ASEE

AMERICAN SOCIETY FOR ENGINEERING EDUCATION

2024 FALL ASEE MID-ATLANTIC SECTION CONFERENCE

Hosted by:

Farmingdale State College

State University of New York

October 25-26, 2024

Welcome from the conference chairs

It is our great pleasure to warmly welcome you to the Fall 2024 ASEE Middle Atlantic Section Conference, themed "Excellence in Applied Learning," hosted by Farmingdale State College, State University of New York.

We are excited to gather educators and students to explore the latest advancements and best practices in engineering education.

Over the course of two days—October 25th and 26th—this event will foster collaboration, spark innovation, and celebrate diversity within the engineering and technology communities.

We sincerely hope you enjoy the conference, reconnect with old friends, and make new connections along the way!

Eugene Kwak
Conference Chair

Amit Bandyopadhyay
Program Chair

Eric Anderson
Poster Presentation Chair

Conference at a Glance

FRI, OCT 25	Event		Location
3:00 - 7:00 PM	Registration and Help Desk		Campus Center Ballroom A
3:00 - 5:00 PM	**Workshop Title**: Harnessing the Power of Generative AI: Responsible Utilization of AI Models for Content Generation	Lead Presenter(s): Dr. Benito Mendoza, Dr. Rosa	
4:20 - 5:30 PM	Executive Board Meeting	ASEE MAS ExCom	Mtg Rm B
6:30 - 7:30 PM	Dinner		Ballroom A
SAT, Apr 20	**Event**		**Location**
8:00 AM - 3:00	Registration and Help Desk		Gleeson
8:30 - 9:00 AM	Breakfast		Gleeson 102
9:00 - 9:10 AM	Conference Welcome	Eugene Kwak, Dr. Kenneth	
9:10 - 10:00 AM	**Keynote Title**: Integrated Approaches to Developing an Entrepreneurial Mindset and Technical Communication Skills.	Dr. Ron Harichandran	
10:15 AM-12:15 PM	**Session 1: AI and Technology Integration in Education** Moderator: TBD	Lead Presenter(s):	
	1. 45349: Integrating AI in Engineering Education: A Five-Phase Framework for Responsible ChatGPT Use	Dr. Gonca Altuger-Genc	Gleeson 127
	2. 45316: Leveraging Generative AI to Enhance Engineering Education at Both Low-Level and High-Level Study	Dr. Zhou Zhang	
	3. 45309: Designing an AI-Enhanced Module for Robotics Education in Mechanical Engineering Technology	Dr. Wenhai Li	
	4. 45347: Introducing AI into an Undergraduate Kinematics of Machines Course	Heather Lai	
	5. 45332: Comparative Analysis of Human versus AI-Generated Codes Regarding the Challenges Faced by Students	Dr. Abdullah Konak	
	6. 45385: Writing Skills Can Be Improved Using AI Tools: An Analysis	Dr. Rajarajan Subramanian	
	7. 45401: Adjusting and Designing Assessments in Reducing the Negative Impact of Artificial Intelligence	Dr. Xiaojin Ye	
Morning Techincal Sessions (Each presentation is 14 min w/ 3 min for questions)	**Session 2: Applied Learning, Experimental Research, and Student** Moderator: TBD	Lead Presenter(s):	
	1. 45305: Empowering Electrical Engineers: Project-Based Learning for Environmental Sustainability	Dr. Uma Balaji	Gleeson 129
	2. 45310: Comparison of Undergraduate Engineering Students and High School Students Solving Authentic Problems	Dr. Gang Liu	
	3. 45331: A Case Study on How to Implement Applied Learning as an Institutional Graduation Requirement	Prof. Orla LoPiccolo	
	4. 45374: Incorporating Applied Learning in a Mechanical Engineering Technology Senior Project Course	Dr. Gonca Altuger-Genc	
	5. 45383: Lessons Learned Implementing a Collaborative STEM Workshop for Community College and University Partners	Jessica Santangelo	
	6. 45370: Relation Between Out-of-Classroom Engagement Activities and Student Performance	Prof. Sarath Chandra Kumar Jagupilla	
	7. 45317: Voices of Student Apprenticeship: Exploring the Unique Needs and Perspectives of Community College Students	Dr. Guozhen An	
	Session 3: Curriculum Development and Pedagogical Strategies in Moderator: TBD	Lead Presenter(s):	
	1. 45306: Mathematicians and Scientists Teaching Engineering Courses: Practices, Advantages, and Concerns	Dr. Aiman S Kuzmar	

