (social pressure influences people when thinking and learning about sustainability). When the aspect of social pressure is raised, it is presented as a broad and common societal phenomenon in Sweden without concrete examples. However, the students' conversation takes a turn when in response to social pressure being raised as an issue, one student (S2, Figure 1) introduces a specific socio-material experience: them buying a banana when the group was having "fika", a traditional Swedish coffee break, due to perceived peer pressure from their very group. As the students' discussion further unfolds, the banana becomes an active shaper in and of their conversation. The student, S2, recalls how they felt compelled to buy a banana simply

because their peers were bringing or purchasing food themselves, demonstrating how materiality influences behavior and decision-making, not only for others in the broader society, but even for them in the group. This shift brings the complex and abstract concept of social pressure into the students' interaction, onto the table, making it explicit that they as a group themselves are agents in the production and negotiation of social pressure. This marks a moment of positional entanglement of the banana, society, the student S2, and the group and illustrates a concrete example for learning to be deeply relational and embodied as well as materially and emotionally situated, rather than remaining a purely cognitive or abstract exercise.

A B

Figure 1: **A** Students, labeled from left to right as S1-5, discussing social pressure. In this moment, S3 takes up social pressure as an abstract concept related to sustainability on campus while everyone is looking at the paper in the middle of the table. S2 then shares their experience of buying the banana, which initiates the banana conversation. **B** Students concretize how social pressure operates in different contexts and in connection with artifacts. They are looking at each other in interaction when developing the relational story of the banana. Image constructed using https://vanceai.com/photo-to-sketch/.

1.2 Workshop Aim and Contribution

In our workshop, we engage all participants in collectively rethinking how material artifacts function as agents in learning about complex phenomena. Through grapplings with the provided material as well as through actively revisiting our own lived experiences, we 1) explore how artifacts shape emotional and relational knowledge productions, 2) experiment with multi-modal and art-based methodologies to analyze socio-material entanglements, and 3) reflect on theoretical and pedagogical implications of socio-material positioning for interdisciplinary teaching in sustainability engineering education. In this process, we draw on positioning theory (Davies and Harré, 1990; Davies, 2023; Harré and Van Langenhove, 1999), post-humanist materialities (Barad, 2007; Latour, 1993), multimodal analysis (Kayı-Aydar, 2019; Lönngren & Berge, 2024) and multiple arts-based methodologies, informing our analysis and broader discussions on how to integrate affect, embodiment, and materiality into higher education pedagogies.

2 Groundings of the workshop

In the following, we provide a brief introduction of the theoretical, analytical, and methodological concepts underlying the workshop's framing. During the actual workshop session, we ensure to deepen our understandings of these concepts before applying them to the material provided and to our own lived material experiences (see 3.1 Welcome and Introduction).

2.1 Positioning Theory and Materiality in Small-Group Learning

Positioning theory examines how people are placed (positioned) and place (position) themselves in relation to others through discursive acts (e.g., Harré and Van Langenhove, 1999). Davies and Harré (1990) highlight how these discourses, as well as power, and social and cultural moral orders make (im)possible certain positions or identities within socio-culturally constructed and historical contexts. They introduced key distinctions within positioning, emphasizing its dynamic interplay in 1) first-order positioning, an initial positioning move of a concept or a subject, 2) second-order positioning, which ensures negotiation of the

initial positioning of a concept or a subject, and 3) third-order positioning, to further position concepts or subjects that were not part of the initial interaction. In other words, ideas, concepts, subjects, positions are first proposed, then rejected or accepted, and lastly, and if accepted, expanded on.

Building among others on Davies and Harré (1990), McVee, Brock, and Glazier (2011) applied positioning theory to literacy education looking at how teachers and students negotiate identities through narratives. Their work connects to Vygotskian approaches of learning and teaching. It underscores how positioning influences students' learning and agency within classrooms and "draws attention to the individual, local knowledge of participants involved in educational contexts" (p. 9).

