

Guest Editorial

Reconsidering Engineering Education – Embracing the Continuum from Emergency Remote Teaching to Future Learning Paradigms

The COVID-19 pandemic forced an unprecedented shift in engineering education, challenging traditional models and accelerating digital transformation. This sudden move to Emergency Remote Teaching (ERT) was not just a crisis response – it became a turning point that reshaped how we approach teaching, learning, and assessment. As institutions worldwide adapted to new teaching paradigms, they faced significant challenges and remarkable opportunities. The rapid shift to online and hybrid models prompted a surge of educational innovation, compelling educators to reevaluate long-standing assumptions about teaching, learning, and assessment.

A critical question has emerged as we move beyond the COVID-19 crisis: How do we transition from emergency-driven adaptations to sustainable, future-ready engineering education models? This Special Issue seeks to address that question. Rather than viewing ERT as an isolated event, this collection of research examines how the lessons learned during the pandemic can reshape engineering education for the long term, informing pedagogical, technological, and institutional strategies that will define the future of the field.

This Special Issue builds on the insights from the previous IJEE special issues series “Engineering Education Everywhere: Good Practices for Emergency Situations and Remote Regions.” These issues provided a global perspective on how institutions adapted to emergency conditions, highlighting innovative responses, new assessment methodologies, and the challenges of remote learning in engineering disciplines.

While these previous issues documented emergency adaptations, the focus now shifts toward sustainability: Which strategies have endured? How have institutions redefined engineering education? What challenges remain?

This Special Issue aims to highlight the lasting transformations that will define engineering education for years to come rather than merely documenting temporary solutions.

Rethinking Engineering Education: Key Insights from this Special Issue

The papers presented in this Special Issue reflect a significant shift in engineering education that transcends temporary crisis management in favour of a more flexible, technology-enhanced, and student-centred approach. Instead of viewing these innovations as isolated developments, this collection illustrates how pedagogical strategies, technological advancements, and faculty training must collaborate to create a more resilient learning ecosystem.

Regarding the pedagogical changes introduced during the pandemic, the articles by Hira et al., Chang and Rodríguez et al. examine the lasting impact of the innovations resulting from ERT and how they have shaped engineering education. Both studies suggest that while some adaptations have been integrated into permanent practice, others have struggled to gain long-term institutional traction, often due to a lack of training, infrastructure, or strategic alignment with the curricula.

Other studies, like those presented by Ning, Koprda et al. or Bojórquez-Roque et al., address integrating digital and blended learning models into engineering education. These studies demonstrate that digital learning is no longer a supplementary tool but a core component of engineering education. However, they also highlight critical challenges, including the need for well-designed hybrid models, faculty training, and student support systems to maximize learning outcomes.

The post-pandemic transition has not been without challenges, and several contributions to this issue, such as Stanojević et al., Samantha et al. and Ivanovic et al., have explored the complexities of digital transformation in engineering education. Their conclusions reinforce the idea that while technology is a powerful enabler, it must be thoughtfully integrated to support – not replace – the essential elements of engineering education: hands-on problem-solving, collaboration, and social interaction.

The Future of Engineering Education: A More Resilient and Adaptive Model

Engineering education is not returning to its pre-pandemic state – it is evolving toward a more flexible,

technology-enhanced, and student-centred paradigm. However, sustaining these transformations requires the following:

- Institutions must prioritize faculty training to ensure the effective and inclusive use of digital tools and hybrid models.
- The nature of engineering learning requires educators to find a balance between digital innovation and hands-on, experiential learning.
- Policymakers must formulate strategies that uphold academic integrity and tackle the ethical implications of AI and digital learning platforms.

The findings in this Special Issue make it clear: Engineering education is at a crossroads. Institutions must decide whether to capitalise on the lessons learned during the pandemic or risk reverting to outdated models. The challenge now is to transform temporary adaptations into lasting improvements, ensuring that engineering education remains innovative, inclusive, and prepared for future disruptions. The pandemic allowed us to challenge traditional assumptions and redesign education models in ways that prioritise inclusivity, engagement, and adaptability. The challenge now is to ensure that the most effective innovations from this period become standard practice rather than exceptions born out of necessity.

For all these reasons, we consider this Special Issue an important step in documenting, evaluating, and shaping the future of engineering education. The insights presented here will be invaluable for educators, administrators, and policymakers as they refine pedagogical approaches, institutional strategies, and technological integration.

We would like to express our deepest gratitude to the authors who submitted their contributions, the reviewers for their insightful evaluations, and Prof. Ahmad Ibrahim, Editor-in-Chief of IJEE, for his support in making this Special Issue possible.

We hope that the findings and discussions presented in this Special Issue will inspire further research and pedagogical advancements, ultimately shaping a more resilient, inclusive, innovative, and effective engineering education system for the future.

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