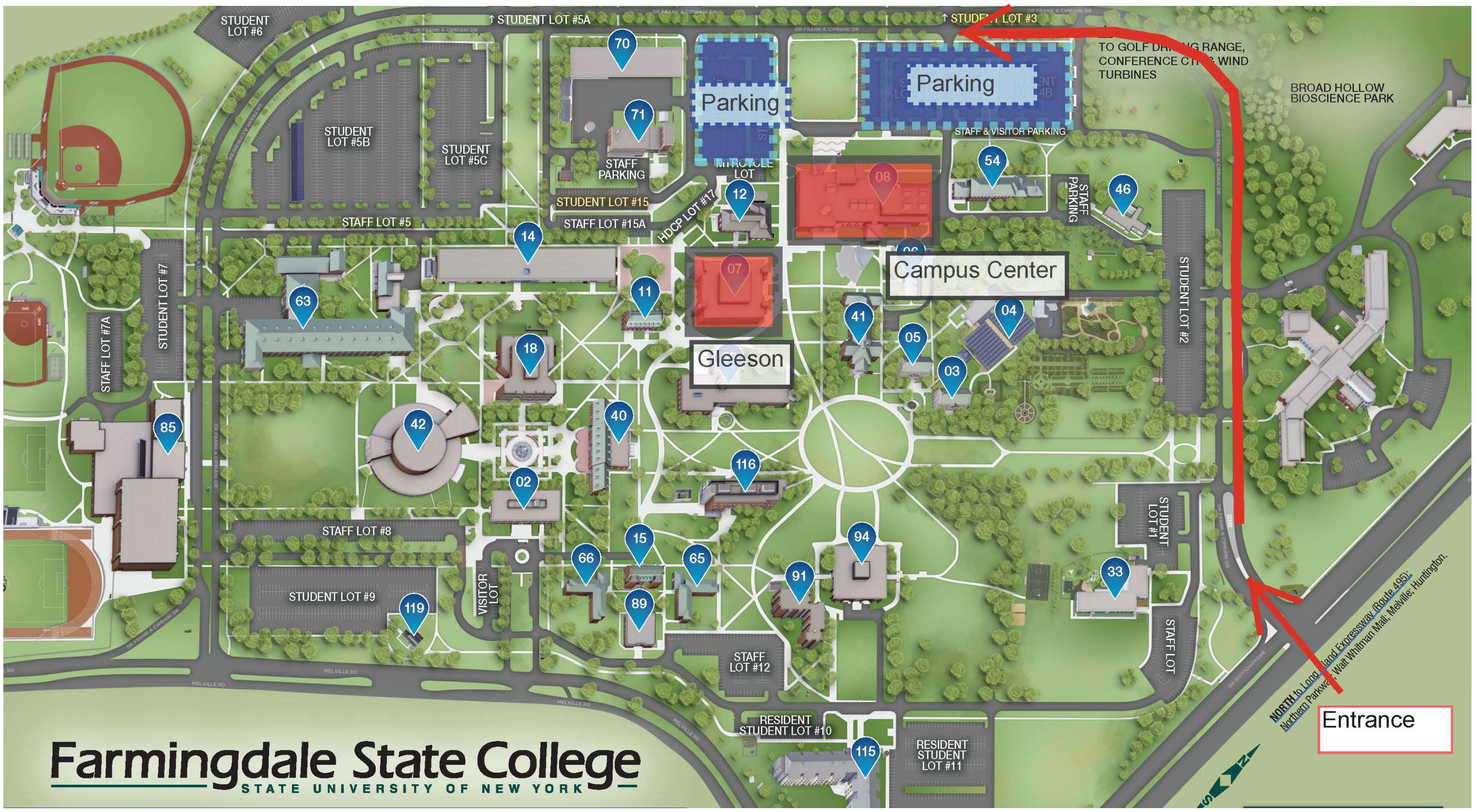
	2. 45358: Helping Mathematically Under-Prepared Students Understand Trigonometric Functions	Dr. Daniel Blessner	Gleeson 125
	3. 45312: Understanding STEM Students' Conceptual Derivative Knowledge Through Analysis of Sub-concept Cognition	Dr. Emre Tokgoz	
	4. 45320: Integrate the iPad, Apple Pencil, and Goodnotes to Enhance Teaching Effectiveness	Arzu Susoglu	
	5. 45314: Incorporating Advanced Industry Practices into the Undergraduate Thermal System Design Course	Dr. Wenhai Li	
	6. 45397: Balancing Theory, Programming, and Practical Application in Finite Element Analysis Courses	Dr. Rachmadian Wulandana	
	7. 45311: Evaluation of Mathematical Building Blocks Impacting STEM Majors’ Ability to Solve Conceptual Power Series Questions	Dr. Emre Tokgoz	
12:15 - 1:45 PM	**Poster Displays**	Presenter(s):	Campus Center Ballroom A
	1. Recycled Concrete With Waste Materials	Konner Stephen	
	2. Data Equity Action Research Initiative	Isaiah Adu, Rachel Burcin, Micah Nye	
	3. Evaluating the Thermal Conductivity and Moisture Transport of Hempcrete	Glenda Giordani	
	4. Inspiring Students' Interest in Math through ODE Simulation: a Self-Paced, AI-Assisted Approach	Chloe Chan, Brianna Fan, Henry Pei, David Shen, Christopher Song, Chenhao A. Zhao	
	5. CLCPA, NYSERDA, Walden and Hofstra: Getting to Net-Zero One Building at a Time	Raymond Spinelli, Joseph Heaney	