As highlighted above, research on positioning in learning contexts has traditionally focused on how individuals position themselves and others through verbal and non-verbal interactions (e.g., McVee et al., 2021; Silvestri et al., 2021). Recently, and building on for instance McVee et al. (2021) and Davies (2023), scholars have expanded this perspective by recognizing the role of material artifacts in positioning processes, illustrating how objects can function as tools through which people position themselves or others (e.g., Lönngren, Günter and Berge, 2024). However, existing research still largely conceptualizes artifacts as passive instruments in the learning process rather than as active and entangled, which we challenge in our workshop.

In the following, we provide a quick overview over conceptualizations of materialities as proposed by Karen River Barad and Bruno Latour.

2.2 Expanding with Latour and Barad

While positioning theory (e.g., Davies, 2023) offers a framework for describing how individuals construct meaning through shifting roles and narratives, the role of materiality in these processes remains rather undertheorized and understudied. To be in this gap and to test different epistemological and analytical avenues to understand complex entangled learning processes, we draw on Bruno Latour's (1993) concept of *hybrids* and *quasi-objects* and River Barad's (2007) *agential realism*, to position material as an active agent in meaning-making and learning processes.

Bruno Latour (1993) challenges the notion that science and society, human and non-human, are distinct categories. His work on hybrids and quasi-objects provides a lens for understanding how material artifacts and human actors co-create knowledges in learning environments beyond dualities of existence/non-existence, nature/culture, objective/subjective. In contrast to traditional models of pedagogy that treat knowledge as static and abstract, Latour's perspective highlights the dynamic, material-discursive processes through which knowledge is and gets constructed and *quasi-objects* to be "much more social, much more fabricated, much more collective" (Latour, 1993, p. 55) than what might be considered science facts.

River Barad's (2007) *agential realism* provides a framework for understanding how material-discursive practices shape realities and understandings of reality. Grounded in feminist theories and rejecting nature-culture and subject-object dualisms, Barad's work invites us to consider how learning is not just about cognitive processes but about performative, embodied, affective, and material engagements. Barad (2007, p. 49) highlights, for instance, that "a performative understanding of scientific practice, for example, takes account of the fact that knowing does not come from standing at a distance and representing but rather from *a direct engagement with the world*." In this view, the banana in our empirical study is not merely a representation of the effects of the abstract concept of social pressure, it is also an active participant in the shaping of students' understanding of the concept, the concept itself, and of how social pressure can influence sustainability efforts of everyone—including themselves—in the engagement with the world.

2.3 Positional Entanglements and Multimodal Analyses

Accounting for the inseparability of human and non-human positioning in learning processes, we have developed the term *positional entanglements* (Günter, Lönngren and Berge, 2024) that serves as a starting point for our analytical conversations during the workshop. Arguing that humans and non-human artifacts

do not exist as independent entities in learning spaces, we use post-humanist materialist perspectives to expand our analytical viewpoint. Instead of being limited to monolithic and dualist analytical perspectives, we stay with the complex troubles of human learning (inspired by Haraway, 2016). In this process, artifacts such as a banana are again not merely understood as objects in the background of any interaction but active participants in shaping students' learning experiences, emotions, and conceptual understandings.

Simultaneously, and accounting for these complexities, we use multi-modal analysis (Kayı-Aydar, 2019; Lönngren & Berge, 2024) as an analytical tool and a workshop paradigm, paying attention to multiple forms and modes of communication such as gaze, gesture, and uses of artifacts, and writing, and performing, drawing, and sketching. Staying with the complexity of the students' interactions allows us to understand different paths of how they make meanings, build relationships, and co-construct knowledges in their small-group discussions.

3 Outline of the Workshop

Our workshop will combine short presentations, individual reflections, small and big group discussions, as well as creative art-based elements to facilitate opportunities to deeply engage with the entanglements of materiality, emotions, and learning.

Duration of workshop: 3 hours, including a break.

Max. number of participants: 40.

3.1 Welcome and Introduction

We begin with a brief introduction of the workshop's objectives and structure, before participants introduce themselves by sharing a personal object they carry or have interacted with, describing its significance in their lives. This exercise exemplifies the relationality of material artifacts, emotions, and learning while fostering a sense of community and serves as an entry point to the theories that we engage with. The facilitators further prompt active familiarizations with key theoretical and methodological frameworks, including positioning theory, materialities, and multimodal analysis, mapping their potential and relevance to engineering and sustainability education.

