PROGRAM

ASEE Northeast Section Conference

"Engineering Education in a Post-COVID World"

Worcester Polytechnic Institute
Worcester, Massachusetts

October 21-23, 2021

Conference Sponsors:

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ASEE-NE2021 Chair's Message:

We are honored and delighted to welcome you to the 2021 American Society for Engineering Education – Northeast Section (ASEE-NE) Conference at Worcester Polytechnic Institute (WPI). We are happy to have a large number of participants from many institutions contributing at this in-person conference in this pandemic era.

Our mission is to showcase the latest developments in engineering education and strengthen partnerships among engineering educators in the region. We are committed to bringing together the best talents from our engineering community and fostering their growth. This is an ideal forum to interact with engineering educators and to listen to the methods of educators in other institutions as well as to listen to undergraduate and graduate students' research. We hope that this regional conference on engineering education will inspire and motivate our younger generation to pursue a career in engineering fields that uplift our world and allow them to play an important role in the ever-evolving technology world.

Our past conferences were excellent, with outstanding presentations, and this year's agenda is also rich and varied, with several sessions and events. We hope that you will benefit from this year's conference, and I like to thank all the participants, committee members, students and the WPI faculty and staff who worked very hard to make ASEE-NE 2021 a successful event.

ASEE-NE 2021 Chair
Bala Maheswaran, PhD.
Northeastern University
Boston, MA, USA

2021 ASEE-NE Conference
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Conference Keynote Speakers

Dr. Pamela McCauley is an internationally recognized innovator, entrepreneur, and engineering researcher in the development of mathematical models, human engineering, and engineering leadership. As an award-winning educator, she is on a mission to empower students and professionals to successfully pursue STEM educational, entrepreneurial and career goals. An author of over 100 technical publications, she is a full professor and taught industrial engineeringat the University of Central Florida for 27 years and previously held the position of Martin Luther King, Jr. Visiting Associate Professor of Aeronautics and Astronautics at the Massachusetts Institute of Technology (MIT). In January 2018, she was selected as a Program Director for the National Science Foundation's I-Corps Program where she served in this role until 2020. In 2019 she was named Technologist of the Year by the prestigious Women of Color magazine. She's recently accepted a position as the Associate Dean of Academic Programs in the Wilson College of Textiles at NCSU. As an award-winning educator, she is on a mission to empower women to successfully pursue STEM educational, entrepreneurial and career goals.

Livingston Taylor's career as a professional musician has spanned over 50 years, encompassing performance, songwriting, and teaching. Described as equal parts Mark Twain, college professor, and musical icon, Livingston maintains a performance schedule of more than a hundred shows a year, delighting audiences with his charm and vast repertoire of his 22 albums and popular classics. Livingston has written top-40 hits recorded by his brother James Taylor and has appeared with Joni Mitchell, Linda Ronstadt, Fleetwood Mac, and Jimmy Buffet. He is equally at home with a range of musical genres – folk, pop, gospel, jazz – and from upbeat storytelling and touching ballads to full orchestra performances. In addition to his performance schedule, Livingston has been a full professor at Berklee College of Music for 30 years, passing on the extensive knowledge gained from his long career on the road to the next generation of musicians. Liv is an airplane-flying, motorcycle-riding, singing storyteller, delighting audiences with his charm for over 50 years.

CONFERENCE SCHEDULE **THURSDAY, OCTOBER 21**

WORKSHOPS / PANEL DISCUSSIONS

Room	IS 203	IS 205	IS 105
1:30 pm	W1. What Engineering Looks Like in PreK-12 STEM	W3. Quantum Computing	PD1. Hybrid & Remote Delivery: Lessons Learned, Future Outlook
3:15 pm	W2. Inclusive Pedagogies for the Undergraduate STEM Classroom	W4. Remote Instrumentation for Hybrid Delivery: Case Studies	PD2. Delivering Hybrid/Remote Labs in Chemical Engineering

4:45 pm Optional Tour of Mechanical and Materials Engineering Department Experimentation Lab - Meet in Innovation Studio Lobby

5:00 pm WELCOME RECEPTION — Higgins House Courtyard

FRIDAY, OCTOBER 22

8:30 am CONFERENCE OPENING | WELCOME REMARKS — Campus Center Odeum (2nd floor)

PAPER SESSIONS

Room	IS 203	IS 205	IS 105
8:45 am	1. Social Justice / Diversity - Equity - Inclusion	2. Engineering Education: Leveraging CS	3. Remote / Hybrid Lessons Learned: Hands-On Lab Experiences
10:30 am	4. Engineering Education: Equitable Student (and Faculty!) Evaluation	5. Engineering Education: Theory to Practice	6. In-Person Lab Experiences

12:00 noon LUNCH KEYNOTE: Dr. Pamela McCauley — Campus Center Odeum (2nd floor)

PAPER SESSIONS

Room	IS 203	IS 205	IS 105
1:30 pm	7. Project Based Learning for Social Justice	8. First Year	9. Remote / Hybrid Lessons Learned: Civil / Environmental Engineering
3:15 pm	10. Project Based Learning	11. Future of Work	12. Remote / Hybrid Lessons Learned: Mechanical Engineering

5:00 pm DINNER KEYNOTE: Livingston Taylor — Campus Center Odeum (2nd floor)

SATURDAY, OCTOBER 23

STUDENT PAPER SESSIONS

Room	IS 203	IS 205	IS 105
8:30 am	13. Engineering Education: Social Justice	14. Sustainability and Green Engineering	15. Engineering Education & Capstones

10:00 am LIGHTNING TALKS — Innovation Studio Amphitheater (1st floor)

STUDENT POSTER SESSION

Room	Innovation Studio (2nd floor)		
10:30 am	Engineering Capstones	K-12 STEM Outreach	DEI / Social Justice
	Hybrid & Remote Learning	Project Based Learning	Sustainability

12:00 noon AWARDS LUNCH Best Paper and Campus Rep Awards; Best Student Paper, Poster — Campus Center Odeum (2nd floor)

1:30 pm ASEE-NE2021 Business Meeting — Campus Center Hagglund Room (2nd floor)

ASEE-NE CONFERENCE

ORGANIZING COMMITTEE:

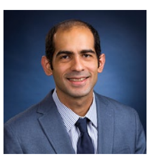
John McNeill
Bernard M. Gordon Dean,
School of Engineering,
Worcester Polytechnic Institute

Funmi Ayobami
Assistant Teaching Professor
Biomedical Engineering,
Worcester Polytechnic Institute

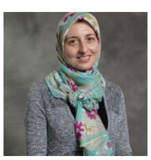
Paul Crilly
Professor,
Electrical Engineering
US Coast Guard Academy

Chrys Demetry
Professor, Mechanical & Material Engineering
Director, Morgan Teaching & Learning Center
Worcester Polytechnic Institute

Tooran Emami
Associate Professor
Electrical Engineering, Cyber Systems
US Coast Guard Academy



Soroush Farzin
Assistant Professor
Civil & Environmental Engineering
Worcester Polytechnic Institute



Afsaneh Ghanavati
Assistant Professor
Electrical & Computer Engineering
Wentworth Institute of Technology

Anuja Kamat
Associate Professor
Civil Engineering
Wentworth Institute of Technology

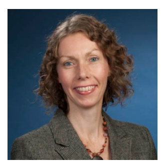
Stephen Kmiotek
Professor of Practice
Associate Dept Head, Chemical Engineering
Worcester Polytechnic Institute

George Pins
Professor and Associate Head,
Biomedical Engineering,
Worcester Polytechnic Institute

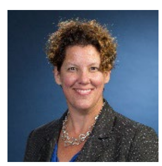
Abhishek Kumar
Assistant Professor,
Mechanical Engineering
Wentworth Institute of Technology

Hadi Kazemiroodsari
Assistant Professor,
Civil Engineering
Wentworth Institute of Technology

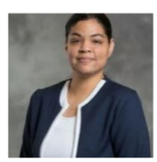
Suzanne LePage
Senior Instructor,
Civil, Environmental, & Architectural Engineering
Worcester Polytechnic Institute



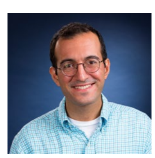
Fiona Levey
Associate Teaching Professor,
Mechanical & Material Engineering
Worcester Polytechnic Institute



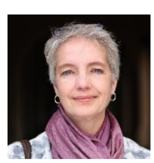
Elizabeth Lingo
Assistant Professor,
WPI Business School
Worcester Polytechnic Institute



Marisha Rawlins
Assistant Professor,
Electrical & Computer Engineering
Wentworth Institute of Technology



Ahmet Can Sabuncu
Assistant Teaching Professor,
Mechanical & Material Engineering
Worcester Polytechnic Institute



Kristin Wobbe
Professor, Chemistry & Biochemistry,
Director, Center for Project Based Learning
Worcester Polytechnic Institute

WORKSHOPS

W1. What Engineering Looks Like in PreK-12 STEM - and How Higher Education Can Support 1:30pm
Martha Cyr, Kathy C. Chen, Room IS 203
Worcester Polytechnic Institute

In order for higher education to effectively support PreK-12 STEM curriculum development and implementation, foundational knowledge of the Science & Engineering Frameworks and current research-backed resources are needed, as well as the recognition of the expertise and assets that PreK-12 educators have. This workshop provides a brief historical overview of PreK-12 STEM and then focuses on what is currently happening with engineering in the classroom today. Educators and researchers continue to innovate, test, and evaluate new and effective ways to include engineering concepts in the PreK-12 curriculum. A variety of these resources are used by teachers, schools, and state level standards committees. For the classroom, these resources range from pre-developed, individual engineering activities to full, multiyear curriculum. What is currently recognized is that understanding and working with PreK-12 educators often leads to successful engineering implementation and student learning.

A few of the quality, pre-developed materials include: teachengineering.org, PBSLearningMedia.org, Engineering is Elementary, Seeds of STEM, Project Lead the Way, and e4usa (Engineering for Us All). Guidance for implementing high quality engineering can come from the Next Generation Science Standards (NGSS) and the new Framework for P-12 Engineering Learning that is supported by ASEE.

The post-secondary (i.e., higher education) community can learn tremendously from PreK-12 Science & Engineering frameworks and researched-based curriculum resources. Furthermore, higher ed faculty need to understand the constraints and assets of PreK-12 teachers and the PreK-12 education system, especially if they desire to broaden the participation in STEM and include PreK-12 activities as their "broader impacts" in grants. This workshop will include small breakout groups to review and discuss PreK-12 STEM resources they would like to explore in more depth, and provide strategies in how to engage with the PreK-12 education community as part of engineering education research and service in higher Ed.

W2. Inclusive Pedagogies for the Undergraduate STEM Classroom 3:15pm
Rachel Gabriel, Connie Syharat Room IS 203
University of Connecticut

This session aims to empower faculty to consider the implications of a set of standards for inclusive pedagogies developed for postsecondary STEM classrooms. These Inclusive Standards (I-standards) were collaboratively developed by engineering faculty as they piloted and engaged in professional learning communities focused on the implementation of Universal Design for Learning and Universal Design for Instruction guidelines. Designed with undergraduate STEM courses in mind, the I-Standards outline opportunities and challenges associated with increasing access and inclusive practices with regard to neurodiversity among learners. Participants will view examples of the standards as applied in undergraduate engineering courses and have an opportunity to explore the implications of these standards in their own teaching frameworks.

W3. Quantum Computing 1:30pm
Liz Ruetsch, Quantum Engineering Solutions Manager Room IS 205
Keysight Technologies

Quantum Science is no longer a niche research area. As universities ramp up quantum courses, Keysight brings e-learning courses designed for engineers tasked with solving the challenges of quantum systems. Liz leads a team focused on the Quantum Computing, Quantum Sensing, and Quantum Communications markets. She will introduce Quantum computing and walk through the current state of quantum engineering.

W4. Remote Instrumentation for Hybrid Delivery: Case Studies 3:15pm
Taylor Varner, Channel Field Engineer Room IS 205
Keysight Technologies

Keysight's industry-ready remote access lab solution offers you a convenient way to provide remote learning ECE students access to industry-grade hardware. We will look at how some universities are continuing to use remote accesses to labs in a post COVID world. This workshop will also look at ways to easily adapt programs to keep up with the fast-evolving technology industry with Keysight's educational resources.

PANEL DISCUSSIONS

PD1. Hybrid and Remote Delivery: Lessons Learned and Future Outlook 1:30pm

Andrew R. Teixeira
Worcester Polytechnic Institute

Room IS 105

In this panel, we will discuss technological implementations of new pedagogical delivery methods for traditional classroom content. Particular emphasis will be made to evaluate the new types of learning tools that were developed in response to the COVID-19 pandemic, including fully remote, hybrid and in person (socially distanced) approaches. Both successful and unsuccessful implementations will be discussed. Finally, looking beyond the pandemic, tools and content delivery methods brought about by the pandemic will be discussed through the lens of good pedagogical methods. Changes to how we teach will be considered, specifically in regard to which tools will stay around, what the observed benefits are, and how that may lead to superior learning and a more equitable teaching landscape.

