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Exploring Child Creative Habits of Mind in an Out-of-School Engineering Program

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Assessing creativity in schools is challenging due to preexisting academic structures, assessment metrics, and curriculum standards. This challenge requires looking beyond schools and traditional curriculum to out-of-school contexts and programs that may encourage what have been identified as 'creative habits of mind'. Within the field of engineering, creativity has been identified as a core component. As such, understanding what creative habits of mind may be fostered through participation in out-of-school engineering experiences is important to garnering engagement and investment in the discipline. This study explores the emergence of creative habits of mind through participation in an out-of-school home-based engineering program. Specifically, we sought to answer the research question: What creative habits of mind emerge through child reflections of their experience in an out-of-school engineering program? Data was derived from post-program interviews with youth from 15 diverse families who participated in the program. Transcripts were analyzed using a priori coding based upon the Centre for Real-World Learning Model of Creative Habits of Mind. Emerging patterns regarding creative habits of mind developed through participation were identified. Imaginative, inquisitive, and disciplined creative habits of mind emerge in the findings as the most prevalent creative thinking processes, with concepts including playing with possibilities, exploring and investigating, and reflecting critically playing a prominent role in youth perceptions of their experiences. This is significant in that it demonstrates a development in creative, independent thinking in children and a fostering of curiosity, imagination, and problem solving through self-reflection that is inherent and critical to the field of engineering.

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Implementation of Interactive Technology to Improve Students' Active Learning and Engagement in MATLAB Programming

Prof. Xiyuan Liu, Syracuse University

MATLAB programming is a required course in the curriculum of Department of Mechanical and Aerospace Engineering at our University. As the first-year fundamental level class, most of the freshman students experience various challenges in this course. For the majority of the students, this usually is the first time exposed to a programming language, which is quite different from the course format that they are familiar with. Due to large class size (˜130 students), the students might not be able to receive enough attention or timely feedbacks on their work in or outside of the classroom. All of these challenges often lead to poor student learning outcomes, since they can easily find themselves struggling with the course at the very beginning of the class. To improve the students' engagements and promote active learning inside and outside the classroom, I have redesigned this class by introducing two online interactive technology tools – Kahoot! and MATLAB grader.

This class is composed of three main components offered in a weekly basis – lectures, labs, and homework. The first lecture introduces fundamental concept, and then the following lecture will solidate students' understanding on the course. To boost the engagement, participation, and motivation in this large class, I adopted Kahoot! Quiz as interactive activities in the class. At the end of each lecture, 5-6 questions are displayed to evaluate the student understanding on lecture content and to collect students' feedbacks. Between two lectures, each student takes an 80-minute laboratory and completes problems by programming in MATLAB software with the support from instructor and TAs. The homework is assigned after the second lecture, and the students are asked to complete the homework on the MATLAB Grader platform, instead of in the MATLAB environment. This platform allows the instructor to scale the assessments for each problem, provide hints and guidelines for students to complete a problem and automatically grade the problem to give timely response. The student performances with and without these interactive tools are compared to demonstrate that student learning outcomes and programming skills are significantly improved in a large class setting due to prompt student-instructor interactions.

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NSF RESET: A Conference to Support Returning Women's Transition to Computing and Technology Discipline

Dr. Farzana Rahman, Syracuse University
Dr. Elodie Billionniere, Miami Dade College
Sinchana Sulugodu Shashidhara, Syracuse University

One of the critical needs of the 21st-century workforce development is the recruitment, retention, and graduation of women with science, technology, engineering, and mathematics (STEM) skills. Research suggests that women drop out of academic programs and leave the workforce to care for their families, financial setbacks, personal obligations and call to active-duty program. Returning women, very rarely choose to pursue STEM education or cannot enter the STEM workforce because - 1) these fields are constantly evolving; 2) the technical preparations can be challenging or unknown; 3) technical skills development require a lot of time and effort; 4) there are not enough transitional programs which can leverage the existing background of returning women to develop new knowledge; and 5) industry and academia do not have enough knowledge to create diverse reentry pathways to prepare returning women for the 21st century workforce environment. Some niches within the STEM field, like Emerging Technology (EmTech) concentrations (e.g., cybersecurity, data science, artificial intelligence, and cloud computing), are expected to grow job opportunities more quickly than others. The demands of these jobs can only be fulfilled by creating opportunities for one of the largest untapped talent pools, which is returning women.

