



Challenges and Opportunities – Future Perspectives of Engineering Education and the Impact of the Pandemic



Challenges and Opportunities – Global Conference on Engineering Education

Symposium 1 - Future Perspectives of Engineering Education and the Impact of the Pandemic

**Co-Chairs, Jesse Zhu and Andrew Hrymak
Canadian Academy of Engineering and Western University**

(8:00-11:30am, June 15, 2021, EDT/GMT-5)

The Canadian Academy of Engineering, in partnership with Western University, is holding a Symposium on “Future Perspectives of Engineering Education and the Impact of the Pandemic”, on June 15, 2021, as part of a Global Conference on Engineering Education - Challenges and Opportunities.

While the world is going through unprecedented changes and rapid developments, the method of engineering education has not seen much change. We have seen the developments in AI, 5G and other technologies, the increasingly inter-disciplinary nature of the engineering profession, and the use of hybrid virtual collaboration tools. There is an opportunity for more fundamental and revolutionary changes in Engineering Education, and the current pandemic seems to have provided the catalyst for faster changes.

The half-day Symposium will feature 3 panel discussions and presentations from 9 world experts on Engineering Education, to discuss the Future Perspectives of Engineering Education and the Impact of the Pandemic, in view of the Challenges and Opportunities of Engineering Education.

Symposium 1 - Future Perspectives of Engineering Education and the Impact of the Pandemic

(June 15, 2021)

(Co-Chairs, Jesse Zhu and Andrew Hrymak)

Time	Sessions	Chairs
8:00-8:15	Opening and Introduction (Jesse Zhu) Opening Remark (Yves Beauchamp)	Jesse Zhu
8:15-9:00	Sustainability and Engineering Education	Jesse Zhu
9:00-10:05	Changes Beyond the Pandemic	Kenneth Coley
10:05-11:10	New Student Experiences	Andrew Hrymak

***Yves Beauchamp, C.M., C.Q., FCAE, Eng., Ph.D.,
President, Canadian Academy of Engineering***

Yves Beauchamp presently serves as the President of the Canadian Academy of Engineering. He is also the Vice Principal (Administration and Finance), McGill University. Prior thereto, he was Full Professor of Industrial Engineering, École de technologie supérieure (ÉTS). Dr. Beauchamp was also Vice-Rector responsible for the development of the new Outremont campus of Université de Montréal and Director General at the ÉTS. At ÉTS, supported by a strong management team, he revitalized this university as a training ground for engineers, which became one of the largest in Canada under his leadership. He also held an academic position at the Université du Québec à Trois-Rivières.



Jesse Zhu, FCAE, FRSC, Distinguished University Professor, Western University, Director of Board, Canadian Academy of Engineering,

Jesse Zhu is a Distinguished University Professor and the Director of Particle Technology Centre at Western University. He serves as a Director on the Board of the Canada Academy of Engineering and is also the current chair of the CAETS Engineering Education Group. He obtained B.Eng. from Tsinghua University and his PhD from the University of British Columbia. After working a couple years for Shell in Europe, he joined Western University in 1993. He is also a Fellow of the Royal Society of Engineering and has received the R. S. Jane Memorial Award, the highest award from the Canadian Society for Chemical Engineering.

Andrew Hrymak, FCIC, FCAE, Professor, Western University, Canada

Andrew Hrymak is currently the Special Advisor to the President on Industry Partnerships, the Green Economy, and Sustainability and Deputy Director of the Fraunhofer Project Centre for Composites Research at Western University. Previously, he served as Provost and Vice-President Academic and Dean of Engineering at Western University and as Department Chair and Professor at McMaster University. His research interests include modeling, design and optimization of materials processing systems. He obtained his B.Eng. from McMaster University and his Ph.D. from Carnegie Mellon University.



Session 1 – Sustainability and Engineering Education (Chair: Jesse Zhu)

Time	Speakers	Titles
8:15-8:30	Elizabeth CROFT	Engineering Education Futures - Global Challenges
8:30-8:45	Jincheng KANG	Innovation in Engineering Education for Sustainable Development
8:45-9:00		Panel Discussion

Elizabeth Croft, Dean of Engineering, Monash University, Australia

Elizabeth Croft is the Dean of Engineering at Monash University in Melbourne, Australia. She is an expert in robotics, advancing the design of intelligent controllers and interaction methods that support human-robot interaction. She has won national and international awards for her research, advocacy for women in engineering, and educational contributions. She is a fellow of the American Society of Mechanical Engineers, the Institute of Engineers Australia, Engineers Canada and the Canadian Academy of Engineering.