PD2. Delivering and Teaching Hybrid/Remote Chemical Engineering Labs 3:15pm

Laila I Abu-Lail
Worcester Polytechnic Institute

Room IS 105

Teaching laboratories is an essential component of chemical engineering education. They are designed to help students think critically about chemical engineering principles and practices by planning and execution of experimental work followed by reflection, analysis, and interpretation of data. However, operating teaching laboratories with social distancing measures poses significant logistical and safety challenges, and alternative modes of delivery could be a realistic way forward in adapting engineering curricula to the post COVID-19 world. This paper is aimed at identifying common approaches and strategies implemented in transforming hands-on labs into hybrid, virtual or remote operation to achieve desired learning outcomes without compromising student self-value. In the hybrid (a combination of remote and traditional lab components) lab, hands-on experiments were performed with half capacity. Face-to-face students worked with their remote partners using technologies such as Microsoft Teams, Zoom, PTZ cameras, and augmented reality. In the remote lab, hands-on experiments were replaced with various types of virtual tours of the equipment, a detailed description and illustration of its operation, and analysis of real data (previously collected). The value of these approaches is being assessed based on learning outcomes. Best practices from this experience can be seen as a great incentive to further develop hybrid teaching approaches in engineering laboratories.

Session 1: Social Justice/Diversity-Equity-Inclusion (DEI) **8:45am**
Session Chair: Funmi Ayobami **Room IS 203**

1.1 Social Determinants & Engineering Design: Teaching the Medical Case (WIP),

Brenton Faber, Worcester Polytechnic Institute

In 2019, just before the COVID-19 pandemic interrupted business-as-usual, WPI embarked on an innovative experiment to place a humanities professor in the department of Biomedical Engineering. The goal of this experiment was to enhance undergraduate exposure to technical communication, ethics, and what has been called the *social determinants* that influence engineering design. This work-in-progress paper will report on early results from this experiment. Specifically, the report will focus on the use of interactive medical cases as a pedagogical method to integrate communication, ethics, and social determinants in biomedical design education.

According to the Centers for Disease Control and Prevention, the social determinants of health are "conditions in the places where people live, learn, work, and play that affect a wide range of health and outcomes." These conditions include healthcare access and quality; education; economic stability; neighborhoods, geography, and built environments; and social communities.[1] Writing in the *New England J. of Medicine*, Holmes et al. argue, "when chronic conditions are viewed as solely biologic or behavioral malfunction, the diagnosis misses the true causes, and often, misdiagnosis leads to ineffective treatments."[2] While the focus of most research in this area has been in medicine, issues like technology adoption, patient adherence, access and quality of healthcare, and patients' social and built environments can also keenly influence engineering design and implementation.

Over the past two years, we have been experimenting with using medical cases as vehicles for introducing biomedical engineering students to these topics and their application for design. As interactive participants and later as authors of their own medical cases, students integrate their medical (anatomy/physiology) and technical (materials, systems, devices) learning within curated contexts that force an exploration and understanding of specific social determinants. The cases also require attention to technical writing and design as the cases blend and integrate material from across the curriculum.

This work-in-progress paper will articulate how the medical case can be deployed as a pedagogy, present a specific case, and demonstrate educational goals embedded in the case design. The paper will also provide resources for cases that specifically address social determinants. The presentation/poster will provide an interactive medical case, deconstruct the case creation to show how specific teaching points related to biomedical design can be embedded and deployed as learning objectives, and emphasize the ways the case integrates multiple ABET requirements for engineering education.

1.2 Relational Justice & Collaborative Self-Determination in Engineering Education (WIP),

Chinmay Mahabal, Feyza Achilova, Dr. Shakhnoza Kayumova, Eleanor Richard, UMass Dartmouth

The value of collaborative work in science and engineering education is well established. Research highlights the unique benefits of collaborative learning and joint-activity, such as social, cognitive, and disciplinary skill development, as well as cross-ethnic communication among varying cultural groups, races, genders, and ethnicities (Boaler, 2008). In sciences and engineering, collaborative learning environments are also recognized to be an important space for developing 21st century skills needed by all young people (National Research Council, 2015). However, research shows that initiating and maintaining equitable and productive joint activity, especially heterogeneous classrooms, can be complex and difficult to achieve (Shah & Lewis, 2019). That is, joint activity and collaborative learning is mediated by social interactions and the relational context by which subsequent social and cognitive engagement and cooperation are achieved (De Abreu, 2000). However, social interactions and relational contexts are not neutral and "can be loaded with issues of identity related to both the self and one's partner" (Barron, 2003, p. 311). Thus, research shows that working in groups has the tendency to existing social hierarchies and "exacerbate status differences" among students by creating the need to rank and codify abilities in order to assign roles and tasks to individuals. This leads to categorizations which can include students from culturally and linguistically diverse backgrounds or students whose cultural repertoire or participation patterns may differ from a dominant group, thus transforming collaborative environments into potentially threatening and isolating spaces. That is collaboration involves complex cognitive and social processes such as "adaptability, perspective-taking, improvisation, self-regulation, and problem solving skills" (Alcalet al., 2018, p. 137), but if there is no symmetrical relation , or what Baoler (2008) refers to as "relational equity", then it is difficult to achieve joint activity. In this study we report on a research conducted with multilingual young people from Black and Brown communities residing in Southcoast Massachusetts. The study is based on a larger longitudinal research which examined the relationship between language and science and engineering identity development among middle school students from multilingual Black and Brown communities (also known as English language learners). Drawing on qualitative methods of data collection and analysis, such as video recordings of the classroom events, interviews with students, and classroom observation, we report on how joint activity was accomplished among multilingual young people and English speaking teachers in the context of engineering learning. Grounding our analysis on what we call collective self-determination, our findings demonstrate how relational equity is achieved among students-students and teacher-students, and how students and the teacher mobilized their resources to co-author their engineering designs. Our finds showed that two different types of emergent processes of collective self-determination were present, parallel and series. We provide examples of two different cases (case 1 and case 2) demonstrating how relational equity and joint activity were accomplished as a collective self-determination of students who mobilized their linguistic and cultural resources, while sharing flexible roles and sophisticated communication and coordination with each other and the teacher. The images have attached in the supplementary document.

1.3 Case Study of Nepal: Opportunities & Challenges COVID-19 Era During Online Education *(WIP),*
Saurav Basnet, Amir Poudel, Wentworth Institute of Technology

Following the nationwide shutdown of educational institutions (that started from 24th March 2020) due to COVID19 pandemic, institutions have been offering its classes via online platform. With more than a month into the online model, the case study was carried out to identify the existing challenges and opportunities for achieving the planned teaching outcomes. Personalized as well as group interviews were carried out to understand the situation. The study mainly adopted qualitative approach mainly using tools such as focus group discussion and key informant interviews. It was seen that initial phase of online education faced numerous challenges developing in countries like Nepal- lack of proper internet connection in remote part of the countries, difficulty in teaching modalities, ensuring proper participation in the class, measure students' performance was highly constrained due to limited interactions. The issue was mainly seen for classes with quantitative contents (such as maths, economics etc.). The findings presented from this case study is relevant to many colleges and universities in Nepal. Based on the recommendation provided from this study, National college adjusted many of its education modality.

1.4 Development of a Virtual Internship in Biomedical Engineering to Increase Access & Inclusion of Minoritized Populations in STEM *(WIP),* Olufunmilayo Ayobami, Solomon Mensah, Kristen Billiar, Worcester Polytechnic Institute

The current COVID-19 pandemic has brought to new light the disparities in the experiences of minoritized students in STEM higher education, including a lack of access to the resources needed to succeed with remote/hybrid learning. Given the pandemic, Biomedical Engineering (BME) departments have had to rethink their curriculum, pivoting from the traditional classroom setting to remote or hybrid learning. While such changes have brought some challenges in pedagogical approaches and student learning, they also provide a unique opportunity to increase access to STEM education for all students including those from minoritized populations. This is particularly crucial as many traditional internships have been cancelled due to the pandemic.

The goal of this work was to increase access for minoritized students to BME internships and associated knowledge about the BME field, engineering design, and professional development. We developed a Virtual Internship in Biomedical Engineering (VIBE) program partially modeled after the virtual program at Case Western University in 2020. The program was an 8-week team-based experience culminating in a BME design deliverable focused on global health and engineering solutions for low-resourced communities. Our recruiting strategy focused on minority students in STEM including students of color, first-generation students, women, and students from low- and middle-income countries (LMICs). Application materials were reviewed to confirm that the student was in BME or a related field, was in college, and that they provided all documents requested. Over 370 students applied, and 321 met the criteria and were accepted. Consistent with our goals, we were able to recruit a diverse cohort of students, with 26% identifying as URM, 63% identifying as female or non-binary and 47% identifying as first-generation or international.

At the start of the VIBE program, students were given multiple topic options for design projects focused on global health and were placed into 71 teams based on their project preferences and time zones. Students were also required to attend 3 sessions each week either by joining a live Zoom meeting or by watching the session recording. In these sessions, students learned about the biomedical design process, developed their professional development skills, and networked with current biomedical faculty. Student teams also engaged with faculty to obtain feedback on their projects throughout the summer. The VIBE program culminated in a YouTube video competition where the teams created 4-minute videos describing their design process and final design. Approximately 250 students successfully completed the program. Ninety-eight percent of students who completed the program evaluation rated it as good, very good or excellent. Further, this program increased access to minoritized populations. Although the landscape of virtual learning has its challenges, we believe that virtual internships can be a way to increase access and inclusion in STEM. In this paper, we will highlight the steps taken to develop the VIBE program, detail its structure and examine its successes, challenges, and opportunities for improvement. Our hope is to inspire other institutions and departments to consider developing their own programs to increase access, inclusion, and a sense of belonging in minoritized populations in STEM.

1.5 Challenges & Opportunities Teaching Diverse Students During COVID-19 Pandemic *(LT),*
Jonathan Mellor, UMass Dartmouth

The COVID-19 pandemic poised a number of unique and sudden challenges for students and faculty alike. The sudden switch to online education was difficult for many students who had to balance their domestic responsibilities with their education. The transition was especially difficult for first generation students and students from traditionally underrepresented groups. Many of these students live with extended family members in smaller houses, have young children at home or must work during the school year to pay for their education. In this lighting talk I will highlight some of the strategies I used to help such students excel during the pandemic.

Session 2: Engineering Education: Leveraging CS **8:45am**

Session Chair: Paul Crilly **Room IS 205**

2.1 An Introduction to Flask for Embedded Web Applications *(FP)*

Krista Hill, University of Hartford

This paper introduces the use of Flask in an embedded Linux for the Internet of Things (IoT) special topics course provided by our ECE department. Consider that to query a device through the Internet, such as a webcam or refrigerator, there has to be a network side or web interface.

A familiar approach with larger systems is to use a web server such as Apache. Unfortunately, the point of that approach is lost on a resource limited IoT device. We chose to use Flask which is a micro-framework for web applications, written in Python. While minimalist, with the use of extensions, Flask can include additional functionality, as needed.

The course is developed for both electrical as well as computer engineering students, at the Junior level. Following the course, several of our seniors have also used Flask in their capstone project.

The system each student uses is a Raspberry Pi running Linux and is operated headless, meaning that the system does not have a video display, keyboard, or mouse. Rather the systems are accessed from a host PC, through a computer network or serial port. The web applications our students write make use of I2C devices such as an analog to digital converter as well as digital logic signals.

As an introductory course, a decision was made to emphasize few languages. The primary programming language is Python. There are also basic uses of HTML and a small amount of Bash shell scripting.

To summarize, our students use Flask to develop embedded web applications. Based on our impressions, the special topics course was well received, and consideration will be given to make this into a permanent course.

2.2 Code for Thoughts: Teaching Programming Courses in a Post-COVID World *(FP),*

Wei Wei, University of Connecticut

Many students chose remote learning during COVID. While most students will return to campus in person in Fall 2021, dynamic pandemic conditions still lead to uncertainties and call for educational methodology that is highly effective in engaging students in learning. In this paper, we report our experience of “Code for Thoughts”, a practice that we developed for programming-heavy courses in Computer Science and Engineering at the University of Connecticut. The main idea behind “Code for Thought” is to break down the learning into small steps, gradually easing students into solving more difficult problems by reinforcing the concepts timely and frequently and building up their skills as well as confidence. Specifically, it includes small programming assignments given to students immediately after a class (e.g., we gave 30 “Code for Thought” assignments in a Data Structure course in one semester). Each assignment is tied with the content just covered in class, with only one or two lines of code for students to fill in to complete the task, and was designed to be interesting (e.g., based on intriguing games, puzzles, or math problems) to engage students. These small “bite-size” exercises provide students opportunities to immediately practice what they learned soon after a class and coding examples written by the instructors. We use data collected from several offerings enhanced with this practice to demonstrate its effectiveness in stimulating students learning and helping them to gain confidence. We believe it can be particularly effective in teaching programming courses in post-COVID engineering education.

2.3 Digital Twins in Mechanical Engineering Classrooms *(WIP),*

Abhishek Kumar, Xiaobin Le, Wentworth Institute of Technology

Digital twins are understood as digital replica of physical models whose behavior can be observed simultaneously (digitally and physically) in real time. These tools are increasingly used in advanced industries for several purposes. The digital representation provides both the elements and the dynamics of how an Internet of Things (IoT) device operates and lives throughout its life cycle. Despite its complexity, the materialization of these digital artifacts in their simplest form implies the use of a threefold technology: sensors, data acquisition systems (DAS) and graphical user interfaces (GUI). I am working on to develop curriculum changes so that we can incorporate these concepts in our courses. Courses where these can be used is Mechanics of Material, Dynamics, Simulation based design and our capstone projects.