Therefore, to understand the barriers and challenges faced by returning women to enter computing and tech education and workforce, a three-day virtual conference, RESET (Re-enter STEM through Emerging Technology), was organized in March 2021. Through our experience in organizing a large-scale national conference, we surveyed 444 attendees (conference organizers and participants) to investigate their level of satisfaction and the overall effectiveness in helping returning women facilitating their transition to computing and technology discipline. In this paper, we present the qualitative and quantitative results on conference attendee's satisfaction level and its effectiveness in identifying appropriate resources to (re-)enter EmTech educational and professional pipeline.

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Project-Based Learning in a Simulation Course to Develop an Entrepreneurial Mindset

Dr. Michael E. Kuhl, Rochester Institute of Technology (COE)

Having an entrepreneurial mindset is often a characteristic of highly successful engineers. This mindset can be cultivated through engineering curriculum and educational methods. This work presents a case study in which project-based learning is utilized in a simulation course to foster the development of an entrepreneurial mindset in engineering students. The activity involves utilizing simulation to design a full-scale production system given an assembly system prototype. In addition to the traditional technical engineering objective, the project engages the key elements of the entrepreneurial mindset defined by KEEN – curiosity, connections, and creating value. Both the project outcomes and results of a student survey support benefits this approach.

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Observation, reflection, and goal setting, support development of inclusive, student-centered practices in engineering peer educators, improve student perception of learning, and create community

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Ryan Sauvé, Cornell University
Dr. Lisa Schneider-Bentley, Cornell University
Jena Michele Rozanski, Cornell University

In higher education, the role of undergraduate educators is growing. Teaching teams in large courses often have a mix of graduate and undergraduate teaching assistants (TAs). This growth is driven, to some degree, by financial efficiency, and many studies that report overwhelmingly positive effects of peer TAs on student learning [1]. We employ and train undergraduate 'Academic Excellence Workshop (AEW) Facilitators' who, in pairs, lead weekly, 2-hour sessions that parallel challenging engineering courses. In application materials and interviews, most facilitators profess a passion for explaining things in different ways, breaking down problems into pieces, gleaning where the comprehension issues are, and putting the information into terms that make sense to fellow students. With these teacher-centered skills alone, they can be excellent resources for their peers. However, training these talented students in evidence-supported, student-centered pedagogy is worthwhile [2]. Our training workshops occur 7 times per semester and model inclusive practices and collaborative learning. Evidence-supported pedagogy is used and introduced, and facilitators reflect on and share success and challenge of their own workshops. At mid-semester, facilitators sessions are observed, and each observes a different workshop. After observations and student mid-term evaluations, facilitators submit a reflection and goal-setting document that asks them to respond to feedback, identify their strengths and challenges, and articulate changes they will enact to address the challenges and improve their teaching practice. Here, we use a combination data sources including 1) rubric guided AEW facilitator observations, 2) AEW student mid-term evaluations, 3) facilitator guided-reflections on observations and evaluations , and 4) end-of-semester surveys, to show that observation, reflection, and goal-setting can guide undergraduate leaders to inclusive, student-centered practices that can positively impact student learning, and begin to transform college teaching and learning by infusing academia with more effective educators, and encourage collaboration and create a sense of belonging.

Selected References

Luckie, D.B., Mancini, B.W., Abdallah, N., Kadouh A.K., Ungkuldee, A.C.P., and Hare A.A. (2020). Undergraduate teaching assistants can provide support for reformed practices to raise student learning. Adv Physiol Educ, 44: 32–38.

Sana F., Pachai M. V., Kim J. A. (2011). Training Undergraduate Teaching Assistants in a Peer Mentor Course. Transformative Dialogues: Teaching & Learning Journal, 4:1-10.

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Using Microfluidics to study the Vascular System in a freshman class

Dr. Shivaun D Archer, Cornell University

Vascular blood flow provides a unique opportunity to introduce microfluidics in biomedical engineering courses, allowing both experimentation and numerical modeling. Microfluidic-based flow networks can be used to illustrate fluid flow in the body and directly connect to normal and disease-state physiological function.

