Global Conference on Engineering Education – Challenges and Opportunities

Symposium 2: Future Perspectives of Engineering Education and the Impact of the Pandemic

(Co-Chairs Clayton Byers and Jesse Zhu)

Monday July 26 2021: 12pm - 3pm EDT

The session can be found on the ASEE conference website here: https://2021asee.pathable.co/meetings/tpcLd9sDXrz9APuYT
or directly through this Zoom webinar: https://trincoll.zoom.us/j/98321979348

The Canadian Academy of Engineering, in partnership with Western University, is organizing a "Global Conference on Engineering Education – Challenges and Opportunities". This conference is consist of a series of symposia, held online, over a period 5-6 few months, organized with different parties. The first symposium, "Future Perspectives of Engineering Education and the Impact of the Pandemic", was held during the AGM of the Canadian Academy of Engineering on June 15 and this is the second symposium.

This Symposium at ASEE on July 26 will focus on the future of our engineering classrooms with a perspective from the lessons we've learned throughout the pandemic. This session builds on last year's ASEE webinar series on "Emerging Insights: Navigating Remote Instruction" and seeks to build off the experiences of a number of those panelists. This three-hour session within the 2021 ASEE Annual Meeting will focus on a few major themes to discuss how we can move forward in our classrooms. Experts have been invited to present in these themes, which will be followed by a Q&A panel discussion.

SCHEDULE OVERVIEW

TIME	SESSION	SPEAKERS
12:00pm to 1:00pm	**The Future of Online Engineering Education**	**Dr. Kerrie Douglas (Purdue Univ.)** **Dr. Julie P. Martin (Ohio State Univ.)**
1:00pm to 2:00pm	**Remote Lab Experiences**	**Dr. Julian Yamaura (Univ. Washington)** **Dr. Margot Vigeant (Bucknell Univ.)** **Dr. Mark Miller (Penn State Univ.)**
2:00pm to 3:00pm	**Community and Engagement**	**Dr. AnnMarie Thomas (Univ. of St. Thomas)** **Dr. Krishna Pakala (Boise State Univ.)** **Dr. Rebecca Bates (Minn. State Univ. Mankato)** **Dr. Clayton Byers (Trinity College)**

SESSION 1:

The Future of Online Engineering

Dr. Kerrie Douglas (Purdue Univ.) and Julie Martin (Ohio State Univ.)

The Future of Online Engineering Education: What's Effective, Less Effective, and Simply Depressing

Since the beginning of the worldwide pandemic, we have been reminded repeatedly that engineering students need interactions with and support from each other and their instructors to be successful and persist. Students also need assessments to help them identify what instructors expect of them and where their current learning is in relation to instructor expectations. The future of online education and our ability to scale learning is contingent upon incorporating these elements in meaningful ways.

Our recent research, funded by the US National Science Foundation's RAPID program, provides rich examples of the value undergraduate engineering students place on interactions with their instructors and classmates in online courses. Our research highlights creative ways that engineering instructors facilitated these important interactions during the pandemic to promote student success.

Our presentation will provide an overview of the potentials for the future of online learning through the lens of our comparative case study research. We will share results from the time of pandemic that highlight: effective implementation, less effective implementation, and depressing experiences in online undergraduate engineering education. We will share recommendations for undergraduate engineering instructors to create a truly effective future of online learning.

Dr. Kerrie Douglas, Assistant Professor of Engineering Education at Purdue, studies how to improve the quality of classroom assessments and evaluation of online learning in a variety of engineering education contexts. She recently received an NSF award to study engineering instructor decisions and student support during COVID-19 and the CAREER award from the U.S. National Science Foundation to study increasing the fairness of engineering assessments. In total, she has been on the leadership of more than $24 million dollars in research awards. Her research on evaluation of online learning (supported by two NSF awards #1544259,1935683) has resulted in more than 20 peer-reviewed conference and journal publications related to engineering learners in online courses. She was a FutureLearn Research Fellow from 2017-2019; a 2018 recipient of the FIE New Faculty Fellow Award and is the 2021 Program Chair for the Educational Research Methods Division of ASEE.

Julie P. Martin, Ph.D. is an Associate Professor and the Associate Department Chair for Graduate Studies and Research Infrastructure in the Department of Engineering Education at The Ohio State University. She is the editor-in-chief of the Journal of Women and Minorities in Science and Engineering. Dr. Martin's research focus is on methodological activism, the use of research methods to advocate for social change. She served as the Program Director for Engineering Education in the Directorate for Engineering, at the National Science Foundation (NSF) from 2017-2019. Since 2004, Dr. Martin has held a number of national leadership positions in the American Society for Engineering Education (ASEE) and Women in Engineering ProActive Network (WEPAN), having served in the latter organization as national president (2009-2010). She was inducted as a Fellow of ASEE in 2019.