	6. Design of Fault Injection Circuit for Digital Systems	Sydney Simpkins, ZsayKaryzmh Harris	
	7. Modelling of Diffusiophoretic Motion for Microplastic Filtration in Microchannel Flows	Graham Werner	
12:30 - 1:30 PM	Lunch & Business Meeting		
12:45 - 1:15 PM	**Lunchtime Speaker Topic**: Update on ASEE	Dr. Grant Crawford	
1:45 - 2:15 PM	**Distinguished Teacher Award Lecture**: Reinventing Engineering Education - Student-Centered Approach	Dr. Sadan Kulturel-Konak	Gleeson 125
1:45 - 4:05 PM	**Session 4: Specialized Topics in Engineering and Science Research** Moderator: TBD	Lead Presenter(s):	
	1. 45298: Exploring Mechanical Anisotropy of 3D-Printed Structures	Marco Hermida	Gleeson 127
	2. 45315: Implementation of Short-Term Undergraduate Psychoacoustics Research Project Involving Human Subjects	Dr. Heather Lai	
	3. 45304: Syllabus Review Assessment: Technical Contract Review	Tracey Carbonetto	
	4. 45328: Flexural Mechanical Properties and Microstructures of 3D Printed Thermoplastics	Dr. Raymond Lam	
	5. 45384: Designing Hands-on Labs for Electrical Principles Courses	Prof. Alireza Dalili	
	6. 45351: Design of Web-Based Engineering Courses to Enhance Student Learning	Shashi S. Marikunte	
Afternoon Techincal Sessions (Each presentation is 14 min w/ 3 min for questions)	7. 45400: Fostering the Development of Engineering Skills Using Online Tools	Dr. Bryan James Higgs	
	Session 5: Education Policy, Sustainability, and Future Engineering Moderator: TBD	Lead Presenter(s):	