3.1 On a Hybrid Delivery Approach to Science and Engineering Courses *(FP),*
Basile Panoutsopoulos, Community College of Rhode Island

Two courses were partially delivered and are planned to be delivered on a hybrid approach. The hybrid approach consists of remote and face-to-face delivery of the same course. The structure of the courses under consideration is Lecture (3 hours) – Recitation (1 hour) - Laboratory (3 hours). The course Lecture and Recitation are combined and delivered in two days: a two- hour remote meeting on one day and a two hour face-to-face meeting the other day. The Laboratory follows immediately after the face-to-face meeting and it is face-to-face itself.

This proposal suggests the remote delivery of the part of the course that includes only half part of the Lecture and half part of the Recitation and the Face-to-Face delivery of the other half of the Lecture part and the other half of the Recitation part of the course that coincides with the Laboratory Face to-Face delivery.

Discussions took place many times with the students on the preferable mode of delivery during the Corona Pandemic (Second half of Spring 2020 – Summer 2020 – Fall 2020 – Spring 2021 – Summer 2021) when the courses were offered either totally Remote for both Lecture/Recitation and Laboratory or Remote for Lecture and Recitation, and Hybrid for the Laboratory. The Hybrid Laboratory consisted of alternating Half Remote Sessions and Half Face-to-Face Sessions.

Students consistently agreed that the preferred format of the laboratory must be face-to-face. For the Lecture/Recitation their replies can be summarized as “You solved problem and we follow over the web and we have a dialogue and asked questions. It does not make big difference the mode of delivery of the course: Remote or face-to-face.”

For one of the courses (ENGR 2150/ENGR 2151 Engineering Physics II/Engineering Physics II Laboratory) the Remote Laboratory part consisted of Experiments Remotely performed by the instructor in his personal laboratory space using the laboratory equipment that he had borrowed from the school.

The face-to-face laboratory part was consisting of the regularly scheduled and selecting the more involved with respect to laboratory equipment experiments. For three out the thirteen topics discussed (DC Electric Current/ Resistance – DC Electric Circuits - AC Electric Current and Circuits) simulation was provided using a free, open-source electric circuit simulator.

For the other course (ENGR 2620 / ENGR 2621 Linear Systems and Electric Circuits for Engineers/Electric Circuits Laboratory) the laboratory is two credits, four hours. The laboratory experiment is split in two parts: The Remote and face-to-face. The Remote Laboratory was used to analytically solve the problem under consideration in the experiment and then simulate it. The Analytical and simulation results must agree. The face-to-face laboratory part was used for the hands-on practical realization and measurements. The comparison of the analytical, simulation, and experimental results was left as an exercise to the studious student and part of the Laboratory Report.

Laboratory Kits – Various companies offered Laboratory kits for the General Physics and Engineering Physics I. Although it is a nice attempt to offer something from nothing under the pandemic conditions, it is far from a replacement of the real Laboratory in school experiment. The cost, the space, the nature of the equipment makes it impossible to delivered prepackaged experiments. The need of a technician to install, maintain, and service the equipment is irreplaceable. One of these sets of experiments was used in a General Physics class (Summer 2020). It is the opinion of this author that the experiments were too simplistic while other important topics totally missing.

Laboratories are not Simulations. Simulation has its own important place in the analysis and synthesis process but at the end the structure under consideration is build and measurements made to verify the analytical and simulation results and to provide the performance characteristics of the real structure. The real structure, the physical structure can never be modeled in and always a model is an approximation of the real structure.

Simulation sites are widely available on the web written by people or over around the world. Some companies offered a simulation approach along with experiment kits. Although computer simulation has its value in the overall education it does not replaces the laboratory measurements. It is only part of the Analysis/Synthesis – Simulation – Measurement’s trilogy of the complete study of a phenomenon. Problems with either exact or non-exact analytical solution can be simulated.

The environmental aspects of the hybrid approach must not be neglected. The patterns of either less transportation from home to school and back from school to home or from home, to work, and back to home will be eliminated or reduced contributed less pollution. The saved time could be effectively used to study.

3.2 Personal Learning Devices & Remote Labs: Applying What We Learned In Pandemic To Post Pandemic Education *(FP)*
Jay Weitzen, UMass Lowell

University of Massachusetts Lowell ECE has been one of the early adopters of personal learning devices in our teaching laboratories. Students purchase the Analog Discovery Kit (ADK2) as first year students and use it throughout their engineering education. This device, when connected to a laptop computer, provides students with the equivalent of a standard lab bench consisting of two channel oscilloscope, function generator, logic analyzer, voltmeter, and power supply. The software GUI emulates the functions of standard lab equipment. Prior to the Covid shutdown, students used the ADK as a supplement to their standard lab benches to work on circuits and electronics laboratories either at home or in the lab. We were one of the first schools to directly integrate personal learning devices such as this into our laboratory curricula.

Then came the Covid shutdown in March 2020. Within a week, we instantly switched from a hybrid lab bench/ADK centric lab curriculum to one totally based on the ADK. For the next 1.5 years we operated in a remote lab format in which students purchased the ADK, we shipped to them a parts kit, and we performed the laboratory exercises over zoom in a virtual lab setting. In fact, our junior cohort will be showing up this fall, never having been physically in the lab.

Unlike many schools that shifted to a “simulation” based laboratory curriculum we maintained a fully hardware centric lab curriculum throughout the pandemic. Students performed basically the same lab exercises remotely that they would do in the lab. We demonstrated our personal learning device-based curriculum in a number of ECEDHA lab manager workshops, and many schools emulated what we were doing. In this paper we will share some key findings that we will take as we enter a new phase of the pandemic with students returning to campus and the lab (at least for now).

Our general observation is that remote labs can work, just like flipped classes work, just not for everyone. We will discuss our plan for re-integrating personal devices with conventional labs and dealing with the fact that our junior cohort has never been in the lab. We will take what worked with remote labs and combine it with what works with on-campus labs.

***3.3 Creating Scenes Using OBS Studio for Streaming Virtual Classroom Over Zoom & Other Platforms** (FP),*

Maqsood Ali Mughal, Worcester Polytechnic Institute

Instructors in a regular classroom setting can rely on various forms of communication, such as facial expressions and tone of voice, which help guide facilitation of student learning. However, establishing a strong teaching presence for blended and online learning environments differs markedly from doing so in a face-to-face classroom. The idea behind this project is to improve student engagement and creating an environment that increases student participation during a virtual class. The goal is to deliver a high-performance real-time video/audio capturing and mixing, creating scenes comprised of multiple sources including window captures, images, text, browser windows, multiple cameras, videos and much more. This will allow us to set-up number of scenes for a class one can switch between seamlessly via custom transitions. In this paper, we demonstrate how instructors can customized scenes using OB Studio for different engineering classes and laboratories as well as setting-up hardware.

***3.4 Leveraging Internet of Things to Enable Remote Experimentation** (WIP),*

Kerri Thornton, Jordan Jonas, Ahmet Can Sabuncu, Worcester Polytechnic Institute

This Work in Progress paper studies one of the major challenges in online education. Enabling experimentation on an at-home basis is a current challenge in online education. Numerous modalities were developed for enabling remote experiments. Virtual experiments that simulate the physical experiment *in silico* are used to facilitate remote laboratories. Virtual and augmented reality technology also supports remote laboratories. Take home kits are also utilized to teach experimentation. In this modality, students use low-cost equipment to conduct experiments off campus. While students are able to “create” more in this modality, the experimental designs are bound by several factors, including cost, infrastructure, and space. Experiments that require expensive equipment with special infrastructure to support them is not possible at-home conditions. Therefore, there is a need for low-cost ways to facilitate laboratory exercises that cannot be completed at-home. The goal of the work-in-progress paper is to leverage Internet of Things (IoT) technology to remotely control an experimental setup. Our solution is cost effective at less than $130 for our first experiment, which includes significant options for dynamic experiments and control. Specifically, our remote lab is an evaporative cooler designed to teach students about psychometrics, the thermodynamics of atmospheric air. Students remotely collect data from temperature and humidity sensors, located on up-and downstream of an evaporative material. We also provide students with the ability to control a fan which will blow air through the evaporative material. In order to parse and display the data our sensors will collect, we have chosen to use the inexpensive open source IoT platform, Thingsboard. This software allows students to view constructed dashboards that include the ability to remotely control devices, view live data as both plots or live numbers, and even allows students to download any data in spreadsheets for further analysis. The two sensors and fan are both connected to two Arduino MKR 1010 microcontroller boards in the experimental setup. These inexpensive microprocessors are able to connect to the Thing board service which students will use to collect data. Finally, to facilitate a live view of the experimental setup, a Raspberry Pi is streaming a live video feed of the entire circuit while it is at work. Ultimately, we hope to match the trend of increasingly prevalent online learning with a low-cost solution where students can learn nearly hands-on experimentation while also learning invaluable skills in the world of IoT and cloud computing.

Session 4: Engineering Education: Equitable Student (and Faculty) Evaluation **10:30am**
Session Chair: Chrys Demetry **Room IS 203**

***4.1 Combining Take-Home and In-Person Exam for Improving Student Performance** (FP),*

Pilin Junsangsri, Marisha Rawlins, Wentworth Institute of Technology

This paper presents a methodology to evaluate students' performance by combining take-home exams with in-person exams. Summative assessments, such as course exams, are an essential part of higher education since it tests whether students are meeting the learning outcomes. These assessments are typically in-person, strictly timed exams. An alternative, take-home exams, have been growing in popularity with the introduction of online degrees, and certainly during the recent pandemic. Take-home exams give students more flexibility and a less stressful exam experience, however, these exams are problematic since they offer students an easier opportunity to collaborate with other students. In order to minimize the temptation to collaborate with others, the instructor in this study combined the take-home exam with an in-person exam. Students were aware that they were not allowed to collaborate during the take-home exam, and that there would be an in-class assessment where they must demonstrate that they understood the material on the take-home exam by answering similar questions.

Subjects of this study were sophomore engineering students who took a programming course, and junior engineering students who took traditional lecture courses. In this study, students must submit their take-home exam before working on their in-person exam. The take-home exam is open-book while the in-person exam is closed-book exam where they demonstrate their work directly to the instructor. Questions in the in-person exams are similar to questions in their take-home exam. Results of this study show that this method increases students' performance in class. They tend to do well on both exams and their scores on both exams are very close. This methodology reduces the number of exam collaborations in the take-home exams, and this method can be applied to both programming classes and traditional lecture classes.

***4.2 Development of Web-service Exam to Improve Integrity of Remote Assessment** (FP),*

Douglas E. Dow, Wentworth Institute of Technology

COVID-19 and remote learning challenged the integrity of exams. At-home, unproctored, and web-based exams resulted in increased reports of a subpopulation of students engaging in exam-taking tactics outside of the rules, restrictions and limitation systems that were intended to ensure independent student work without unauthorized references or help. Students could copy and paste a question into a web-service that would provide an answer, possibly after a prolonged delay. Multiple Internet connected devices thwarted lock-down methods and enabled communication and access to web assistance. The examination methods provided by typical learning management systems (LMS) did not seem adequate to ensure exam integrity. Without exam integrity, the following are diminished: the motivation for learning, the correlation between achieved competency and grade, and the value of the academic transcript or diploma. Certain inadequacies of LMS examinations methods that appeared to need immediate attention included the following. Allowing cut and paste of questions that eased web-based searches or assistance. Lack of timed questions that enabled prolonged results of web-based searches or assistance to be returned and used for the same question. This paper will report an attempt to address some of these issues in the development of a custom web-based examination service. A Google Sheets web-service was programmed, utilizing the programming languages of Google Apps Script, HTML and JavaScript. The exam web-service was suitable for certain types of questions, similar to multiple choice, so not appropriate for all scholarly assessment. The following features were intended to reduce the ease of unauthorized assistance. The questions were presented as an image, so more difficult to cut and paste. The student was only allowed a certain amount of time to answer a question to minimize use of web-assistance that would require more time for a response. Each student received the questions in a different order to minimize the ability of students to take the test "together". Some limitations in the prototype included only allowing single-character answer and not allowing backtracking to review a previous question. The prototype of this developed web-service exam was utilized over 3 semesters in multiple courses. The results of this exploration will be presented. Development of new methods of student assessment that minimize unauthorized, and web-based assistance is necessary to maintain the value and quality of formal education.

4.3 Real-Time Smart Feedback System for Effective Course Evaluation *(FP),*

Salem Othman, Marisha Rawlins, Afsaneh Ghanavati, Wentworth Institute of Technology

Gathering formative feedback from students in the classroom contributes significantly to learning and teaching excellence as well as students' success in higher education. The feedback obtained from course evaluations are multi-purpose and are typically used to improve the content and pedagogy of the courses. The mainstream, end-of-the-semester course evaluation system that exists in universities, colleges, and educational institutions although provides the necessary formative feedback, is not free of flaws; namely that it is usually performed once per semester, is complex in nature, and any improvement resulting from it is not applicable to its related semester. In this work, we propose an anonymized course evaluation system that allows students to submit their feedback at any point of the semester. The collection of this continuous feedback will cause appropriate modification to the course material and method of information delivery to the students, benefitting the current and future students of the course. A survey including over 40 students was conducted to confirm the simple and adaptive nature of the proposed system. Over 75% of students who participated in the survey concurred that the system was easy to use, that it was not distractive, and that communication with the instructor could be strengthened whilst using the system.