In an introduction to biomedical engineering class that combines labs with lectures, students visualize flow in a model vascular system using a poly(dimethyl)siloxane (PDMS) microfluidic device consisting of a network of various sized channels. The objective of this experiment is to characterize a simple model of the microvascular system using a PDMS microchip. This chip is made using photolithography and simple microfabrication techniques. Students measure flow velocities of micrometer-sized beads within the model network before and after blocking one of the channels and track the redistribution of flow when a channel is occluded. Using a MatLab simulation, students then calculate the resistance of the overall network as well as pressure and velocity in each channel before and after the blockage. These are then compared to experimentally measured velocities and network resistance. This exercise allows students to visualize and model what happens to microvessels when blocked and how the surrounding vessels compensate and redirect flow. The use of a PDMS chip allows for reproducible and easily visualized results without the need for an animal model. Students learn microfluidics, image acquisition and analysis, microfabrication, and MatLab simulations as well as gain an appreciation of the fluid dynamics of microvascular blood flow in health and disease.

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Utilizing Teaching Assistants to Increase Active Learning in Lectures

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Students learn most effectively while participating in interactive activities, where they construct knowledge with peers in addition to what the instructor provides. Studies show that retrospective post-assessment, where students recall their thinking prior to an activity and compare it to that after the activity, improves students' metacognition and scientific thinking. Many college educators state their desire to adopt such student-centered techniques into their lectures, but unfortunately, lack the support to do so. This work describes a pilot program we called the "Interactive Learning Collaborative" that employs teaching assistants (TAs) as interactive-activity and retrospective-post-assessment designers and facilitators with the help of an experienced-TA mentor. The objectives of the program were to 1) provide engineering TAs an opportunity to practice activity design, 2) improve students' comprehension of the material through peer interaction and reflection in lectures, and 3) introduce instructors to the practice of backward design, active learning techniques, and their positive impact on student perception. In the fall of 2021, TAs met with the mentor weekly or biweekly to design an interactive activity and the subsequent post-activity student reflection questions around a topic that was either critical or historically confusing. The mentor worked with six TAs from four courses to design and execute 13 activities. 70–95% of students stated that their comprehension of the topic improved with peer interaction and reflection. Instructors who were previously inexperienced with student-centered learning mentioned that they felt more confident designing interactive activities and delegating the task to their TAs after this program. The mentor observed that the TAs became more confident and independent, and the quality of their designed activities improved as time went on. Overall, this pilot was beneficial for the students' perception of their learning, course instructors' exposure to active learning strategies, and TAs' confidence in implementing this pedagogy in the classrooms.

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Exploring Engineering Students' Attitudes: Impacts of Sociotechnical vs. Technical Courses

Felicity Bilow, Clarkson University
Dr. Jan DeWaters P.E., Clarkson University

Current engineering curricula fail to recognize the sociotechnical nature of engineering problems (i.e., technical and non-technical factors), and rather primarily focus on technical problem solving. This is problematic because in order for engineering graduates to be able to solve the complex engineering problems facing the world today and in the future, they will need to understand the technical and non-technical (social, political, economic, environmental, cultural, legal, safety, etc. factors) implications of their work. In addition, women continue to be underrepresented in engineering education. Previous research has suggested that presenting engineering within a societal context can help attract and retain women in engineering. Courses that are designed to present engineering from a sociotechnical perspective may allow female-identified students to find social relevance to the field, which could help them to find a sense of belonging in engineering, which could lead to an increase in the retention rate of women engineering students. These sociotechnical courses will also allow engineering students to understand the technical and non-technical factors that are incorporated in engineering design and work.

The purpose of this study is to examine how undergraduate engineering students' attitudes (i.e., sense of belonging, self-confidence, satisfaction with engineering, and social responsibility) toward and understanding of engineering are affected after taking sociotechnical vs. more technical focused engineering courses at Clarkson University.

Undergraduate engineering students enrolled in "middle year" sociotechnical and technical engineering courses at Clarkson University will complete a pre-/post-survey during the spring 2022 semester, with a few students participating in a post-interview at the end of the semester.

This presentation will cover the background behind the project, the methods that will be used in the study, the results of pilot data collected during the fall 2021 semester, and plans moving forward.