	1. 45399: Integrating Climate Change Into Engineering Education	Dr. Bryan James Higgs	Gleeson 129
	2. 45308: Innovative Work-Holding Tool Designs for Safety in Manufacturing Labs	Dr. Khosro Shirvani	
	3. 45325: Development and Assessment Methods for Computer-Aided Manufacturing Courses	Dr. Yue Hung	
	4. 45301: Preparing Students for Inertial Confinement Fusion Jobs in Technology	Dr. Sunil Dehipawala	
	5. 45302: Assessment of Radiation Learning in Physics-Two Course Using the US Bureau of Labor Statistics Occupation Outlook Handbooks for	Dr. Sunil Dehipawala	
	6. 45299: Pedagogy in Undergraduate Cosmic Ray Research Projects with Hands-On Explanation of Engineering vs. Engineering Technology for	Dr. Raul Armendariz	
	7. 45369: The Impact of AI Assistance on Student Learning: A Cross-Disciplinary Study in STEM Education	Mohammad Alshibli	
	8. 45360: Impact of a Femalized Architecture, Engineering, and Construction Kinesthetic Learning Model on the AEC Career Knowledge, Self-efficacy, and Outcome Expectations of African American Middle School Girls	Mercy Folashade Fash	

FSC Map

Main entrance is located on Rt 110, Travel on Route 110, On the right-hand side, you will see a large facility (Broad Hollow Bioscience Park). Turn right into the campus at the Farmingdale State College sign.