4.4 Crisis Teaching In 2020 Has Improved Our Next Decade in the Classroom *(FP),*

Anuja Kamat, Lamberchts James, Wentworth Institute of Technology

In March 2020, when we all went online due to the pandemic, we had to rethink our teaching strategies, goals and so many other factors. We would not want to call it online teaching or learning. Instead, we prefer to say it was "Crisis teaching". We were in a crisis mode of teaching and just trying to get by. However, this crisis teaching taught us many lessons which has improved our next decade in the classroom. Four examples of what we did pre-2020, during the crisis and how it changed us for the better are explained in this paper. This paper includes student insights and faculty observations as well for the four examples:

1. Physical ability vs mental agility: New Labs format developed in online learning show how to better utilize future lab time.
2. Origami and other new tools: New Labs were developed to demonstrate new structural engineering ideas.
3. Lab in a box – Sent the students materials that they used while instruction was given via zoom.
4. Teaching old dogs new tricks – Fully embracing the idea that the use of videos is an effective learning tool for repetition, rather than reading and re-reading.

5.1 Incorporation of Matching Networks Fundamentals into State-of-the-Art Technology for Electrical Engineering Designs in General and RF-Microwaves Circuits in Particular Using Smith Charts and Matlab *(FP),* Kanti Prasad, UMass Lowell

In order to conduct applied research and carry out innovation in MMIC Design and Fabrication technology, theoretical instructions in MMIC, RF, and Microwave electronics course work must integrate fundamentals in research investigations. The analytical calculations are then to be complemented with adequate graphical tools such as Smith Charts and EDA tools like ADS, HFSS, and Microwave Office. In order to validate the design from its conception to the layout stage, the final mask set has to be prepared for fabrication strategy. In Microwave Solid-State Circuits and their Applications at Monolithic stage, this basically involves the design of Input Matching Networks (IMN), Output Matching Networks (OMN) as well as the Inter-stage Matching Networks (ISMN). MMIC modeling in the design of High-Power Amplifier involves scaling transistor sizing so as to improve transistor Gain and minimize losses.

The author proposes an innovative method of inferring Smith Charts obtained in ADS and then validating them with Matlab codes in an academic setting which includes my MMIC Design and Microwave Courses. It incorporates thorough classroom understanding of (1) Transmission Line theory fundamentals, (2) MMIC Design, and (3) Smith Charts, which are of vital importance to create perfectly matched networks in the designs. A case study of designing a High-Power Amplifier involving IMN, OMN and ISMN is planned to be presented and validated using Matlab codes. ADS Simulation results of Insertion and Return losses for all the three matching networks will be presented briefly. This will assist the Engineering educators and RF circuit designers to precisely apply their Engineering education knowledge into practice for becoming innovators predominantly in the Emerging technologies focused on RF-Microwave Engineering.

5.2 Teaching "Virtual Work" in Engineering Statics by a Project *(WIP),*
Marguerite Matherne, Jahir Pabon, Soroush Irandoust, Kai-tak Wan, Northeastern University

Engineering Statics curricula in most institutes do not comprise virtual work (VW), though the subject appears in most standard textbooks. A possible reason is that it requires a shift in the approach to solve equilibrium problems. The students need to think in terms of work and energy; and derivation of solution is more mathematically intense than the other topics such as force and moment balance. However, because it introduces the important concept of stability, we decided it is worthwhile to include VW in our Statics course.

Our approach to teach VW, is to introduce a project with an experimental design and discovery. Students are asked to build a few prototypes of a composite object (a *roly-poly*) made up of simple geometric primitives (hemisphere, cylinder, cone) with different ratios in the dimensions of the components. The ratios are chosen to examine whether the composite is stable, unstable, or neutral when subject to an external force. The prototypes can be fabricated using simple materials such as ice, paper, chocolate, play-doh, wood or metal etc. readily available at home, while lathe and machining, 3-D printing, and molding are also allowed.

A horizontal force F acting at the tip, tilts the roly-poly until the axis inclines at an angle q with the vertical. A homemade force gage using strings, paper, pencil and sand / rice grains is designed and constructed at home. Students will submit final reports covering the following topics: (i) Free body diagram, (ii) Mechanical equilibrium, (iii) Center of gravity of the composite roly-poly, (iv) Potential energy formulation with and without the external force, (v) Theoretical prediction of F(t) for different dimension ratios using Matlab, (vi) Experimental force and angle measurements, and (vii) Data analysis. Video clips and photos are required to show the prototypes and force measuring mechanism. Project assessment is based on mathematical rigor, ingenuity and aesthetics in engineering design, and measurements and analysis. Interested students are encouraged to rock the roly-poly to perform simple harmonic motion and to measure the oscillation frequency and amplitude, which is a preamble to subsequent courses in dynamics. The project promotes experiential learning and arts of design and incorporates calculus-based energy method of VW into conventional Statics curriculum. A forerunner ME 2350 Statics project was implemented in Fall 2020, and an improved version is underway in Fall 2021.

5.3 Einstein-Podolsky-Rosen Experiment: An Introductory Overview *(WIP),*

Christian Bach, University of Bridgeport

The history of the Einstein-Podolsky-Rosen (EPR) experiment started in 1935 with the famous EPR paradox. In 1964 Singlare Bell at the CERN Institute at Geneva formulated the so called famous Bell Theorem that incorporates a simple statitical method to test the EPR paradox of Einstein, Podosly and Rosen. The hisotry says, that Einstein never approved the 1935 paper and never talked to Podolky and Rosen after publication without his consent. However, history tells us that the EPR paradaox and the Bell Theorem triggered the development of the now so called EPR-experiments to experimetally decide between two paradigms that have not been well defined and articulated. In this work-in-progress paper I will introduce the fundamental aspects of the EPR debate and how it fudamentally impacts engineering in particular in the fields of quantum computers and artifical intelligence (AI) where important groundbraking technical development have been accomplished by industry leaders such as IBM, Google, Tesla, GM, Bank of America, BIS, IMF, Honda, and many other large companies in the world. The aim is to prepare studetns for the new technologies to understand the very fundamentals of the technologies that will shape the future.

5.4 The Novel Hybrid Model for The Design of High Entropy Alloys *(LT),*

Yu Zhong, Worcester Polytechnic Institute

The Al-Co-Cr-Fe-Ni system has been one of the most thoroughly studied systems in high entropy alloys (HEAs) due to their promising mechanical properties. However, the prediction of mechanical properties in this system with a full composition range could be challenging purely based on experiments. In the current study, the high-throughput ab initio modeling combined with the machine learning (ML) approach is used to predict the elastic properties of the quinary FCC Al-Co-Cr-Fe-Ni HEA single crystals by using the special quasi-random structure (SQS) approach. The predictions will start with pure elements of the Al-Co-Cr-Fe-Ni system and will be continued with binaries, ternaries, and quaternary compositions. More than 100 compositions were simulated. After that, the elastic property database of the FCC phase in this system will be contoured with composition space.

5.5 The Traveling Wave Versus the Standing Wave Antenna - How They Are Different *(LT),*

Paul Benjamin Crilly, United States Coast Guard Academy

To many electrical engineers, an antenna is merely the vehicle to radiate or receive electromagnetic signals. Many of those engaged in communication systems may focus on antenna requirements such as size, gain, directionality, etc. but may not understand that there are two very different types of antennas, the Traveling Wave and Standing Wave. These types have fundamental differences in their operation and therefore, it behooves an engineer to understand these differences so they will be better positioned to make a more optimum choices in their communication system design. This paper will discuss the theory of the traveling wave and standing wave antenna, laboratory demonstrations so that students can visually observe the differences between these two types, examples of each type, where each type is used and under what conditions a standing wave antenna starts to look like a traveling wave antenna. A goal of the presentation is to provide an improved pedagogy in the theory of the two types and thereby help the instructor better able to describe the two antenna types to undergraduate electrical engineering students.

Session 6: In-Person Lab Experiences **10:30am**

Session Chair: Anuja Kamat **Room IS 105**

6.1 Use Mini Humanoid Robot Platform for Experiential Lab Activities in A Biomechatronics Course *(FP),*

Kathleen Lamkin-Kennard, Rochester Institute of Technology

The field of Biomechatronics is important for the design of devices, such as wearable robots, humanoid robots, assistive devices, or rehabilitative robots. Due to the multidisciplinary nature of the field, courses in Biomechatronics typically encompass fundamental background material in both engineering and biomedical disciplines, as well as more domain specific knowledge related to the end application areas. To reinforce this multidisciplinary knowledge, a series of team-based challenge exercises were recently incorporated into a Biomechatronics course at the Rochester Institute of Technology (RIT) using the low-cost Robotis Mini Humanoid robot. Students were required to complete task-based challenges using both the Robotis virtual platform and the physical humanoid robots. The virtual environment allowed students to do the majority of programming outside of the laboratory, thereby minimizing the amount of time required with the actual robots. As part of the challenge exercises, students needed to both complete the challenge task and describe the associated biomechanics associated with the task. Examples of challenges included hitting targets in 3D space, designing a wearable exoskeletal device to add functionality to the robot platform, or participating in a limbo contest to demonstrate balance. Student responses to the challenges were favorable and suggest that the Mini humanoid platform can be used as a relatively low-cost, engaging means of reinforcing key multidisciplinary course concepts.

6.2 Biomedical Instrumentation Lab Activities for Remote and Hybrid Delivery *(FP),*

Dirk Albrecht, Worcester Polytechnic Institute

Biomedical instrumentation applies fundamental physics, electrical circuits, and engineering principles to the detection, recording and control of biological and biomedical signals, including clinical biosensors for patient monitoring and laboratory measurements. Typically, bioinstrumentation courses are taught using in-person laboratories with commercial equipment. Recent advances in inexpensive hardware and sensors have allowed transformation of these costly, seat-limited labs into flexible hands-on experiences, scalable to over 100 concurrent students, and able to be performed both at home and in a campus laboratory. A series of hands-on bioinstrumentation lab activities were developed to lead student exploration in basic electrical circuits, dynamic signals, frequency filters, and amplifiers, culminating in a working electrocardiograph (ECG) instrument built from individual components and performing comparably to commercial devices. Students explore their heart signals under various conditions, and add features such as heartbeat detection, sound, and light feedback. Labs require minimal resources, only an inexpensive Arduino-based electronic sensor kit (<$40) and open-source recording software. A final open-ended sensor project allows students to explore their interests, learn to program basic sensor-actuator systems, and build confidence in constructing electronic systems using modern microcontroller-based circuits. These exercises have undergone refinement over the past 8 years at WPI and were successfully pivoted to hybrid and remote delivery during the past year. Student responses to the at-home labs were highly positive during both in-person and remote/hybrid formats, reflecting advantages of incorporating flexible, inexpensive microcontrollers in engaging and impactful bioinstrumentation lab activities.

6.3 Virtualizing IoT Development *(FP),*

Kriti Bhargava, Phillip G Bradford, Nandor Verba, University of Connecticut

The effectiveness of Kinesthetic learning activities as compared to traditional lecture method has been demonstrated for practical STEM programs such as Computer Science and Engineering [1]. Kinesthetic activities enable the application of theory to practice, teach the proper use of software and hardware tools, enhance understanding through experimentation, and improve communication and collaboration among peers. This is particularly important for courses relating to systems programming such as 'Hands-on IoT development' that require thorough hands-on learning. However, these courses have had to be moved to online modality over the past year owing to the COVID-19 pandemic, which invites several different challenges in effective learning. This paper discusses the challenges, lessons learnt, and opportunities in virtualizing the development of IoT systems based on our experiences of conducting three online programs: two workshops on 'Pseudo-blockchains with Virtual Raspberry Pis' at IEEE CCWC 2021 and IEEE World AI IoT Congress 2021, and a graduate course in 'WSN development using TinyOS and Contiki' in Spring 2021 at Coventry University, UK.

The aim of the workshops was to demonstrate the computation of pseudo-blockchains on Raspberry Pis. While the workshops were typically held in-person and made use of physical Raspberry Pis, the online workshops in 2021 were modified to make use of virtual Raspberry Pis using QEMU virtual machines that support ARM Raspberry Pis on MacOS and Windows 10. Similar differences were observed in conducting the online graduate course in WSN development. Typically designed for an in-person modality, the course aimed at hands-on programming of embedded systems using sensor devices such as TelosB and Firefly, which invited a range of challenges in working with physical hardware. In the online modality of the course a single physical machine, owned by the instructor, was set up with the required development environment and connected to several TelosB devices. Each student was provided access to a single device through a virtual machine session and ssh tunnelling.

Although the objectives and outcomes of the in-person and the online programs were similar, the component and component integration skills developed were very different. Whereas the in-person modality enabled the participants to physically engage with both hardware and software, the online programs did not afford physical engagement, though they offer some detailed understanding of emulating hardware. For example, in-person workshops with physical Raspberry Pis had to contend with WiFi and physical devices, SD-cards, etc. The virtual workshop pointed-to and set up a series of downloads to build many things pre-packaged. Such issues led to different learning experiences. Furthermore, whereas the long-term goals of the workshops were the same – to show the use IoT systems to simulate aspects of proof-of-work blockchains, the short-term goals differ for the physical and virtual workshop. In the short-term the physical Raspberry Pis had to communicate through the local WiFi network while the virtual Raspberry Pis had to communicate on a virtual network. On the other hand, the online programs provided several unique opportunities, through the use of virtual machines, that were otherwise difficult in in-person programs. For example, in the online workshop, it was possible to program two, three or four virtual Raspberry Pis (memory dependent). Physically adding another Raspberry Pi or two requires a trip to a specialty hardware store or even an overnight wait for a delivery. Moreover, virtual hardware cannot be shorted, dropped, or otherwise physically damaged and rebooting a VM image from scratch is easy and quick. Besides, online programs provided a platform for increased number of participants due to broader reach.