Engineering Education Futures - Global Challenges

Engineers are needed more than ever. As makers and creators who turn raw ideas into real solutions, engineers have the capability and responsibility to imagine, design and build a safer, more sustainable world for the future. Time is running out to achieve the United Nations' 2030 Agenda for Sustainable Development, including the 17 Sustainable Development Goals. As leaders in engineering education, we must activate our students, staff and community to deliver on the goals of affordable and clean energy, sustainable cities and communities, clean water and sanitation, zero hunger and more.

As leaders in engineering education, it is critical that that our programs extend beyond the physical and virtual classroom to prepare future leaders ready for international careers. We must model an engineering culture that promotes professional ethics, sustainability, collaboration, creativity, and diversity. In this talk we will look at curricular and co-curricular approaches to achieving these goals leveraging Transnational Education, Student Design Teams, and Industry Experiences.

Jincheng KANG, Strategic Expert, UNESCO International Centre for Engineering Education (ICEE), Tsinghua University, China



Mr. KANG Jincheng graduated from Beijing University of Foreign Studies in 1982 and studied science policy at Sussex University 1991-1992 with an MSc for Science and Industrialization. He was a senior science officer at the Chinese Embassies in London and Dublin 1999 and 2002, and was Director General for International Cooperation Bureau of the Chinese Academy of Engineering (CAE) before his retirement in 2016.

Mr. KANG is now a Strategic Specialist of International Centre for Engineering Education (ICEE) under the auspices of UNESCO and Vice President of China High-tech Industrialisation Association. His major areas include research and innovation policy, sustainable development and international engineering education.

Innovation in Engineering Education for Sustainable Development

China is currently in the middle stage of industrialisation and urbanization with unprecedented pace and level of development in high-technology and basic infrastructure. While having many advances such as the long mileage of high-speed railway, bridge building, etc., China is still faced with the daunting challenge of

unsustainability such as resource waste and energy inefficiency, and low-value added products etc. resulting in environmental degradation. To address these challenges, China is now striving into a difficult system innovation in engineering education:

(1) Engineering education for fostering a large contingent of high-level engineers in the frontiers of engineering technology and millions of skilled masters solving practical problems in productions lines - It is aimed at breaking the blockage for these two types of talents with inter and cross disciplinary knowledge and social responsibility mindset to converge.

(2) Engineering profession to be equipped with sustainability mindset - Only by actively joining international efforts in global engineering education, can China truly develop itself and contribute to achieving the UN SDGs.

The International Centre for Engineering Education under the leadership and guidance of UNESCO is aimed at international education so as to help strengthen engineering capacity building in developing countries.

Covid-19 pandemic has brought about huge challenges but also greater opportunities for China’s engineering education endeavor, both domestically and internationally.

Session 2 – Changes Beyond the Pandemic (Chair: Kenneth Coley)

Time	Speakers	Titles
9:00-9:15	Ishwar K. Puri	The Pivot: Transforming Engineering Education during and after the Pandemic
9:15-9:30	Jane Goodyer	COVID-19 Levelling the Playing Field in Engineering Education
9:30-9:45	Jim A. Nicell	The Pandemic: Every Crisis is an Opportunity to Improve, and Engineering Education is no Exception
9:45-10:05		Panel Discussion



Ishwar K. Puri, Dean of Engineering, McMaster University, Canada

Dr. Ishwar K. Puri is Dean of Engineering and Professor at McMaster University in Hamilton, Canada, where he leads The Pivot, a project that is transforming engineering education by emphasizing rich experiential learning opportunities for students and experiential microcredentials for lifelong learners. His current research interests include 3D printing of cells and tissues with bioinks and development of nanoparticle colloids for biosensing, chemical sensing and supercapacitor applications. He is a Fellow of the Canadian Academy of Engineering and an appointed member of the Natural Sciences and Engineering Research Council of Canada.

The Pivot: Transforming Engineering Education during and after the Pandemic

The Pivot, the largest transformation of the student experience at McMaster Engineering, occurred during the pandemic. Design thinking, an innovation mindset and entrepreneurship are embedded in virtualized forms in all programming. We have redesigned our curriculum using gamification and virtual reality platforms, combining courses and changed our approach to teaching to create an integrated learning experience that will last after the pandemic. Our students are learning to understand and solve grand challenges, such as climate change and sustainability, collaboratively in virtual spaces. They are encouraged to view these complex problems with a multidisciplinary lens. First-year students learn how sustainability is the basis of countering climate change. Of the four substantive projects that they must complete over the academic year, Project 1 asks them to complete the mechanical design of turbine blades in renewable wind technology. Project 3 is the design of a system for sorting and recycling containers. These sustainability solutions become part of students’ online portfolios so that they can reflect upon the importance of practicing and embracing the philosophies of

sustainability to counter climate change. Through the projects, traditional ‘chalk and talk’ teaching is replaced by self-directed and group learning. While there will undoubtedly be more face-to-face learning after the pandemic ceases, the virtualized experiences will remain so that students can learn anytime anywhere, improving their access to education. These integrated experiences applied to real-world problems allow for deeper and more integrated learning, connecting classroom experiences to a relevant societal context.