SESSION 2:

Remote Lab Experiences

Dr. Julian Yamaura (Univ. Washington), Dr. Margot Vigeant (Bucknell Univ), and Dr. Mark Miller (Penn. State Univ.)

Reflecting on a Year of Adapting, Assessing, and Refining: The Impact of Remote and Hands-on Labs

For over a year, the COVID-19 pandemic has changed the way we teach traditional hands-on lab activities. As the impact of the pandemic gradually diminishes, faculty and staff involved in engineering education have an opportunity to reshape our courses using lessons learned from the past year. This talk presents some of the advantages and disadvantages observed from teaching construction materials lab activities in a remote online setting. Incremental changes made over four iterations of this course will be shared. The talk will conclude by discussing elements of both in-person and remote labs that may be adopted in future offerings of this course.

Dr. Julian Yamaura is a full-time Assistant Teaching Professor in Civil and Environmental Engineering at the University of Washington. He teaches courses related to construction materials, design and construction of temporary structures, and infrastructure construction means and methods. Prior to the UW, Julian has worked for Pavia Systems, Inc., as an engineering consultant assisting with the development and deployment of a construction project inspection technology for public organizations and construction engineering and inspection firms across the country. He has also worked for Atkinson Construction as a construction engineer working on large transportation infrastructure projects in Washington.

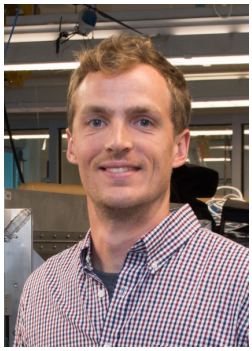
What We Learned from a Year of Remote Teaching: Directions for Laboratory Improvement

In early spring 2020, universities around the world were forced by the pandemic to rapidly switch to remote instruction. A particular challenge for engineering disciplines in this switch was hands-on laboratory instruction. In some cases, this meant inconvenience - such as when students needed access to expensive or complex software that typically only runs on institutional computers. In some cases, this required wholesale rethinking of the laboratory experience - such as when students were intending to use a 5m tall distillation column. Adapting laboratories for remote learning successfully requires identification of the “normal” lab’s core learning objectives, creativity, and significant effort. Existing labs were converted to simulations, streamed through video, or recreated by students using materials shipped to them or that they found in their homes. While few of these experiences were identical to what had gone before, a great many of them successfully demonstrated their core learning outcomes as well as some additional (sometimes unexpected) learnings. As institutions begin to return to “normal,” there were some benefits from the remote laboratory work that the field should consider retaining. In this talk, I will share a research-based approach to developing alternative laboratory experiences, and discuss some of the pros- and cons- of the remote work, and brainstorm with the panel and attendees about how best to preserve the positive changes into the future.

Margot Vigeant is Rooke Professor of Chemical Engineering at Bucknell University. She teaches chemical engineering thermodynamics, applied food science and engineering, and capstone design. Margot’s broad research area is effective pedagogy in engineering, including approaches to conceptual learning and inquiry- based activities for thermodynamics and heat transfer. She is also interested in“making”in engineering and using technology to broaden engagement and access. Margot completed her doctorate at the University of Virginia. She is an ASEE Fellow, Apple Distinguished Educator, and chair of the 2022 ASEE Chemical Engineering Summer School.

The Surprising Benefits of Remote and Hybrid Teaching Methods in Undergraduate Engineering Education

Unexpected side effects can bring welcome change to the classroom, creating an opportunity for new methods and ideas to flourish. The academic year of 2020 brought no small number of challenges to the forefront, notably a reassessment of how educational content can be accessed by students. A hybrid instructional method known as “Covid Mixed Mode” or CMM was implemented at Penn State University which, as the name implies, allowed for a mixture of in-person and remote instructional activities. Following covid guidelines in the state of Pennsylvania meant that most instructional spaces had significantly reduced capacity for students, with most rooms only approved for 1/3rd or less of their total enrollment. This presented an interesting challenge to the CMM instructor of balancing in-class and online students in a fair and equitable way while still presenting course material effectively throughout the semester. In this talk I will discuss specific examples of how this method of content delivery was adapted for the Aerospace Engineering introductory fluid dynamics course, AERSP 311, as well as a graduate course in wind turbine aerodynamics, AERSP 583. New engagement tools such as using a flipped classroom, development of extra-content “mini-lectures”, and holding in-class competitions were met with positive student responses in end-of-semester reviews. Future iterations of both courses will also be discussed, considering lessons learned and with the goal of continuing to make engineering education more broadly accessible.