Friday parking requires visitor parking pass



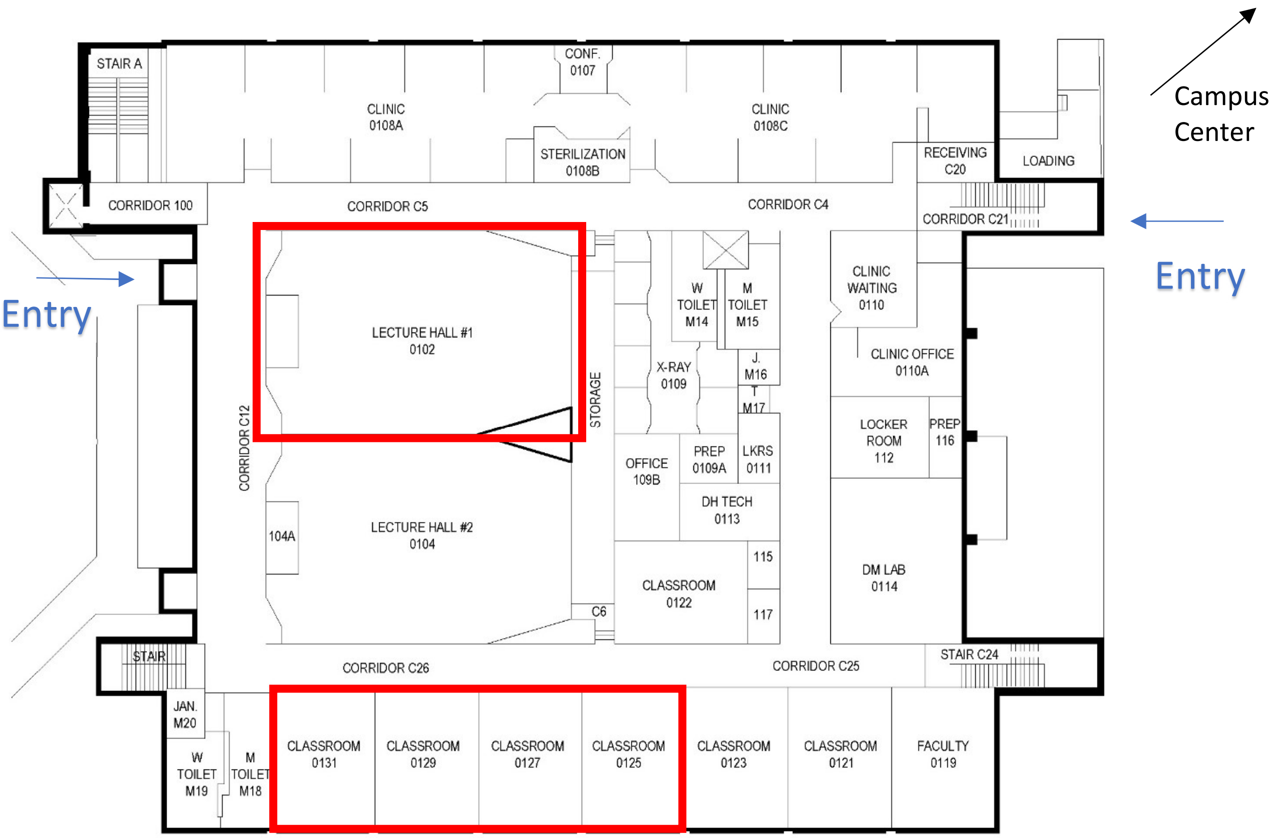
Conference Internet Access

FSC_WiFi Information - Username: fscevents@farmingdale - Password: 796950

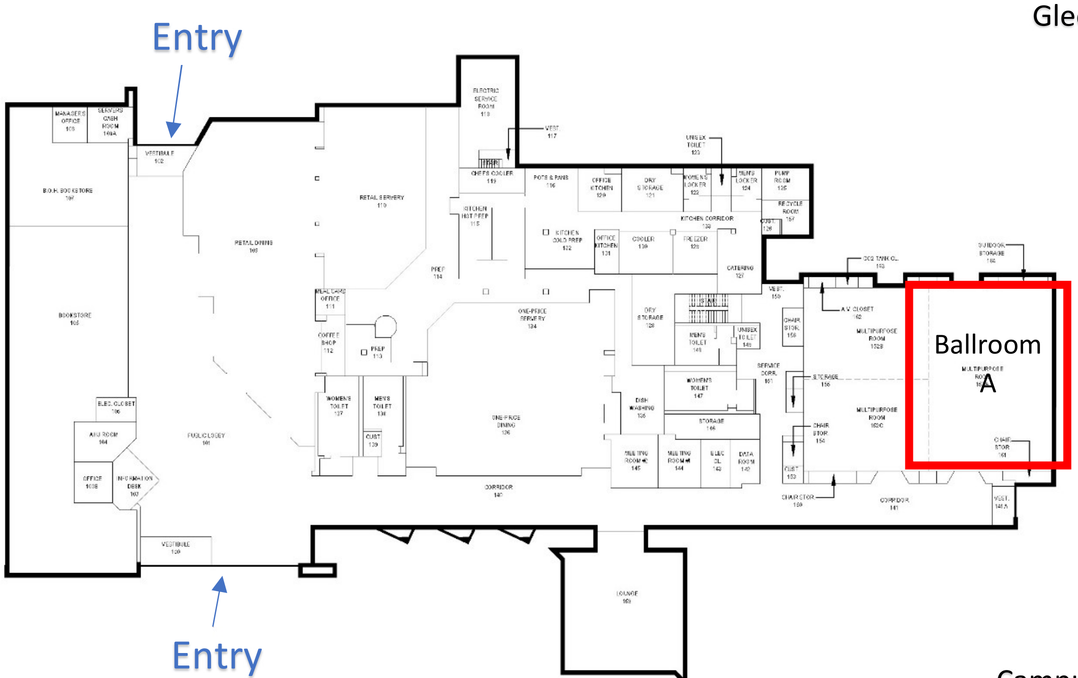
Conference Schedule Link

https://docs.google.com/spreadsheets/d/1WS9ama0gF1-yWDjdf7guAHIqosxOvyzXdT3LnROXsNQ/edit?usp=sharing

Conference Locations



Gleeson Hall



Campus Center

ASEE Conference Speakers

Dr. Ron Harichandran

ASEE Keynote Speaker
Dean of Engineering and Vice Provost for Research at the University of New Haven

Keynote Title: Integrated Approaches to Developing an Entrepreneurial Mindset and Technical Communication Skills.