3.2 Setting the Scene: Social Pressure and the Banana

In this phase of the workshop, participants engage with multiple representations of the above-mentioned 23-second sequence in which the university engineering students discuss social pressure through the story and materiality of a banana. Following the engagement, we facilitate individual reflections, jotting down initial observations about how students interact with the concept of social pressure. Emotions and material-non-material interactions will be at the centre stage of this reflection.

After this, participants break into small groups to analyse the trajectory of the banana and how it is transformed from a passive, ordinary material object into an active, meaningful educational subject and emotional artifact. This activity's discussion is informed and guided by positioning theory, prompting participants to explore how students position themselves in relation to the banana and each other, and how this positioning influences their meaning making in the learning process.

3.3 Expanding the Story: Thinking with the Banana

Building on the group discussion, participants engage in an art-based group activity, where each group uses the banana or their own artifacts to create a multisensory narrative (e.g., through drawing, writing, or performance) with the aspiration to transform different provided sustainability concepts into concrete and embodied knowledges. Prompts for this activity include: How does the artifact "speak" about sustainability? What emotions does it carry in different contexts? What happens if the artifact is positioned as a quasi-object (Latour, 1993) or an agentic entity (Barad, 2007)? Each group presents their main insights in a three-sentence

story that will be shared with the full group. This exercise encourages participants to experiment with forms and shapes of storytelling, embodiment, and other artistic expressions as pedagogical tools for education.

3.4 Critical Reflection on Teaching Methodologies

Initiating the final reflections, the workshop transitions here to a large-group discussion, where participants critically reflect on how educators can integrate materiality, emotions, and storytelling in engineering and sustainability education. They consider the challenges of moving beyond traditional teaching approaches and discuss how socio-material entanglements might be leveraged to enhance learning experiences.

3.5 Conclusions and Closing

To conclude, each participant writes a teaching commitment statement—a single sentence outlining how they will incorporate socio-material entanglements in their teaching practice. This serves as a personal reflection and a concrete takeaway for future pedagogical development. Facilitators also provide a brief summary of the insights generated throughout the workshop and encourage continued engagement with the thoughts, emotions, and materialities that have been shared in community during the workshop.

4 Expected outcomes

This workshop is designed to provide university educators with a transformative perspective on the entanglements of materiality, emotions, and learning in engineering and sustainability education. By engaging in both theoretical reflections and hands-on activities, participants develop a nuanced understanding of how artifacts, emotions, and social dynamics can shape relational knowledge productions and educational experiences. One key outcome is an enhanced awareness of how everyday artifacts, such as a banana, function as socio-material agents in learning environments. Drawing on River Barad (2007) and Bruno Latour's (1993) material conceptualizations, participants gain insights into how material objects can be understood as not passively but actively shaping meaning-making processes in learning. This shift in perspective can encourage educators to rethink their teaching practices, particularly in fields such as engineering and sustainability, where materiality plays a crucial role in conceptual understandings.

Another critical outcome is a deeper comprehension on uses of positioning theory (e.g., Davies, 2023) in educational settings. Through engagements with our empirical material, analysis and group discussions, participants will explore how students dynamically position themselves and others within conversations, shifting roles, power relations, and narratives. This will help educators become more attuned to the implicit social dynamics in group learning and recognize the impact of these dynamics on students' engagement, participation, and knowledge productions.

The art-based group work fosters creativity and interdisciplinary thinking, encouraging educators to integrate multisensory and narrative-based methodologies into their teaching. By experimenting with storytelling, artistic expression, and performative techniques, participants will learn how to make abstract sustainability concepts more tangible, embodied, and personally relevant for students. This is particularly valuable for addressing complex, multi-layered topics such as social pressure, sustainability ethics, and human-non-human entanglements, which require experiential and affective engagement rather than purely theoretical instruction.

Finally, participants, we hope, will leave with practical pedagogical tools and personal commitments to incorporating materiality, emotion, and entanglement-based learning approaches into their own classrooms. They will reflect on how these methodologies can enhance student engagement, critical thinking, and interdisciplinary learning—essential skills for addressing contemporary sustainability challenges. The workshop thus empowers educators to create more inclusive, relational, and multisensory learning environments that integrate human and non-human concerns in meaningful ways.

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