Mark A. Miller is an Assistant Professor of Aerospace Engineering at Penn State University. He conducts theoretical and experimental research on the fluid dynamics of rotating and unsteady systems, including rotorcraft, future vertical lift, and wind turbine applications. Other research interests include novel sensor design, turbulent flows interactions with roughness, as well as development of unique experimental facilities. He is also the PI for the with the Penn State Wind Energy Club which competes annually in the DOE/NREL sponsored Collegiate Wind Competition.

SESSION 3:

Community and Engagement

Dr. AnnMarie Thomas (Univ. of St. Thomas), Dr. Krishna Pakala (Boise State Univ.), Dr. Rebecca Bates (Minn. State Mankato), and Dr. Clayton Byers (Trinity College)

The Playful Side of Engineering Education: Finding the Whimsy and Surprises in Our Content

Play isn't just for kids. Elements of playfulness can aid in student engagement in college engineering classes. This short talk will look at adding joy, whimsy, and surprise to undergraduate engineering courses. In light of the changes brought from COVID, I will also focus on ways to ring these elements to online and hybrid classes.

Dr. AnnMarie Thomas is a Professor in the School of Engineering, the Opus College of Business, and the Center for Engineering Education. AnnMarie is the founder/director of the Playful Learning Lab, and executive director of the OK Go Sandbox project. She is the co-creator of Squishy Circuits, and the author of Making Makers: Kids, Tools, and the Future of Innovation. She has an SB in Ocean Engineering from MIT, an MS and a PhD in Mechanical Engineering from Caltech, a certificate in Sustainable design from MCAD, and a postdoctoral certificate in Marketing and Management from University of Florida.

Developing Human Connections by Embracing Digital Togetherness

The future of engineering education has continually evolved in the last 16 months. We went from rapid transition to remote learning, to adoption of a wide variety of teaching modalities in a short time to support everyone's well being. The COVID-19 pandemic has significantly impacted the day-to-day realities of engineering educators and students and has contributed to higher levels of stress, anxiety, and mental distress among students. Many educators have taken this challenge as an opportunity to increase their student support efforts, implementing practices for supporting students both in and out of the remote classroom. This presentation explores strategies for effectively supporting students remotely or in person (with face coverings and physical distancing), sharing insights on virtual office hours/lectures, empathetic syllabi and in-class icebreakers, instructional techniques to support students inside/outside the classroom, and additional ways that faculty, staff, and peers can interact to support student success. The presentation also focuses on alternate authentic assessments that can drive student learning.

Krishna Pakala, Ph.D, is an Assistant Professor in the Department of Mechanical and Biomedical Engineering at Boise State University (Boise, Idaho). He is the Director for the Industrial Assessment Center at Boise State University and served as the Faculty in Residence for the Engineering and Innovation Living Learning Community (2014 - 2021). He served as the inaugural Faculty Associate for Mobile Learning and as the Faculty Associate for Accessibility and Universal Design for Learning. His academic research interests include innovative teaching and learning strategies, use of emerging technologies, and mobile teaching and learning strategies.

Lessons Learned About Community Building

Student engineers and their professors learned a lot about themselves and their communities over the last year. One thing that became obvious was that building a supportive and inclusive community is not accidental, although the process can benefit from serendipity. When we consider the known benefits of developing an engineering identity, the value of belonging, and creating inclusive pathways to expand participation in our field, the engineering education community can benefit from maintaining pandemic approaches that provided more access to more students while shoring up the beneficial experiences and relationships that come from more traditional in-person learning. The pandemic has expanded our idea of a "third place", something other than home and the classroom or office for building relationships, but has also heightened the longing for places that allow for hands on experiences that can bring meaning to engineering theory. While building a sense of community amongst students is crucial for their development, building and maintaining a sense of community for faculty, whether it's within a department or with colleagues from across the nation, is just as important to the long-term success of engineering education.

Rebecca (Becky) Bates is Professor and Chair in the Department of Integrated Engineering at Minnesota State University, Mankato where she directs three project-based learning engineering programs, Iron Range Engineering, Twin Cities Engineering and the new IRE Bell Program. Her research interests range from automatic speech recognition to belonging and community in undergraduate STEM learning to institutional change in academia. She has been a Program Officer at the National Science Foundation where she supported programs to broaden participation in STEM. She has served in the leadership of ASEE's Commission on Diversity, Equity & Inclusion (2017-2020) and is the chair of the ASEE Ethics Committee. She is on the Editorial Board of the Online Ethics Center.

Lessons Learned in Engaging Hybrid Classrooms

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. We should ask ourselves what the purpose of our assessments serve, and how they work in conjunction with our classroom activities to help form a strong foundation for our students. 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.

Clay Byers is an Assistant Professor of Engineering at Trinity College in Hartford, CT, USA where 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.