Based on our experiences in conducting the online versions of the above programs, thus far, we laid down the following best practices to leverage the unique opportunities provided by virtualized environments in our subsequent online offerings of 'Hands-on IoT development:

1. Adjust the curriculum to modify the component and integration learning skills required for a virtual environment and organize the material to best fit the duration of the program.
2. Use plug and play online platforms that reduce the task of setting up virtual environments to a minimal to avoid hindrance in learning of the actual course material.
3. Provide clear and concise preparatory material to get started with virtual environments. Vet the documents thoroughly on different operating systems before sharing with the students.
4. Make shorter lecture and demo videos to avoid Zoom fatigue [2] and make recordings of the same available to allow learning at different pace.
5. Focus on project-based learning to enhance social component of learning.
6. Check-in periodically by holding support sessions to avoid any lag in learning.
7. Conduct surveys to gather feedback on the use of online tools.
8. Encourage self-directed learning to allow the participants to continue to learn and grow.

6.4 Mechatronics Projects in Engineering Education *(FP),*

Saeid Moslehpour, Claudio Campana, University of Hartford

An automated paperclip forming machine was designed, manufactured, and programmed to potentially produce paperclips. This machine was designed topotentially produce different size paper clips with a variable control at a given rate. The system consisted of 3D printed parts, solenoids, ultrasonic sensors, a power supply, a programmable processor, on and off buttons, and a frame to house the machinecomponents. By using a generated algorithm in the program Arduino, this allowed for the machine to vary its speed based on the number of times the ultrasonic sensor is triggered by the spoke to ensure a constant feed rate. This design also consisted of another ultrasonic sensor to monitor the radius of the spool to enable the machine to turn off prior to running out of wire. There were two solenoids, one was to bend the wire and the other was to cut the wire. The last major component was two buttons that would turn on and off the machine. The desired goal of this machine was to be able to form and count the number of paperclips and once the desire amount was reached the machine would automatically turn off.

Session 7: Project Based Learning (PBL) for Social Justice **1:30pm**
Session Chair: Kristin Wobbe **Room IS 203**

7.1 Impact of a STEM Mobile Laboratory Initiative on K-12 Students in High Needs Schools *(FP),*
Nancy K. DeJarnette, Ruba S. Deeb, Jani M. Pallis, University of Bridgeport

It is well known that exposure of young students to authentic STEM experiences can lead to lifelong learning and exploration. One University and one Science Museum located in the northeastern United States have collaborated to develop and implement a mobile STEM laboratory on a 35-foot New Flyer Bus (Model D35LF) with a capacity for 23 individuals per lesson and named it STEM On Wheels. The goal of this project is to bring technical STEM lessons and hands-on experiences to urban high-needs K-12 schools. During the first-year pilot (2018-19), the team developed K-12 STEM content lessons that are NGSS aligned and enriched with hands-on activities. The STEM on Wheels bus traveled to local urban K-12 schools where they immersed students in exciting and interactive activities using technology typically not available in most classrooms. Area schools viewed the STEM on Wheels project as a vital partner in their quest to actively engage their K-12 students through hands-on learning. Participating students from all grade levels were positively impacted as they were engaged and inquired about the next STEM bus visit to their school. This case study presents data collected during the initial pilot year of the project.

7.2 The Impact of Gender and Extracurricular Activities on Retention Undergraduate Engineering Programs *(WIP),*
Kathleen A Lamkin-Kennard, Michael Schrlau, Rochester Institute of Technology

The goal of this work in progress is to use quantitative surveys to elucidate how the gender composition of participants in experiential extracurricular activities affects the development of self-efficacy in males and females and to inform how team practices and attributes improve self-efficacy and retention of female and male students in undergraduate engineering programs. The Kate Gleason College of Engineering at the Rochester Institute of Technology (RIT) hosts two automotive-based competition teams. The RIT Hot Wheelz team is predominantly female while the RIT Formula SAE team is predominantly male. Both teams have similar performance goals, but the gender composition, attributes, and practices of the teams are very distinct. Qualitative data from the predominantly female team suggests that among the key benefits of the team is that it provides an environment with psychological safety where female members can be themselves and take risks to learn new skills or take on leadership roles. Participants have also cited the team as having contributed to their confidence and identity as an engineer and as one of the reasons they remained in engineering. Survey data is being collected from at least 30 existing and 30 former Hot Wheelz and Formula SAE members to quantify demographic characteristics (including gender and race), year level, and current levels of self-efficacy. Pre-existing validated scales for measuring self-efficacy and psychological safety are being used to assess engineering and career self-efficacy. The survey data will be used to quantify differences in self-efficacy for males and females and to inform how team practices and attributes improve self-efficacy and retention of female and male students in undergraduate engineering programs.

7.3 Fostering Creativity for Neurodiverse Students through Final Projects in Statics *(WIP),*
Shinae Jang, University of Connecticut

Diversity, equity, and inclusion is a current and emergent issue to solve in our society, and it is so for academia as well. At the University we have been hard at work re-designing our courses to improve inclusivity and diversity. Through the funding from the National Science Foundation, we initiated the project, and implemented universal design of learning (UDL), also known as universal design of instructions (UDI) in our program. Under the project, a series of model courses, namely I-courses, were selected for re-design, with Statics being one of the first cohorts.
One of the major interventions in the Statics course for neurodiverse students was the final project option. Students can choose either the final exam or the final project based on their preference and individual strengths. If they choose the final project, they can then choose from two tracks; (1) the problem-solving track, where they create the problems on their own, solve them, and present, and (2) the creativity track, where they define their own project, conduct the project, and report the findings and deliverables. Students can also choose the format of the reports, including written or oral presentations. This final project has been implemented in the Statics course since Fall 2020, and continuously offered as a part of I-course.
This presentation will describe the final project development procedure, the considerations for neurodiverse students and fostering creativity, outcomes, and student feedback. To date, many students have chosen the final project option and have developed a variety of projects in both tracks. Overall, student feedback has been positive, and performance was better when compared to those who chose the final exam option. This paper is a work in progress and preliminary Academic Year 2020-2021 results will be presented to our New England division colleagues.

7.4 Social Determinants of Health and Engineering Design: Implementing a Diabetes Module into Undergraduate Coursework *(WIP)* Jeannine M. Coburn, Worcester Polytechnic Institute

This work-in-progress paper will report on early results from implementing social determinants of health (SDOH) and engineering design into an undergraduate course at Worcester Polytechnic Institute. Engineering students spend much of their time focused on technical aspects of their education to develop new technologies to address challenges. Biomedical engineers are uniquely situated at the interface between engineering, biology, and human health, though often coursework does not focus on the societal aspects that impact if patients will have access to new technologies. Access to high quality healthcare and state of the art technologies is not equal, several factors impact if a patient will have the same access as others. These factors can be defined as SDOH or “the conditions in which people are born, grow, work, live and age, and the wider set of forces and systems shaping the condition of daily life” (World Health Organization). Through learning about SDOH within the context of engineering design, students will improve their ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global and societal contexts (ABET outcome 4).

To increase student awareness of challenges surrounding access to medical technologies, a two-day module focused on the interface between technology and social determinants was developed for a drug delivery course focused on diabetes. In this two day active learning module, students learn about the technologies used to treat diabetes (focusing on type I diabetes) as well as SDOH that impact diabetes care and ultimate quality and longevity of life. Students are assigned multiple readings to prepare themselves for the technical and societal aspects of the learning activity. On day one, a brief presentation is provided to ensure students have the foundation understanding of insulin, the pancreas, diabetes, glucose monitoring, and treatment. The students break up into small groups and research a technology aspect of diabetes treatment, develop a mini presentation, and report back to the entire class what they learned. On day two, the learning experience focuses on SDOH and diabetes. The students discuss in small groups the SDOH that impact diabetic patient outcomes and access to high quality treatment options. The two-day module wraps up with a class-wide discussion on SDOH with students identifying ways in which we, as engineers, can address these inequalities. This work-in-progress will provide detailed information on this active learning modules, instructor reflection on what improvements can be made for future offerings, and the initial assessment of learning outcomes based on a student reflection assignment.

8.1 School of Engineering First-year Academy to Help Underprepared Students *(WIP)*

Quinton Swan, Quinnipiac University

To significantly improve the retention rate of first-year students in the School of Engineering at University X, First-year Academy (FA) was implemented. This academy aims to strengthen the underprepared students by helping them in three main categories: academic support, transitioning to college, and building a sense of belonging. Closer monitoring of underprepared students and developing a significant support structure can improve the success rate of underprepared students and improve the School's retention rates. The academy will be especially beneficial to women and under-represented minorities, thereby strengthening diversity in the School of Engineering.

Students in FA have access to a Peer Mentor, Faculty Advisor, Academic Coach, Peer Tutors, and a peer support structure to help navigate a successful transition into the University community. As FA works with the School of Engineering, the inclusive, excellence-driven community will grow to include a more diverse student population. Participation in FA is at no cost to the students. However, the program is the beneficiary of corporate sponsorship. The value proposition for the corporate partner is the strengthening of diversity in the talent pipeline. The criteria used to invite students included financial aid eligibility, representing family's economic strength, race/ethnicity (self-reported), high school GPA, and gender. Due to a delay in funding, only nine students participated in the information sessions and started in the academy. Our target size for next year is 20 students.

The academy began virtually in the Summer II term. In this 7-week term, the students took a 3-credit computer programming course and a 0-credit Learning Strategies course. During the seven weeks, there was peer tutoring support available. The Peer Mentor helped with study habits and general questions, as well as conducting social events aimed at cultivating a sense of community. Given the three credits completed in summer II, the students are taking 13 credits in the Fall semester. The reduced academic load, combined with the metacognition knowledge learned in the Learning Strategies course is likely to result in better performance in the remaining 13 credits.

As students begin their Fall and Spring semester, they are cohort courses to continue building their community for peer support. The Peer Mentor, Faculty Advisor, Academic Coach, and Peer Tutors will continue to interact with FA students during their first year. Academic support will be provided in the form of weekly Study Tables, and social events will foster community building throughout the first semester.

To measure the success of FA, the Fall math grades of FA students will be compared to other first-year students because performance of students in their first math course tends to correlate to their overall first-year success. Additionally, the Fall and Spring average midterm grade and GPA of FA students will be measured against those received by other first-year students. The final key performance indicator will compare the retention rate of FA students to the other first-year students. Specifically, this comparison will focus on students who were identified as high-risk, in terms of failing or transferring, at orientation, per the CSI College Student Inventory survey.

8.2 Embodying Design: Increasing Self-Efficacy Through Somatic Education *(WIP)*

Andrea Mecquel, Princeton University; Rafe Steinhauer, Dartmouth College; Jeremy D.W. Clifton, University of Pennsylvania

Self-efficacy is a known factor in academic performance (e.g., Loo & Choy, 2013) and student retention (e.g., Marra et. al., 2013) in engineering. Bandura (1977, 1997) proposes four modes to increase self-efficacy, one of which is *physiological and affective states*. Research suggests that all four pathways are correlated with academic outcomes among undergraduate engineering students (Loo & Choy, 2013), yet there are no known interventions that attempt to increase engineering students' self-efficacy through somatic education, including training students to be more aware of physiological and affective states. Purpose/Hypothesis: This work-in-progress study is investigating if embedding somatic learning in curricula increases self-efficacy in undergraduate students enrolled in engineering courses.

Design/Method: A novel six-session remote training program was developed for an introductory engineering design course that served as the initial intervention group. Each session was developed to investigate a core experience in Liedtka et. al.'s design process framework (2021): *Immersion*, *Sensemaking*, *Alignment*, *Emergence*, *Imagining*, and *Learning in Action*. Students participated in activities that both: elicited physical, emotional, and cognitive experiences commonly experienced in engineering design projects; and practiced skills to observe the somatic sensations aroused by these experiences. A course in introductory computer engineering—with enrollment of similar demographics and of similar high-popularity among students—was used as a natural control group. Quantitative data in the form of a pre- and post-survey (N=81) using the new General Self-efficacy scale (Chen et. al., 2001) was collected and analyzed. Using the General Self-efficacy Scale (GSE), a modest increase in self-efficacy was found in the intervention group

Little research has investigated the role of somatic education on self-efficacy when embedded in and in support of curricular content. We found a small but significant change in the experimental sample after receiving a somatic engineering intervention. This suggests that somatic education might increase self-efficacy when thoughtfully integrated with curricular goals yet given the theoretical underpinnings and limitations in study design and breadth, extensive further investigation is merited.

8.3 Training Innovative Thinkers: Engineering Education for the 21st Century *(LT)*
Afsaneh Ghanavati, Joshua Luckens, Wentworth Institute of Technology

Engineering education is evolving to meet the demands of a rapidly changing world. We are facing unique global challenges that require bold design approaches to craft human-centered solutions. In the 21st century, complex societal problems inevitably involve technology and cannot be addressed by a single discipline. Therefore, it is more essential than ever to train engineering students with creative problem-solving and innovative-thinking skills to design a better, more inclusive future for humanity.