Jane Goodyer, Dean, Lassonde School of Engineering, York University

Jane Goodyer is a British-New Zealand engineer and academic. Prior to her appointment as Dean and Professor at York University's Lassonde School of Engineering, Jane served as Head of School of Engineering and Advanced Technology at Massey University. From her personal experience, Jane knows that education can transform lives. She is a first-generation learner who has benefited from postsecondary studies and is passionate about opening doors and providing opportunities to other first-generation learners, especially from under-served communities. Jane has always sought to bring academia and industry closer together and has now brought her expertise to Canada.



COVID-19 Levelling the Playing Field in Engineering Education

COVID-19 has accelerated the use and integration of technology to support learning. In our Engineering Schools across the globe, we have pivoted to be online providers, challenging the typical pedagogical approaches; even when we rely so much on experiential learning through projects and laboratories.

Online learning has been promoted as benefiting learners in terms of accessibility and flexibility, allowing students to accommodate other commitments such as full-time/part-time work or personal commitments.

For our learners many are increasingly having to work to pay for their education, or have long commutes, or caring responsibilities. This in turn significantly reduces the opportunities for them to fully engage in their studies and any broader learning possibilities such as clubs, study groups, networking, etc.

As engineering educators, do we now have a window of opportunity to keep these pedagogical innovations and build momentum that allows for more flexibility and accessibility for learners and truly have programs that are inclusive?



Jim A. Nicell, Dean of Engineering, McGill University, Canada

Jim Nicell joined McGill University's Department of Civil Engineering as a professor in 1992 and has served as Dean of the Faculty of Engineering since 2013. He is an environmental engineer who specializes in applied green chemistry, pollution control and impact assessment. From 2007-12, he was Associate Vice-Principal (University Services) at McGill with responsibility for campus planning, construction, infrastructure and building operations, safety and business units. He has been a registered professional engineer since 1991 and is a Fellow of the Canadian Academy of Engineering. From 2019-21, he served as Chair of Engineering Deans Canada, comprised of Deans from cross Canada.

The Pandemic: Every Crisis is an Opportunity to Improve, Engineering Education is no Exception

For better or worse, the COVID-19 pandemic has forced change upon us at a rate and to an extent that are unprecedented. All of us – in universities, in business, and in the general population – have developed new capabilities, have adapted to new technologies and platforms, and have learned to function in our working, learning and personal lives in ways unforeseen just one year ago. Fortunately, this is an opportunity for us to address pivotal questions when it comes to education and to mobilize to make the most of our new capabilities. For instance, what unexpected benefits were derived from remote learning? How can we use this knowledge to ensure that students get the most out of their educational experience? What are the necessary-but-not-sufficient elements of an education that all engineers should share and how should we deliver these? How can we fine-tune education to meet the diverse needs and interests of our students and, ultimately, their employers?

What is assessment for and how can it be best achieved? How can remote technologies enable experiences that formerly were out of reach? Can we now make education more inclusive, equitable and diverse? What is the purpose of hands-on learning and how can we make the best of it? How can we better prepare our students for a very different and evolving workplace? How can we engage more effectively with partners – including other disciplines, other institutions, businesses, and broader communities? The good news is that more of us are now asking these questions and have a newfound drive to answer them. The bad news is that time is wasting, and there is an urgent need to address these questions before we lose momentum.

Session 3 – New Student Experiences (Chair: Andrew Hrymak)

Time	Speakers	Titles
10:05-10:20	John Mitchell and Emanuela Tilley	The Future of Integrated Engineering
10:20-10:35	Alexandra Knight	Integrating Industry and Inclusion into Engineering Education Utilising Online Delivery
10:35-10:50	Clayton Byers	Effective Education: Lessons Learned From a Hybrid Classroom
10:50-11:10		Panel Discussion

John Mitchell, Vice-Dean Education, UCL Engineering, UK

John E. Mitchell is Professor of Communications Systems Engineering in the University College London, Vice-Dean Education in Faculty of Engineering Sciences and Co-director of the Centre for Engineering Education. He led the introduction of the Integrated Engineering Program and has published on curriculum development with engineering education. He is a Chartered Engineer, Fellow of the Institution of Engineering and Technology (IET), a Senior Member of the Institute of Electrical and Electronics Engineers (IEEE), Member of the Board of Directors of the European Society for Engineering Education and Principal Fellow of the Higher Education Academy. He is currently Editor-in-Chief of the IEEE Transactions on Education.