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STEM QuESTS: A Design Challenge to Engage Students in STEM Education

Dr. Jan DeWaters P.E., Clarkson University
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Seema Rivera

STEM QuESTS:

A Design Challenge to Engage Students in STEM Education

Engineering competitions are a popular mechanism to engage students in engineering and, more broadly, in STEM studies and careers. Participants typically work in teams to solve real-world problems, integrating conceptual learning with hands-on activities. Engineering design challenges provide an authentic engineering experience that integrates science, mathematics, and engineering principles and helps students develop innovative design thinking. They also improve student engagement, motivation, and self-efficacy, and provide students the opportunity to develop important ”21st Century” professional skills.

Most engineering design challenges have at their core a ”design and build” objective, requiring problem solving through technical innovation (bridges, cars, wind turbines, etc.). Particularly in higher education, the growing popularity of maker spaces has led to more students collaborating in these hands-on creative endeavors. Clarkson’s Institute for STEM Education created the STEM QuESTS Challenge (Questions that Explore STEM for Teachers and Students) as an alternative to design and build challenges. The STEM QuESTS Challenge invites students to create engaging STEM curricula that will entice pre-college students to pursue STEM studies and careers. Participating teams are invited to reflect on what inspired them to study STEM, and then create a similarly-inspiring, hands-on educational experience for local students.

The lessons should be unique and innovative, interdisciplinary or cross-disciplinary, and must engage students in inquiry and active learning. Teams submit a 90-second video pitch to compete for a finalist position. Finalists then work with a mentor to create complete lesson plans, tied to New York State learning standards and ready to use in a middle or high school classroom. Teams present their lessons as part of the competition for a grand prize.

So far STEM QuESTS has successfully produced quality lessons and engaged students in a fun, educational, professional development opportunity. Our presentation will share more details about the Challenge, with the objective of encouraging other universities to adopt this alternative approach to an engineering design challenge.

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Educational Comics: A novel pedagogy for teaching transferable and humanistic skills in Engineering

Dr. Kai Hua Zhuang, Brave49
Dr. Mojgan A Jadidi P.Eng., York University
Ms. Dimpho Radebe, University of Toronto
Mr. Evan Hu, Brave49

Educational Comics: A novel pedagogy for teaching transferable and humanistic skills in Engineering

Kai Zhuang (1, 2), Dimpho Radebe (3), Mojgan Jadidi Mardkheh (1), and Evan Hu (2)

1: Lassonde School of Engineering, York University, Canada

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Transferable, humanistic, and future-ready skills, such as emotional intelligence and ethical leadership, are essential for students' success, thriving, and contribution, particularly in technical fields such as engineering. However, many engineering students, being technically-focused, find these topics difficult to engage with and may lose interest and motivation along the way.

We have been developing and piloting a novel method for teaching complex subject matter centered on educational comics. Educational comics combine the engagingness of visual storytelling with the searchability and indexability of text narratives. They can be exceedingly effective for communicating complex ideas and promoting creative and associative thinking, making them an ideal medium for teaching transferable and humanistic skills to engineering students. Once developed, base-comics can be converted to different learning formats and experiential education activities, including self-directed workbooks, standalone workshops, and facilitated online courses. By replacing unfamiliar and hard-to-understand language with intentionally designed comics, we were able to make the learning experience more inclusive, accessible, and approachable. Graphic representations, more so than rational words, facilitate emotional connections to the subject matter, keeping more students engaged and contributing to more meaningful learning.

Over the past two years, we have applied this pedagogy to the teaching of visual thinking, storytelling, ethics, teamwork, motivation, and other humanistic topics in various curricular and co-curricular settings in two Universities, including two courses taken by all engineering students, a peer mentorship program attended by all first-year engineering students, two bridge-programs for students entering university, a workshop for graduate researchers, and a STEAM program for female high school students.

Our initial experience applying this pedagogy supports our hypothesis that educational comics are a highly effective pedagogical strategy for teaching complex non-technical subject matter to engineering students. We are beginning to develop a formal research program to assess the efficacy and impact of this pedagogy.