Wentworth's ENGR 1500 "Introduction to Engineering Design'' is a required 1st-year course that empowers novice engineers with future-oriented skills like holistic needs analysis and collaborative design innovation. ENGR 1500 is different from classical first-year engineering curricula that mainly focus on technical skill development. Instead, this course challenges students to think outside the box, training them with a designer's worldview, and building essential skills like communication and confidence through project-based learning.

The pandemic forced ENGR 1500 from an in-person laboratory modality to the online environment of Zoom. In response, we empowered small groups of students to collaborate virtually on a series of design challenges, present their work, and provide each other with feedback to continually improve their product designs, integrating conceptual frameworks such as Lean Thinking and empathetic design.

In this lightning talk, 1) we will elaborate on our experience of re-designing the ENGR 1500 course to meet the demands of the virtual classroom, and how we will transfer those lessons learned to the design and facilitation of future in-person iterations of the course. 2) We will enumerate the specific changes we intend to make in spring 2022 to improve the learning experience. 3) We will explain how our thoughtful course design gives students increased autonomy and choice, space to fail and try again without penalty, and multiple pathways to mastery. We will articulate learning goals that integrate the development of a growth mindset to empower engineers to be lifelong learners and cross-disciplinary collaborators. 4) We will emphasize the central role of metacognition and reflection in the processes of both learning and design. 5) We will elaborate on discovery-based learning initiatives that we created, such as a series of design challenges framed around essential questions that spark genuine curiosity. We hope to inspire a vibrant conversation around the need to transform engineering education to meet the dynamic needs of the 21st century.

8.4 Widening the Umbrella in the Midst of a Pandemic: Mathematics, Statistics, and Computer Science Students Join First Year Engineering Design Course *(FP),* Courtney D Giles, The University of Vermont

Prior to emergency remote instruction in Spring 2020, the UVM College of Engineering and Mathematical Sciences (CEMS) began a significant realignment of undergraduate curricula across its Engineering (Mechanical, Civil, Environmental, Biomedical, Electrical), Mathematics, Statistics, and Computer Science programs. An early outcome of this transition was the redesign a first-year seminar course (1 cr.), previously only available to students in engineering. The proposed course (CEMS-050) would be required for all incoming first-time, first-year students (~300) and would create opportunities for students to practice key skills common to the CEMS disciplines, including technical communication, teamwork, and problem-solving. In addition, the course would introduce students to each of the College's ten academic programs, campus resources, advising, and provide opportunities for cohort-building during a semester when most general education courses occur in other colleges. In Spring 2020, feedback was gathered via department-led discussions and a multi-disciplinary working group was formed to develop the course learning objectives and assessment strategies for implementation in Fall 2020.

Course Structure: Learning outcomes focused on the Design-Thinking process, effective and inclusive teamwork, technical communication, self-reflection and bias, and the ability to leverage campus resources. A project-based structure was adopted to incorporate these learning outcomes into two projects: (1) "Micro-Design Projects", to practice teamwork and design while building simple mechanisms and structures (floating table, mechanical hand, water-balloon launcher), (2) "Semester-long Projects", in which students address a campus-based problem, posed by a partnering campus organization (Facilities, Waste, Transportation, Health and Wellness). In both cases, students voted on their desired project and were placed into interdisciplinary teams. Semester project options spanned three themes (Energy, Resources, Health) and seven specific challenges. Students presented their proposed solutions to the campus community at a final virtual poster event in December 2020.

COVID-Specific Challenges: In Fall 2020, students chose whether to attend courses entirely from home or remain on campus for in-person and hybrid courses. CEMS-050 held in-person labs, which required additional space, PPE, disinfection protocols, and specialized classroom technology to engage at-home students. Micro-Design kits were sent to at-home students and additional instruction was provided to support teamwork in mixed-modality teams. UVM's infection rate remained low during this period (0.07%) due in part to strict testing and quarantine requirements.

Lessons Learned: Overall, students across disciplines responded positively to the opportunity to engage with peers and campus partners while working on meaningful real-world problems. Student feedback indicated a strong positive impact of in-person instruction (most other courses were entirely remote). At-home students expressed some difficulty working in mixed-modality teams and many teams struggled to manage team productivity regardless of modality. Further improvements include streamlining project-planning assignments and strengthening the peer- and self-reflection components of the course. In fall 2021, we will consider the role of sense of belonging in the academic trajectory and retention of first year students.

Session 9: Remote/Hybrid Lessons Learned: Civil/Environmental Engineering **1:30pm**

Session Chair: Suzanne LePage **Room IS 105**

9.1 Enhancing Student Engagement in Civil Engineering Courses During the Pandemic Using Remote and Hybrid Modes *(FP)*

Shinae Jang, Sarira Motaref, Manish Roy, Mousumi Roy, University of Connecticut

COVID-19 pandemic enforced instructors, to shift the modalities of courses to either remote or hybrid in a very short time during 2020-2021 academic year. To assist and accommodate our students' preferred learning modes, multiple course delivery options were provided. The University of Connecticut and the School of Engineering were supportive to provide resources and tools for the instructors to make the transition. In the department of Civil and Environmental Engineering, most courses were transformed into either remote or hybrid modality for this reason. In this paper, the changes for Civil Engineering undergraduate courses with four instructors with different interventions were summarized: Soil Mechanics, Mechanics of Materials (2 sections), and Statics.

Soil Mechanics was to be taught as in-person with all COVID-19 related restrictions in place. Due to the response to a survey sent out to the students before the start of the semester prompted the instructor to opt for a dual mode of instruction. Therefore, the course was taught in an in-person setting and at the same time, it was livestreamed to students, who opted for a distance learning mode. This paper delineates the measures taken to actively engage both in-person as well as distance learning students, the challenges encountered, and the lessons learned.

Next course is Mechanics of materials, which was taught in distance learning mode. Student involvement is essential for promoting student learning and satisfaction. However, engaging students in virtual classrooms can be challenging, particularly for courses with high enrollment. Specific techniques and pedagogical strategies that were used to engage students in virtual classroom will be discussed. A mid-semester assessment was administered to evaluate teaching effectiveness including student engagement, the results for which will be presented. The Student Evaluation of Teaching (SET) highlighting students' perception of learning and satisfaction will also be shared.

Another instructor taught the Mechanics of Materials course, that was offered in hybrid modality to accommodate both in-person and distance students. Collaborative problem-solving activity during class time was offered to students to enhance peer-to-peer interactions, aligns students' progress with the class schedule, and enhances student engagement. To address complexities such as social distancing and a mixed population of learners in hybrid classes, the instructor used Google slides and breakout groups in Blackboard Collaborate Ultra to offer teamwork activity during pandemic. The effectiveness of online teamwork has been studied by collecting students' feedback and evaluating student performance in the course assessments. The results will be compared with data from in-person classes to quantify the impact of online collaborations on students' experiences.

Lastly, Statics course was taught as distance learning mode, and the active learning activities were replaced by the online clicker REEF polling activities and the chat box interaction. Because of the large class size of the Statics course (120~ students), having break-out sessions during the class time was not effective; therefore, a hybrid class size was adopted and implemented. Students met altogether as a lecture once a week, and then they met with smaller discussion sections for more in-depth problem solving and peer interaction. The students' feedback and assessment results and lessons learned will be provided.

9.2 What the Pandemic has Taught Me about Teaching *(LT)*

Suzanne LePage, Worcester Polytechnic Institute

In this lightning talk, hear about the changes made when some or all students could not be in the classroom -- and which of those changes will remain part of this instructor's course delivery.

***9.3 Pedagogical Improvements in the Delivery of Surveying Education Discovered in Responding to COVID-19 Disruptions** (WIP)*

Anthony Richard Vannozzi, Carlton Brown, Curtis Marston, University of Maine
Leonard Anderson, Wentworth Institute of Technology

Prior to the onset of CoVID-19 surveying and geomatics education was undergoing a transformation with numerous programs offering on-line or remote courses or utilizing hybrid learning models to deliver some course content on-line. For many, the content offered on-line was that focused on processing and analyzing surveying data rather than data acquisition and instrumentation. As the CoVID-19 pandemic stretched into the summer of 2020 it became clear that face-to-face teaching in the Fall of 2020 would come with severe restrictions, if allowed at all. This reality meant that surveying educators would need to re-imagine the hands-on instrumentation labs, a staple of introductory surveying courses.

In the process of redesigning their courses with: (1) health and safety restrictions, (2) the need for concurrent multi-modality teaching and/or (3) preparedness for pivoting to full online, the authors creatively re-examined decades-old field lab pedagogies. As the semesters unfolded what started as stop-gap changes, became a framework for restructuring surveying field labs for the non-pandemic future. Five (5) key initial findings were: (1) creating videos by a team made up of faculty teaching different courses, in different programs, to different majors and from different institutions, and the need for consensus that required improved the nature of the content and the plausible use of the videos by all instructors. (2) The team videography approach provided a broader base of private practice experience and teaching experience that enriched content. (3) Rethinking the traditional “lab group” to accommodate social distancing led to a more engaging student experience. (4) Streamlining assignment submissions via an LMS provides students with improved access to feedback. (5) The refocusing of labs on the most critical experiential interaction that is hands on the actual equipment, allowed for better integration of those personal experiences into students’ long-term memory for access, scaffolding and supporting theory comprehension.

The collaborating faculty are continuing the integration of the lessons learned from their CoVID-19 experiences in their Fall of 2021 teaching. It is anticipated that the improved engagement and student outcomes along with greater student satisfaction that was noted during the Fall of 2020 can be preserved and enhanced though the permanent and institutionalization of creative hybrid modalities in introductory surveying courses going forward. The collaborating faculty anticipate the preparation and publishing of detailed recommendations at the conclusion of the 2021-22 academic year but felt that sharing their experiences to date with regional colleagues at this time would be useful.

Session 10: Project Based Learning | **3:15 pm**
Session Chair: Fiona Levey | **Room IS 203**

10.1 Project-Based Engineering Competition in Upper-Level Engineering Laboratory *(FP)*
Ryan C. Cooper, University of Connecticut

In this paper, I will discuss a project-based competition in an upper-level mechanical engineering laboratory course. I redesigned the course in Fall 2018 to prepare students to make engineering decisions and accomplish design goals. My short-term objectives were to prepare the students to start their capstone projects senior year and improve technical writing. The course introduced static and dynamic beam models and experiments. The project-based competition asked students to use a cantilever beam to measure the mass of an object. The laboratory course focused on learning from failure in the form of writing exercises, peer-editing, and graded progress reports during experiments. Students spent the first 9 weeks of the course following experimental procedures and writing lab reports. In the final project-based competition, the students designed their own set of experiments including finite element analysis and experimental procedures. The students were graded upon their approach to the problem and quantification of uncertainties in measured and predicted values. I awarded a cash prize to the most accurate mass measurement. I will discuss the impacts of the project-based competition on the following year's senior capstone projects and detail the measured improvements in technical writing throughout the semesters in Fall 2018 and Fall 2019. The impacts will be measured based upon a standardized rubric and qualitative interviews.

10.2 Integrating Engineering Standards into A Laboratory Course for Both Theory and Practice *(WIP)*
Kristen Billiar, Worcester Polytechnic Institute

In this work-in-progress, we explore the use of engineering standards within a junior-level biomechanics laboratory course to both teach students about the development of standards and their use in practice. Engineering standards help engineers create efficient design and testing processes, they are important for consistency of validation and aid in market acceptance due to uniformity in across labs and companies. Due to the importance of standards in the field, ABET has long required that standards be used by students in their coursework and/or projects. However, it is often unclear how to incorporate standards most effectively into the already-packed engineering curriculum.

Senior capstone design is a natural please for students use engineering standards during validation of their design, yet simply applying standards without understanding how and why they are developed and without discussion of their importance and limitations provides only a superficial understanding. Assessment of student learning is often difficult in the context of capstone projects as well. Alternatively, an entire course on engineering standards provides the opportunity for in-depth learning but is hard to justify – what other course would be dropped from the curriculum? A third option is to incorporate engineering standards into open-ended laboratory courses in which the students learn both the theoretical underpinnings of the standards and their practical application in a (simulated) real-world context.

Herein, we describe the integration of engineering standards in a junior-level biomechanics laboratory course over two years. Why standards are needed, who develops standards, and the process creating standards are discussed in lectures and interactive sessions. The students use specific engineering standards to guide their mechanical testing of various type of materials and medical devices in a series of projects. They test the sensitivity of test parameters within the range allowed by the standards and structure how they report out the required metrics based on the requirements of the standards. As this work is a work-in-progress, analyses of student learning were not performed, and the student outcomes were not compared to a control group.

***10.3 The Impact Strength-Based Projects on Engagement of Students in Mechanics of Materials Course** (WIP)*

Sarira Motaref, University of Connecticut

The Mechanics of Materials course has been offered in flipped modality over the past few years at the University of Connecticut. This course is an entry-level course required for several engineering majors such as Civil, Mechanical, Biomedical, Materials Science, and Manufacturing Engineering. The goals of this flipped course are to improve student learning in large enrollment classes and promote inclusive teaching by providing online content to all the students. In this design, the lectures are delivered using pre-recorded videos. The in-person class time is used to present a brief recitation of the lecture material, discuss challenging concepts, and solve problems, individually or in groups.