Emanuela Tilley, Director of Integrated Eng Programme, UCL Engineering,

Emanuela is the Director of the Integrated Engineering Programme (IEP) in the Faculty of Engineering Sciences at UCL. Emanuela is a Fellow of the Higher Education Academy. In 2013 she joined UCL Engineering and created the engineering design curricula and IEP Challenges to introduce problem, experimental, research and enquiry-based learning to a multi-disciplinary first year cohort of engineering students at UCL. She champions a teaching and learning programme focused on self-awareness, teamwork and leadership aimed at supporting students in their development of engineering skills.

The Future of Integrated Engineering

In 2014, the Engineering Faculty at University College London launched a major curriculum revision of all of its engineering programme. The framework, known as the Integrated Engineering Programme (IEP) brought a thread of project-based learning, interdisciplinary activities and an emphasis on skills and employability into all courses. Now established with an intake of around 1000 students per year, this framework continues to evolve. In particular, it is beginning to move from a specific structure to broader set of principles that give guidance to all teaching within the faculty.

The pandemic and the pivot to online learning presented a particular set of challenges to programmes that had become centred on an interactive and practical teaching style. In this presentation, we will give an overview of the IEP and describe how the programmes are using the experience of adapting to the requirements of online learning during the pandemic to introduce new structures.

Alexandra Knight, Brunel University, CEng FIMechE MIAM FWES

Alex is a Chartered Engineer and Fellow of the IMechE with over 15 years' experience in Industry, specialising in Asset Management. She is also a Visiting Professor with the Royal Academy of Engineering at Brunel University London, bringing industry insights into academia. She represents the UK on the ISO 55000 committee and is a Trustee on the Board of the Women's Engineering Society. In 2019 she founded STEMAZING Ltd – a social enterprise dedicated to inspiration and inclusion in STEM.



Integrating Industry and Inclusion into Engineering Education Utilising Online Delivery

The pandemic has opened our eyes to the opportunities of online delivery of many aspects of engineering education. One of the benefits of this is it provides us with options to integrate more diverse role models from Industry into teaching, thus supporting graduates to meet industry expectations and enhance diversity and inclusion in engineering.

The Royal Academy of Engineering in the UK runs a programme enabling improved integration of Industry with Academia by funding Visiting Professors to engage with HE establishments and provide students with industry insight and skills. In addition to this, the latest requirements from the Engineering Council in the UK for Accreditation of Higher Engineering Programmes (AHEP) specifies that diversity and inclusion must be a part of the engineering syllabus. Online delivery of lectures provides more options for giving students diverse role models from industry to support meeting the AHEP requirements in addition to helping students be “industry-ready”.



Clayton Byers, Asst Professor of Engineering, Trinity College in Hartford, USA

Clay is an Assistant Professor of Engineering at Trinity College in Hartford, CT, USA. He teaches Engineering Mechanics, Materials, and Thermodynamics in a liberal arts setting and performs research in turbulent flows. In the classroom, Clay has an interest in transforming education and making the rigorous mathematics that forms the foundation of engineering into an interactive and exciting exploration of our world. He earned the Princeton's Luigi Crocco Award for Teaching Excellence and the Princeton University Engineering Council's Excellence in Teaching Award. Prior to entering academia, he was a project manager with the US Air Force Space and Missile Systems Center.

Effective Education: Lessons Learned From a Hybrid Classroom

Engaging students in the classroom requires a constant self-assessment and update to the course plan and instructor activities. With the onset of the pandemic, many necessary changes were forced on us in order to continue providing an education to our students. However, not all of these changes aligned with our teaching techniques or pedagogical beliefs. In the transition to online, remote, and hybrid learning, we were presented with an opportunity to learn and grow as educators. I will explore how the disruption to our classroom norms may provide us with an opportunity to rethink how we approach education while continuing to develop and leverage what strengths we already possess. The balance of compassion and flexibility with rigor and discipline provides a tension that will force us to assess and continually update how we work with our students and prepare them for their future in the engineering field.

Copy the following link to register: https://us02web.zoom.us/webinar/register/WN_JrEcdriKTouSbSrao_BiIA