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Representation of Black women in STEM roles in popular films

Mr. Syed Ali Kamal, University at Buffalo, The State University of New York
Dr. Matilde Luz Sanchez-Pena, University at Buffalo, The State University of New York

The representation of female STEM professionals in popular films influences the public perception of their participation and contributions in STEM. Moreover, it has been argued in the literature that media portrayals of the STEM professionals as white male characters, has created gender stereotypes that affect the participation of female STEM professionals from marginalized racial communities in the STEM professions. This study aims to employ content analysis techniques to examine the portrayals of women of color in 20 high-grossing sci-fi films from 2010-2020. We use the theoretical lens of intersectionality and the social identity theory to discuss the role of STEM media representations of women from racially marginalized communities on their STEM identity development. Specifically, we will be trying to answer the following research questions: 1) how women from marginalized racial groups are represented in STEM roles in popular films? and 2) what is the ratio of their representation in STEM professional roles in proportion to white male STEM professionals? This study will highlight the trends and stereotypes about women of color in popular films. Also, the findings will call for action against negative/lower representation of women of color in STEM roles so that gender stereotypes against them could be eliminated.

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Integration of a Local Riverbank Failure Problem in Civil Engineering Undergraduate Curriculum

Dr. Suguang Xiao, Clarkson University
Mr. Robert J Schneider, Clarkson University
Prof. Erik Backus, Clarkson University

One of the primary goals of undergraduate educators is to provide engineering students with engaging problems to build skills needed for their careers. Project based coursework puts responsibility on the student to initiate self-directed learning and opportunity to apply fundamentals. Recently, with the solicitation of the local municipality, Dr. Xiao volunteered in assisting a homeowner to rectify a slope failure along the St. Regis River in Brasher Falls, NY through the development of a course project. Clarkson University students enrolled in CE 415 Foundations, Stability, and Retaining Structures (Fall 2019), and CE310 Geotech Engineering I: Soil Mechanics (Spring 2019), two fundamental geotechnical engineering courses, were tasked with the following engineering problem: two major riverbank failures occurred near the house in 2016 and 2019, respectively, which threatened the nearby resident's home. Fluvial erosion undercuts bank toe and steepens the slope which is the main reason for bank failures. In the project, students were given the site layout and additionally performed in-situ dynamic cone penetration tests to determine the soil parameters such as soil strength and friction angle. Students classified the soil as silty sand through sieve analysis and Atterberg limit tests. Based on these results, students self-learned the slices and circle method to perform a slope stability analysis. After determining the possibility of another failure, the students of CE 415 provided reinforcement solutions. The importance of project-based coursework is essential to the department's curriculum and the development of industry ready professionals. In addition, the project assisted the owner in performing a slope stability analysis and designing retaining structures for the bank slope. With the efforts of the local municipality and other parties, the threat to the house has been removed. Exposing students to local community engineering problems enhances their interest throughout the course and better prepare themselves for their future careers.

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The Mind-Controlled Wheelchair

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Mr. Siddesh Sood
Mr. Thomas B Griebel, Clarkson University
Anthony Seybolt, Clarkson University

The application of a brain-computer interface to control an electric wheelchair may enable individuals with impaired motor skills to move without the need for any physical input. The overall design and implementation of our wheelchair system with the brain-computer interface is discussed within this paper. The integration of our system utilizes a Drive wheelchair, Emotiv EPOC X headset, BLE 5.0 adapter, Raspberry Pi development board, Sabertooth 2x32 dual motor controller, LM2596 buck converter, and a 24V battery. The construction as well as drawbacks of our final system are discussed, and alternate designs as well as future improvements are explored.

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Simulators as Teaching Tools

Dr. Elizabeth A O'Neill, Buffalo State College

Abstract

The practice of all snow-sports involves movements at a high rate of speed down a sloped sometimes steep hill over various terrain. This method of adaptive skiing can also involve avoiding trees, people, towers, rocks, and various other objects. In learning adaptive snow-sports the participant must accept that risk. It is the intent of all instructors to teach students how to safely learn adaptive snow-sports. What if we could remove that risk altogether? The amount of communication to comprehend adaptive snow-sports takes time and much repetition. Many of the instructors expressed this difficulty in a recent snow-sports survey conducted for improving adaptative snow-sports. The need to communicate with the participant for learning purposes is necessary and takes up most of the time during a lesson. Participating in sports on a regular basis has shown to increase mental outlook and help improve their quality of life (Hong, 2014). People using this equipment sit in a sled type ski (on 1 (mono) or 2 (bi) skis) and use their arms with outriggers that are shorter arm poles with ski ends on one side and a brake on the other.

Improving future comprehension of an adaptive sit-ski lesson by exploring future teaching methods that could use 3D simulators as a teaching tool.