A recent study evaluated the impact of using real-life examples by asking students share images of engineering concepts. It found that while this activity benefits learning of students, only a small group of students was motivated to actively participate. It was hypothesized that the single-domain approach relying on photography skills and interests of students is a limiting factor in broadening participation of students. In academic year of 2020-2021, a series of optional small strength-based projects were added to the course to further improve student engagement and participation. Students were able to contribute to the course based on their personal interests and expertise. Students were prompted to identify one or more areas of interests such as photography, drawing, filming, sports, programming, computer gaming, comedy, woodwork, cooking, planting, poetry, reading, and puzzles. After students identified their area of interest, the instructor assigned individual, or group projects aligned with the student interests and course content. More than 25% of students participated in this activity compared to 5% in the previous single-mode approach. The participants created unique projects that are being used as learning materials in the course. This paper discusses the observations from this pilot implementation, the impact of strength-based projects on students' engagement, and improvement in students' learning experience. A retrospective survey was used to collect students' feedback weather this activity reinforced their sense of inclusion and improved their skill related to the implementation of their knowledge in real-life problems.

Modifications were made on the structure of strength-based projects to enhance student's experience and improve the quality of the projects in the academic year of 2021-2022. The changes and expected outcomes will be discussed in this paper.

10.4 Biomedical Engineering Capstone Project - Development of Digital Stethoscope & Portable Chest-Cavity Sound Trainer

(WIP) Saeid Moslehpour, Takafumi Asaki, University of Hartford

Listening heartbeat is still one of fundamental medical practices for physicians. It is the simplest procedure, listening the sound, but it can determine a wide variety of information: the irregular heart rhythm, failure of heart valves, respiratory complications, and so on. It is obvious that identifying normal or abnormal sounds requires many hours of practice, but medical apprentices are not yet familiarized use and placement of stethoscope and the sound itself. Thus, it is considered to develop a digital stethoscope and portable chest-cavity sound training system that will be able to share the heartbeat with experienced doctors and students simultaneously. Medical Practices and trainings are highly demanded in the schools for health professionals, as well as post-professional courses. Many medical training devices have been developed and implemented in the clinical training programs. However, the training device and simulation manikins are traditionally expensive and lack of customizability. Therefore, this study was proposed and pursued by the recent technological advancements that made many cost-effective components and design approaches.

In the Biomedical Engineering Capstone and Independent Research activities at the University of Hartford, development of portable chest sound trainer has been conducting since 2020. Due to the COVID-19 pandemic brought several unique engineering designs and learning opportunities to students. Though the project has been set in mainly hybrid situation, prototypes of a digital stethoscope and heart chest sound trainer was developed. The system needs to go over more intensive testing and validation for ensuring its capability; however, it is very promising that the hybrid engineering design processes can be a unique teaching process.

Session 11: Future of Work **3:15pm**

Session Chair: George Pins **Room IS 205**

11.1 A Progressive Approach to Professional Development for New Engineers *(WIP),*

David Bowler, Sam Francois, CommScope

Investing in the development of each new generation of engineers provides tremendous benefits to both the employees and the company. Early career professional development is a combination of growing both the skill set and the credibility of a new engineer. One common approach often involves shadowing or assisting a more senior engineer, with the expectation of learning through observation and exposure. For some individuals this approach is very effective. However, for others this approach is less effective, depending on their unique skills and needs. Furthermore, remote work and the decrease in face-to-face time is a significant obstacle to early career development.

This presentation introduces an alternative approach to early career development, consisting of three key elements:

- Flipped projects for skill and responsibility development
- A targeted and guided mentorship program
- Creation of a "Promotion Resume" for building credibility

Flipped project assignments present a unique approach to skill development. In this model, the new engineer owns the project deliverable, and their more experienced colleagues assist as necessary, rather than the experienced colleague owning the project and delegating smaller tasks as they deem appropriate.

The targeted and guided mentorship program provides a two-year curriculum with four distinct modules and assigns an experienced colleague mentor to work through a series of developmental exercises with the new engineer.

The "Promotion Resume" is the building of a track record of demonstrated contributions and delivery on commitments that builds credibility right from the earliest part of their career.

This unique approach provides clear advantages for developing early career engineering talent in a post COVID world and a structure that supports engineers of a wide range of backgrounds.

11.2 Additive Manufacturing – How Did We Get Here and Where Are We Going? *(WIP)*

Theodore Greene, Wentworth Institute of Technology

Additive manufacturing (AM) is known to many as 3D-printing or rapid prototyping. Since the inception of the technology in the mid 1980's, there have been steady advances in the equipment, availability, and applications of additive manufacturing. With a strong foothold in Industry 4.0, this new manufacturing method has currently made its presence known in many different product sectors. In reviewing the 7 ASTM classifications of AM, one finds pros and cons of each process that vary based on intended application. As we look to the future, the available technology, ease of use, and viable applications are all on a positive trajectory. Though plans for the future are never 100-percent assured, the advances shown by AM is evident that the new technology will continue to find ways to complement traditional manufacturing as well as compete with it.

11.3 Examining Student Experiences in Summer Engineering Programs During the Covid-19 Pandemic *(WIP)*

Athenia Jones, Olufunmilayo Ayobami, Jessica Anne Rosewitz, Worcester Polytechnic Institute

The COVID-19 pandemic has undoubtedly affected every aspect of life. For students, the effect of the pandemic has been particularly acute in their academic and professional growth. Further, the pandemic has magnified the disparities between the experiences of underrepresented minorities (URM) and first-generation students, and their Asian and White male peers in higher education. This research aims to identify key differences in the experiences of minoritized students in their applications and success in obtaining positions in summer engineering programs.

First, we investigated how the pandemic affected students' abilities to obtain an internship, research experience, etc. in a Science, Technology, Engineering and Mathematics (STEM) field, and how their identity groups, class year and type of mentor affected their experiences in applying and success in obtaining summer internship positions.

Secondly, we investigated the differences in applications between majority and minority groups to the Virtual Internship in Biomedical Engineering (VIBE) and Early Research Experience in E-term (EREE), two summer engineering programs at Worcester Polytechnic Institute (WPI). We examined if gender, social identity or first-generation status affected how students responded to the essay prompts in each program's application. Specifically, we examined how students wrote about their strengths and assets as compared to the skills they wanted to obtain from the programs.

***11.4 Developing the Entrepreneurial Mindset of Engineering Faculty** (LT)*

Maria-Isabel Carnasciali, University of New Haven

Recent years have seen a proliferation of efforts to develop engineering students' entrepreneurial mindset. Many of these efforts rely on the ability of faculty to embed the concepts into their own courses. Questions arise as to whether faculty see themselves as possessing an entrepreneurial mindset. A key aspect of the mindset is attributed to curiosity and opportunity recognition. Do they, then, take advantage of efforts to provide training on embedding the concepts into their courses. A variety of efforts will be addressed.

***11.5 Capstone "Plus" – Projects with Impact** (LT)*

Len Polizzotto, George Pins, Curtis Carlson, Worcester Polytechnic Institute

Engineering education today requires interdisciplinary teams of students to complete a capstone project, where they demonstrate the ability to apply the technical concepts they have learned to an actual "real life" problem. WPI pioneered project-based learning in the 1970's and branded its capstone as the Major Qualifying Project, or MQP. As WPI envisions the future of engineering education in the post-COVID era, it is adding to the value students gain from performing their MQP by incorporating the discipline of value creation to reframe how students approach their projects.

Value Creation is the process of solving an important unmet stakeholder (end-user, for example) need better than any alternative. Rather than simply complete a compulsory project to satisfy a graduation requirement, they must complete a project with significance for stakeholders in the community. That is, complete a project that matters to others.

To evaluate the value of integrating these principles in the MQP experience at WPI, we have developed a course over the past 3 years that uses active learning principles to teach capstone design students and their teammates the fundamentals of Value Creation. These fundamentals include:

1. Identifying the key stakeholders for the project and deeply understanding what their needs are. Specifically, students are asked to identify what the stakeholder wishes they could do but cannot, and what has prevented that need from being met previously.
2. Determining how the need can be solved better than any other existing approaches.
3. Identifying the riskiest part of their approach and how to mitigate that risk.
4. Developing a Value Proposition for their project based on 1) the stakeholder's unmet Need, 2) their Approach for solving the need, 3) the Benefits per costs (i.e., value) to the stakeholder from the solution, and 4) why the new solution is superior to the Competition and all other alternatives.
5. Iterating and reframing the Value Proposition by repeatedly presenting it to their interdisciplinary peers and receiving feedback on how it might be improved.

We will assess the performance of the student MQP teams by comparing those who have taken the Value Creation course to those who have not. We are also offering the Value Creation course to graduate students to help them better define the impact of their research.

11.6 Engineering Unleashed – A KEEN Experience **(LT)**

George Pins, Worcester Polytechnic Institute

Engineering Unleashed is a community of more than 3,500 engineering faculty and staff with a shared mission to graduate engineers with an entrepreneurial mindset so they can create personal, economic, and societal value through a lifetime of meaningful work.

An entrepreneurial mindset helps engineering faculty and students identify opportunities, solve for problems, and create long-lasting value—in their classes, campus, community, and the world. When combined with the skills and work engineers already do, entrepreneurially minded engineers become powerful agents of societal good.

Session 12: Remote/Hybrid Lessons Learned: Mechanical Engineering **3:15 pm**
Session Chair: Ahmet Can Sabuncu **Room IS 105**

12.1 Designing & Implementing A Successful Engineering Class with Quality Matters (QM) Rubric Standards. Lessons Learned in Teaching Introduction to Solidworks During Covid-19 Pandemic. *(FP)*

Jorge - Paricio Garcia, University of Connecticut

The author built and taught many online classes for the last 18 years for The Art Institute of Pittsburgh, the Rhode Island School of Design and Ohio University, and while many they ran on full attendance, they lacked the rigor of research-supported and published best practices that a fully implemented QM program brings. Having arrived at the University of Connecticut during the Fall of 2020, I answered UConn's call from Center for Excellence in Teaching and Learning (CETL) to develop an online class, taught over the Summer 2021. The chosen course was Introduction to Solidworks, a popular parametric computer modeling program class, which was traditionally taught in a computer lab in my home department of Mechanical Engineering.

The successful writing and implementation of such course involved meeting weekly for a full semester with a QM specialist, who monitored the set of 42 standards and verified the progress on learning outcomes, including the verification of student participation with Respondus LockDown Browser. Some core questions we want to hit when preparing an online course worth 100 QM points, revolve around these important questions: Does the course have different delivery modes? Are the exercises and learning modules rich and engaging? What kind of learner interaction is it providing? What steps are we taking to make the course more accessible and usable? Besides offering quizzes, reading material and discussions, the course involved recording, editing, chaptering and closed captioning of 36 unique video tutorials, as well as the preparation of a strong Course Orientation and post-completion survey.

12.2 Evolution of Project Based Learning in Inverted Undergraduate Mechanical Engineering Classrooms for Online Modalities: Heat Transfer *(FP)*

Michael G. Schrlau, Rochester Institute of Technology

Inverted classrooms support learner-centered approaches to improve conceptualization, comprehension, and problem-solving skills by delivering content outside the classroom and actively engaging students inside the classroom. In previous work, we reported on the inversion of a core course in the undergraduate mechanical engineering curriculum, Heat Transfer, where in-person team-based case studies were utilized to motivate learning and apply learned knowledge to real world problems. With the sudden shift to online instruction during the pandemic, it became difficult to motivate and engage students through these same case studies and for teams to work together effectively. This report describes how we evolved project-based learning in the course for online modalities in order to reengage remote learners and, in doing so, improve the student learning outcomes and perceptions of the course. Comparisons of student performance before and after, as well as their observations and perspectives, show the positive trajectory of the evolution.

12.3 Improving Our Approach Towards Teaching A Content Intensive Subject in Higher Education - An On-Line Variant *(FP)*

James Lamberchts, Anuja Kamat, Wentworth Institute of Technology

The authors carried out a study and published the results on teaching a largely content intensive course in an engineering school, where it is often a challenge to achieve student learning and retention of the course material. Methodologies involved encouraging student notetaking, a study guide sheet to follow along with the PowerPoint, homework built to serve as a study aid, weekly quiz, and a comprehensive final exam, as well as a research paper. An additional challenge in last year's course was added when the course went on-line in the middle of the semester. To accommodate this on-line crisis, recordings of each lecture were added. At the end of the course, the students were given a survey to evaluate the effectiveness of these methodologies. Based on the survey results and student performance, the text for the course was changed which then required significant modification our course materials. This year the course is only on-line for the entire semester. With the textbook changed, study guide sheet was made more focused, homework was revised and shortened somewhat, quizzes were modified to comply with on-line testing available, recorded lectures were uploaded onto the Brightspace, and an additional project was added. The students were given a mid-semester survey to evaluate the effectiveness of these modifications to that point, and some course tweaks have been instituted. We are sharing with reader what we have been able to do and how our students have reacted. What worked well, what could be improved further, and why, are then discussed in this paper.

12.4 A MATLAB Toolkit Replacing All Steam Tables in Undergrad Thermodynamics Courses *(WIP),* Mir Masoud Ale Ali, Bjorn Kierulf, Adam Hametz-berner, Ahmet Coskun, Kai-tak Wan, Northeastern University

In common undergraduate thermodynamic courses, standard syllabi comprises first and second law involving phase diagrams of solid-liquid-vapor. Most numerical examples and exercises involve calculation of internal energy, enthalpy, entropy etc. using the property tables from National Institute of Standards and Technology. It is irksome and prone to errors to look up numbers from many tables of water, R134a, and other refrigerants, since it is difficult to visualize the thermodynamic process in standard 3-dimensional PVT diagrams, let alone multiple references to the tables and the mundane linear interpolation between two lines in the tables. In fact, the instructors usually need to put in extra efforts on usage of such tables, rather than spending precious time delving into more sophisticated contents in the course. The confusion also makes learning difficult to many who might ultimately miss the fundamental concepts and even lose interest in the important subject altogether.