Investigate new technologies such as simulators that would allow better communication and comprehension of adaptive snow-sports for this population. Review the other adaptive sports issues from the surveys; equipment, public relations, and other barriers to participation that arose from this research. Paralympic ski teams already use simulators to practice for competition year-round. If simulators were made available to those at resorts, it would seem likely to see an increase in trial lessons.

The original research focus is on improving adaptive snow-sports equipment through ergonomic design form and function using three phases. The adaptive snow-sports research focused on increasing participation by using 3D simulators. This idea has been used in multiple industries where risks to people and equipment were great. 3D simulator training has been a safe and effective method for many to learn something without any risk. Adaptive sports deals with a population that has limited physical mobility and some cognitive limitations, so getting them outside is an important part of their health. If we could make it easier to try a sport without all the heavy clothes and equipment, it should increase participation.

Teaching a regular adaptive sit-ski lesson takes time, approximately 2 hours to learn all the beginner motions to control a sit-ski, not to mention the practicing of the lesson, over and over. This makes it difficult to teach complex maneuvers when you are on a tight time schedule. Not to mention the limitations of the weather that could be a factor, time of day, and the limited number of instructors. Offering a 3D simulator in a safe learning environment, we could assist students in learning what is required to control a sit-ski for alpine skiing. Starting with basic flatland maneuvers, progressing in each level of lessons, simulators could possibly spark interest in a disabled population who may otherwise be hesitant to try something that may seem risky, or dangerous. Groups could use the simulator to ready themselves before the winter season. It could also be used to show others how much is required to control a sit-ski. Including getting adaptive instructors in the simulator to see how they could improve their skills in teaching, and how to control a sit-ski on the slopes as well. Multiple benefits could be seen from this teaching tool. Costs need to be considered since making them might be costly.

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Confirmation of ammonia recovery net effectiveness on energy production at increased loading rates

Bryan Dwyer, Clarkson University
Prof. Stefan J. Grimberg, Clarkson University

Annually food waste in the United States is approximately 30 percent of the total supply (Buzby, 2014), and more than 50 percent end up in landfills (EPA, 2018). New York State legislation requires 2 tons weekly food-waste producers to separate and treat waste through organic recyclers. (Food Donation, 2021) The Institute of Environmental Sustainability at Clarkson University estimated that the Potsdam Campus pre-and post-consumer food waste stream is over 2 tons per week.

Operated in a shipping container Clarkson University's anaerobic digesters AD functionality was constrained, and moving into a larger space was necessary to handle the newly required food-waste stream. In Spring 2020, a capstone design class developed a plan to move the digester to a larger building on campus, later completed that year. Reusing major equipment, a student-led team constructed new plumbing, electrical, and controls systems. A dual purpose of Clarkson's AD is to implement pilot-scale research to improve the anaerobic digestion of high-strength organic waste.

Current research focuses on ammonia inhibition mitigation in AD systems and total ammonia nitrogen TAN recovery. TAN buildup during food-waste AD inhibits methanogens, the organisms responsible for methane generation. Extraction of TAN from the digester has been shown to yield an increase in biogas production, and recovered ammonia can be added to the reactor effluent, increasing its fertilizer effectiveness. Results of a pilot study operated at 25 lbs/day resulted in a reduction of 42% TAN with a corresponding 55% increase in biogas production; 99% of the removed TAN was recovered (Hunt, 2020).

As the system feeding increases to total capacity, biogas production, methane concentration, effluent produced, and ammonia recovery effectiveness will be collected to confirm the net effectiveness of the ammonia recovery on energy production at design loadings. Results will be presented at the regional conference later this year.

Primary Author Bryan Dwyer

Secondary Author Stefan Grimberg

References

U.S. Environmental Protection Agency - EPA - Food: Material- Specific Data. Received from www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/food-material-specific-data.

Jean C. Buzby, Hodan F. Wells, and Jeffrey Hyman. The Estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States. 2014. United States Department of Agriculture - USDA Received from https://www.ers.usda.gov/webdocs/publications/43833/43680_eib121.pdf?v=0

Food Donation and Food Scraps Recycling, Chapter 43-B Article 27 New York State. Section 27-2203 (2021) Received from www.nysenate.gov/legislation/laws/ENV/27-2203.

Hunt, Jacob. Implementation and Performance of a Pilot Scale Ammonia Removal and Recovery System for Food-Waste Anaerobic Digestion. 2020. Clarkson University, Master thesis.

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Mitigation of cyanobacterial harmful algal blooms (cHABs) and cyanotoxins by electrochemical oxidation: from bench-scale study to field application

Shasha Yang, Clarkson University

Cyanobacterial harmful algal blooms (cHABs) and the release of carcinogenic cyanotoxins have become a great threat to the recreational use of lakes and sources of drinking water. It is challenging for conventional water treatment techniques to mitigate cHABs events that occur massively and irregularly. Therefore, the development of emergency-responsive technology for point-of-use treatment is imperative.

In this study, an electrochemical oxidation and filtration (EOF) process was developed that enables pump-and-treat of phytoplankton plumes and cyanotoxins. With the microporous filter anode as the key component, the novel technology features the effective production of oxidants (i.e., free chlorine, radicals, ozone) within the micropores of the anode by water electrolysis driven by direct current. Cyanobacteria and cyanotoxins will be readily inactivated and destroyed when passing through the pores. Fundamental studies indicate that the EOF process generated locally concentrated free chlorine (> 16 times higher than the bulk chlorine concentration) at the porous Ti4O7 filter anode surface. Additionally, the concentration of disinfection byproducts generated by EOF was five times less than conventional homogeneous chlorination to achieve the same level of treatment. A boat-mount full-scale EOF system was developed and deployed in Lake Neatahwanta impacted by cHAB. The system can effectively remove >50% of phytoplankton and > 80% of the ambient cyanotoxins at a treatment capacity of 110 m3/d and energy consumption of 1.1 kWh/m3.

To better deploy the EOF process to combat cHABs, ResET Water was founded to commercialize the technology from research to production phase. Through participating in the National Science Foundation's Innovation Corps course and conducting 103 cold call interviews, ResET Water was able to identify several potential customer segments for their technology and narrow in on a beachhead market. By reducing recreational downtime associated with cHABs by 90%, ResET Water's technology would provide significant value to the lake associations and other organizations.

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The portrayal of faculty wellbeing in popular media: a comparison of STEM vs non-STEM faculty

Matilde Luz Sanchez-Pena, University at Buffalo, The State University of New York
Dr. Kelly Tenzek

While institutions of higher education in the U.S. are implementing strategies to address the mental health crisis of undergraduate and graduate students, the needs and beliefs of other institutional actors tend to be overlooked. To promote sustainable changes in academic cultures, however, we need to explore the views held by several key players of academic spaces—for example, faculty, who interact first-hand with students and whose perceptions and philosophies can propagate professional beliefs that our graduates reproduce. Many of those beliefs are also influenced by the representation and reproduction of stereotypes of professions that are promoted through popular media, and in particular, those for STEM professions. Furthermore, faculty roles are traditionally demanding, challenging the ability of faculty to procure their wellbeing. With the pandemic adding to those challenges, it is not surprising that faculty wellbeing can directly impact students' experiences and views of an academic field.

This work aims to explore the representations of college faculty in popular media under the framework of the eight dimensions of wellness for educators. Our research question was: how is faculty wellbeing portrayed by media? We also explored if there were any differences in such representation for STEM faculty when compared to non-STEM faculty. Using data from movies and TV series, we conducted a content analysis on the eight wellness dimensions. Our results showed that in general movies showcased negative portrayals of physical, emotional, occupational, and financial wellbeing of faculty while slightly positive representations of their environmental and intellectual wellbeing. When comparing the general distribution against the instances specific to STEM fields, STEM fields contributed with the total of negative portrayals of physical, social, and financial wellbeing. These results are expected to contribute to ongoing valuable conversations about faculty wellbeing in U.S. higher education.

ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Creating Equity-Focused STEM Learning Programs with k2i academy

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Ms. Michelle Tsui-Woods, k2i academy, Lassonde School of Engineering, York University
Vanessa Ironside, k2i academy, Lassonde School of Engineering, York University

k2i (kindergarten to industry) academy within the Lassonde School of Engineering at York University works to meaningfully design and integrate equity and inclusion based science, technology, engineering and math (STEM) programs into all areas of education. These programs address systemic barriers that limit youth from succeeding in STEM areas, pursuing further education and finding a place in industry. The Bringing STEM to Life: Work-Integrated Learning program was designed to address inequities for underrepresented high school students by offering a high school physics credit during the summer in addition to a paid position as a Lab Assistant collaborating with Lassonde Faculty researchers and industry partners. k2i academy partners with school boards in the greater Toronto area to identify Women, Black and Indigenous students within their communities to participate in the experience. The educators, faculty researchers and undergraduate mentors who facilitate the work collaborate to create culturally relevant curriculum that focuses on engineering design, coding and computational thinking with a focus on sustainability through the use of the United Nations Sustainable Development Goals.

ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Hands-on Labs for Secure Programming on Modern Trusted Platforms

Prof. Yuzhe Tang
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With the increasing awareness of cyber-security issues, the cybersecurity workforce becomes an urgent societal need. Of particular importance is the development skills of building secure applications. To meet the educational demand, we propose to develop hands-on labs and education tools for ”secure development on modern trusted platforms”. This work focuses on two emerging trusted platforms, that is, trusted execution environments (e.g., recently released Intel SGX CPU) for secure application hosting on a third-party cloud (e.g., Amazon), and the Blockchain technology that underlies the Bitcoin and other cryptocurrencies by trustworthy data recording. We develop two sets of lab modules, respectively for Intel SGX and Blockchain. The SGX labs address the necessary skills and techniques on software partitioning, SGX memory protection, side-channel security and software attestation. For Blockchain, we build an education tool enabling the integration of Blockchain in students' course-taking experience. We also develop two Blockchain labs on transaction programming and logging applications. Through evaluation, it is shown that the project helps improve students' interest in SGX and Blockchain, and helps them develop secure applications on these platforms.

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Experiences of engineering women faculty in the era of affirmative action

Esther Jose, University at Buffalo, The State University of New York
Matilde Luz Sanchez-Pena, University at Buffalo, The State University of New York

The purpose of this research paper is to question a narrative that is prevalent in a world with an increasing emphasis on diversity- that women succeed easier in STEM/ Engineering careers because they are women. While extensive literature has documented that women still face significant discrimination in academic spaces, the narratives of growing commitments to Diversity, Equity and Inclusion (DEI) efforts by institutions often mislead people to believe that such efforts reflect in direct benefits that give an advantage edge to women or other minorities. This paper explores these dynamics by asking, are women faculty being told that "they have it easier because being a women"? if so, how often, and how it affects their self-confidence? We present the results of an anonymous survey conducted in two Engineering departments at university in the US east. The results reveals that women faculty are indeed told such misconception, and that they are often left doubting themselves when this happens. This extended abstract offers a literature review on the topic, followed by the results of the survey and a discussion of its results.

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Efforts at Syracuse University to Engage Undergraduate and K-12 Students on Research Topics Related to Sustainable Energy Resources and Power Engineering

Dr. Sara Eftekharnejad

At Syracuse University (SU) College of Engineering, various efforts exist to increase participation of the undergraduate students and particularly students underrepresented in the Engineering fields. In this talk, we present specific efforts planned to be conducted as part of a grant enabled by the National Science Foundation CAREER program. It is essential to provide research opportunities to undergraduate students to better prepare them for their future careers and improve student retention rates. Similarly, engaging high school students in engineering research further broadens their understanding of the field and motivates them to pursue careers in engineering. To engage undergraduate students and high school students in research the principal investigator (PI) of this grant will organize two summer internship programs at SU. During the first internship program, which is intended for undergraduate students, the students will work on research topics directly relevant to the field of electric power engineering. Power engineering offers significant job opportunities in the coming years. These new jobs are driven mainly by the retiring workforce as well as the new opportunities brought by the expected increase in renewable energy resources. To recruit students, the PI has partnered with SU College of Engineering Ambassador Scholars Program, which supports students from historically underrepresented groups in Engineering and Sciences. Students will also be recruited from the local community colleges, and the Louis Stokes Alliance for Minority Participation (LSAMP) program, dedicated to increasing the underrepresented students graduating with Bachelor's degrees in STEM fields. For the high school internship program, the existing relationships of the College of Engineering with the local community will be leveraged. SU has an established relationship with the National Society of Black Engineers (NSBE) Syracuse Chapter, which will be leveraged to recruit students.