The proposed MATLAB Toolkit allows one to (1) access the related properties by entering only the state such as pressure and temperature, (2) visualize the thermodynamic processes using a graphical interface. Both instructors and students can therefore (1) focus more on the fundamental principles, (2) solve more complex problems, and (3) enrich the course by covering interesting areas such as nano science. The toolkit is expected to be implemented in ME 2380 Thermodynamics in Spring 2022 and might be used also in other departments in engineering, physics, and chemistry. This work is financially supported by a MathWorks 12-month micro-grant (Jan 2021 to Dec 2021). Participants include graduate and undergraduate students and instructors.

12.5 Navigating the COVID Landscape with a Mechanical Engineering Junior Laboratory*,*

Charles White, Norwich University

At the author's institution, all Mechanical Engineering undergraduate students are required to take a two semester laboratory course sequence covering topics in measurement and instrumentation. As with most hands-on instruction, the restrictions imposed by the COVID pandemic required significant adjustments to the course, especially the number of students that were permitted in the laboratory space at any given time. In this paper a comparison is made between the Fall semester course from before the pandemic (Fall 2019) and the same course during the pandemic (Fall 2020). Although COVID disruptions continue into 2021, the most dramatic adjustments to the course were made for the Fall 2020 semester.

This paper describes the course as historically taught and the course with the COVID adjustments. It also shares observations about how these changes may have benefited the students as well as detracted from the normal experience. Finally, a comparison is made between several of the relevant questions from the end of term student evaluation questionnaire.

STUDENT PAPER SESSIONS

Session 13: Engineering Education: Social Justice **8:30am**
Session Chair: John McNeill **Room IS 203**

13.1 Reforestation Drone Mapping Coverage System
Eric H. Spooner, Wentworth Institute of Technology

13.2 Factors Affecting the External Framework of a Secondary-school STEM Program,
James Accuosti, University of Bridgeport

13.3 A Preliminary Analysis of Healthcare Disparities Curriculum: Piloting an Educational Module at WPI,
Lily Cordner, Sammy Hankoui, Delainey O'Connor, Emilly Pollock, Blake Wooford, Kristen Billiar, Worcester Polytechnic Institute

13.4 ***Plastics Crash Course: An Online Database for Teaching Plastics Recycling Through Graphics,***
Madison Reed, Grace Chen, UMass Lowell

13.5 Teaching 3D Vectors in Virtual Reality,
William Cashel-Cordo, Anuja Kamat, Wentworth Institute of Technology

13.6 Identifying Differentially Expressed Genes between COVID-19, Influenza, and Healthy Patients,
Aparna Deokar, Boston University Academy
Aditi Deokar, Dartmouth College

Session 14: Sustainability and Green Engineering **8:30am**

Session Chair: Paul Crilly **Room IS 205**

14.1 Hydrokinetic Renewable Energy Application in Bangladesh,
Waliur Bhuiyan, Fairooz Haque, SUNY New Paltz

14.2 Power Potentials of Vortex-Induced Bladeless Turbines,
Fairooz Haque, Mario Cora, Rachmadian Wulandana, SUNY New Paltz

14.3 Powering the Blue Economy Through Offshore Vertical-Axis Wind and Current Turbines; From Fundamental To Two-Phase Flow Experimental Testing,
Sarah Dulac, Ross Jacques, Joseph Silveira, Chandler Jardin, Andrea Elloian, Kevin Raggiani, Dylan Souza, Tyler Viera, Alec Peinkofer, Darion Gregory, Konrad Jamro, Hamed Samandari, Banafsheh Seyed-Aghazadeh, UMass Dartmouth

14.4 Green Energy Golf Cart: Project Based Learning for Innovation & Sustainability,
Peter Raymond Stupak, Raritan Valley Community College

14.5 Applied Energy-Efficient Ethernet Strategies for Effective Business Practice,
James Accuosti, Graduate Student

14.6 Measurement of Turbine RPM with Hall Effect Principle,
Bennett Terrill, Fairooz Haque, Rachmadian Wulandana, SUNY New Paltz

Session 15: Engineering Education & Capstones **8:30 am**

Session Chair: Abhishek Kumar **Room IS 105**

15.1 Spectroscopy of Ruby Fluorescence,
William Cutler, John Donaghue, Donald Heiman, Haridas Kumarakuru, Northeastern University

15.2 Simple Laboratory Experiment on Coupled Electric Oscillators,
Tyler Locke, Lucas Faria de Sa Tucker, Donald Heiman, Haridas Kumarakuru, Northeastern University

15.3 Analysis of the PGE2 EP4 Receptor Gene Expression Considering COPD Disease Progression,
Amanda Pooter Hennemann, University of Bridgeport

15.4 Empire State Building,
Michael Tokarski, Anuja Kamat, Wentworth Institute of Technology

15.5 Design of an Attitude Determination and Control System with an Embedded Kalman Filter for Cube Satellites,
Tyler Ellingwood, Ashanthi Maxworth, Daniel Martinez, University of Southern Maine

15.6 Parametric Design Optimization of a Light and Strong Quadcopter Frame,
Nhat Pham, Christian Dejarnette, Derek Cerulli, James Zakhour, Junling Hu, University of Bridgeport

15.7 Client-Server Radar Security Circuit,
Saurav Basnet, Jason Rinehart, Trinh Huynh, Douglas Dow, Wentworth Institute of Technology

LIGHTNING TALKS **10:00 am**

Innovation Studio, Amphitheater, 1st Floor

The Novel Hybrid Model for the Design of High Entropy Alloys,
Yu Zhong, Worcester Polytechnic Institute

The Traveling Wave Versus the Standing Wave Antenna – How they are different,
Paul Benjamin Crilly, United States Coast Guard Academy

Training Innovative Thinkers: Engineering Education for the 21st Century,
Afsaneh Ghanavati, Joshua Luckens, Wentworth Institute of Technology

The Challenges & Opportunities Teaching Diverse Student Groups During COVID-19 Pandemic,
Jonathan Mellor, UMass Dartmouth

Examining Student Experiences Summer Engineering Programs During COVID-19 Pandemic,
Athenia Jones, Olufunmilayo Ayobami, Jessica Anne Rosewitz, Worcester Polytechnic Institute

Developing the Entrepreneurial Mindset of Engineering Faculty,
Maria-Isabel Carnasciali, University of New Haven

Capstone "Plus" – Projects with Impact,
Len Polizzotti, George Pins, Curtis Carlson, Worcester Polytechnic Institute

Engineering Unleashed – A KEEN Experience,
George Pins, Worcester Polytechnic Institute

STUDENT POSTER SESSION **10:30am**

Innovation Studio 2nd floor

Note: For equitable judging, presenters should be at their posters during the following times:

Odd numbered posters: 10:30am – 11:15am

Even numbered posters 11:15am – 12:00 noon

SP1. Back Bay Fens Bridge,
Jack Ryan McNulty, Sebastien Aymard Paul, Andrew Mark Hesse, Tyler Adam Russell, Anuja Kamat

SP2. Multiclass ECG Signal Analysis Using Global Average-Based 2-D Convolutional Neural Network Modeling,
Muhammad Wasimuddin, Khaled Elleithy, Abdelshakour Abuzneid, Miad Faezipour, Omar Abuzaghleh

SP3. Monitoring and Diagnosing the Diseases Related to Vital Signs and Organs of Human Body Using Cmos Image Sensor Systems, Suparshya Babu Sukhavasi, Susrutha Babu Sukhavasi, Khaled Elleithy

SP4. Surveillance Systems Based on Cmos Image Sensors in Most Popular Fields,
Susrutha Babu Sukhavasi, Khaled Elleithy, Suparshya Babu Sukhavasi

SP5. Why One-Way Hallways Are Safer Than Two-Way Hallways,
Charles Y Tang

SP6. Improved Quantum Approximate Optimization Approaches to Solve Large-Scale Combinatorial Optimization Problems,
Bishad Ghimire, Khaled Elleithy, Ausif Mahmood

SP7. A Fast and Highly Efficient Campus Safety Mobile App,
Mohamed Aly Mohamed, Khaled Elleithy, Wafa Elmannai

SP8. Powering the Blue Economy Through Offshore Vertical-Axis Wind And Current Turbines; From Fundamental To Two-Phase Flow Experimental Testing,
Sarah Dulac, Ross Beauregard Jacques, Joseph Silveira, Chandler Jardin, Andrea Elloian, Kevin Raggiani, Dylan Souza, Tyler Viera, Alec Peinkofer, Darion Gregory, konrad Jamro, Hamed Samandari, Banafsheh Seyedaghazadeh

SP9. Lessons Learned from Hybrid Laboratory Instruction during the COVID-19 Pandemic,
Julia Clarin, Kevin Bardon, Ana Vargas, Joshua Pace, Helen Markewich

SP10. Neural Network Implementation in Ethereum Block Chain Smart Contract,
Cesar Garcia

SP11. Initial Methods in Developing a Free Body Diagram Mobile App,
Paloma Gonzalez Galvez, Raymond Dolan, Anna Eng, Jennifer deWinter, Kimberly LeChasseur, Andrew Sloboda, Sarah Wodin-Schwartz

SP12. Analysis of The PGE2 EP4 Receptor Gene Expression Considering COPD Disease Progression,
Amanda Pooter Hennemann

SP13. Designing A Novel Testing Platform for Long-Term Effects Of Environmental Carcinogens On Zebrafish,
Feyza Achilova, Tracie Ferreira

SP14. Bit Modeling and Gray Level Prediction Permits High-Accuracy Decoding of Extreme High-Density 2D Barcodes,
Eugene Gerety, Khaled Elleithy

SP15. Towards Value Creation in Engineering Education: A Review Of Entrepreneurial And Innovative And Implications For Engineering Programs' Epistemology,
James Accuosti

SP16. K-12 STEM Outreach: A Review on Subject-Based STEM Initiatives Over the Last Decade,
James Accuosti

SP17. K-12 STEM Teaching and COVID Challenges: A Summative Exploration Of Significant Lessons And Solutions,
James Accuosti

SP18. 5G Network: Core Services and Consumer Benefits,
Bishad Ghimire, Joseph Antos, Brian Parker, Hewan Soltau, Nasir Sheikh

SP19. Development of Hypertension Tracking System,
Lan T. Bui, Douglas E. Dow

SP20. RPA: The Virtual Assistant,
Kanwaljeet Singh

SP21. Computation Study on the Effects of Granzyme A on Follicular Lymphoma Microenvironment During CAR T Cell Therapy,
Tanvi Reddy Gorre, Pabir Patra, Bhushan Dharmadhikari

SP22. 3D Spatial Mapping of Indoor Spaces of Historical Buildings Using Virtual Reality,
Brandon Merluzzo, Jenna Rice, Shafi Sheikh, Kai Ren

SP23. Parametric Design Optimization of a Light and Strong Quadcopter Frame,
Nhat Pham, Christian Dejarnette, Derek Cerulli, James Zakhour, Junling Hu

SP24. Racial Bias in Biomedical Engineering and Medical Diagnostics in Relation to Osteoporosis and Diabetes Among Black Female Patients,
Feyza Achilova

SP25. A Simulator for Quinnipiac University's US News Rankings,
Thomas Gadacy, Ruby ElKharboutly, Emre Tokgoz

SP26. Improving Students' Understanding of Manufacturing Systems Through Project-Based Learning,
Patrick Germano, Ziyad Aloufi, Joseph Ekong

SP27. Designing an IBL Curriculum on Renewable Energy for the Girls Talk Math Camps,
Aunika Yasui, Victoria Mirecki, Francesca Bernardi

SP28. Reducing Cybersecurity Exposure for Smart Home Networks,
Benjamin T. Bassett, Douglas E. Dow

SP29. Forensic Engineering 3D Printed Parts – A Preliminary Study,
Maria-Isabel Carnasciali, Jared Gabriele

SP30. Laboratory Exercises in Arsenic Remediation for Engineering & Environmental Science,
James Vincent Masi, USM

SP31. Outfitting Mobile Foundry System for Department of Defense Rapid Equipping Force,
Zebang Zhang

SP32. Application of GPS in Monitoring Movement & Behavior of Primate,
Saurav Basnet, Patrick Blanchard, Tommaso Verdiglione, Wentworth Institute of Technology

SP33. Solar Panel Tracking and Data Analysis,
Saurav Basnet, Jesse Khoury, Nicholas G Toledo, Douglas Dow, Wentworth Institute of Technology

ASEE-NE 2021 Business Meeting

Saturday, October 23, 2021, 1:30 PM
Hagglund Room, Campus Center

Agenda

- Welcome and Introduction
- Minutes of the ASEE-NE Spring 2020 board meeting
- Treasure Report
- Campus Rep Chair Report
- Membership Chair Report
- ASEE-NE2021 conference summary – by WPI
- Future conference locations:
    - 2022: Wentworth Institute
    - 2023: Zone1?
- ASEE-NE Future Conference Format – In-person, Hybrid
- ASEE-NE2021 Board member election (for any vacant position)
- Open discussion about other Issues
- Adjourn

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