Dr. Grant Crawford

ASEE President
Professor of Mechanical Engineering, School of Computing and Engineering at Quinnipiac University

Lunchtime Speaker Topic: Update on ASEE

Dr. Sadan Kulturel-Konak

Distinguished Teaching Awardee
Professor of Management Information Systems,

Distinguished Teaching Lecture Title: Reinventing Engineering Education- Student-centered Approach

by Sadan Kulturel-Konak

As engineering evolves rapidly, educational approaches must also adapt to prepare students for this dynamic field. This presentation highlights innovative approaches for transitioning from traditional, lecture-based models to a more balanced blend of lecturing, mentoring, teamwork, independent work, and active learning in both curricular and co-curricular settings. This approach prioritizes student-centered experiential learning, interdisciplinary collaboration, and real-world problem-solving to foster technical proficiency, critical thinking, creativity, and adaptability. Furthermore, finding synergies among all supporting activities through integrated hands-on projects, industry partnerships, and mentorship opportunities will ensure that students are well-equipped for the challenges of the modern engineering workplace. By placing students at the center of their educational journey and acknowledging the crucial role of informal learning in this process, we aim to cultivate the next generation of engineers who are not only skilled and knowledgeable but also innovative, resilient, and prepared to lead in a rapidly changing world. The student-centered initiatives' measurable outcomes will also be highlighted to demonstrate their impact on student engagement and career readiness.

Workshop

Harnessing the Power of Generative AI: Responsible Utilization of AI Models for Content Generation

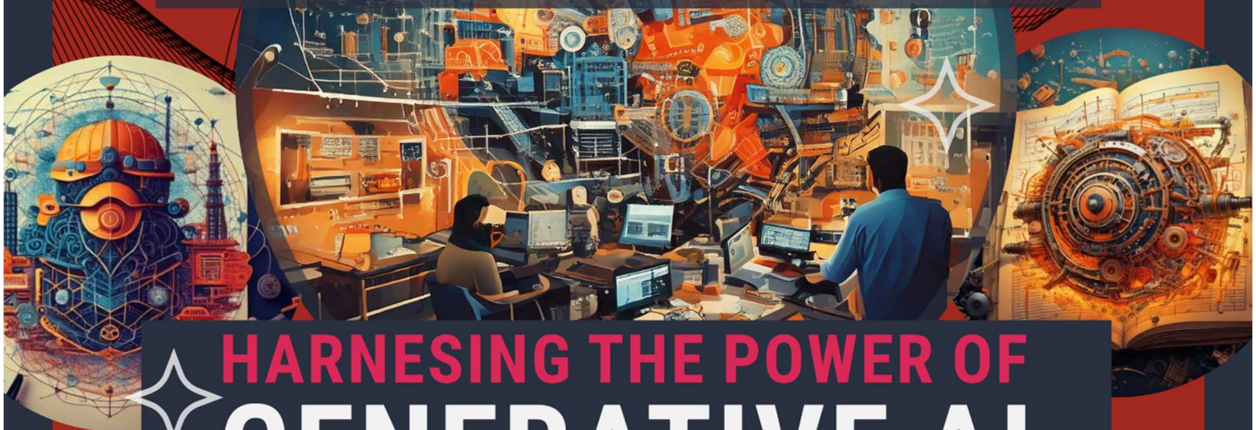
In the last couple of years, artificial intelligence (AI) has become a predominant buzzword, especially after the release of ChatGPT. Generative AI (GenaAI) is a subfield of AI focused on developing models that can generate new content, such as images, text, audio, or even video. ChatGPT is a GenaAI model. In this workshop, participants will learn the basics of GenaAI and how it differs from other traditional AI and machine learning models. They will explore GenaAI's immense potential in various domains, including art generation, content creation, text completion, design, and more. Participants will also learn about the limitations and associated risks of GenaAI. Finally, they will examine ways to mitigate these risks and prevent misuse, including responsible usage strategies, addressing social biases, intellectual property, privacy concerns, and ethical considerations.

Workshop Instructors

Dr. Benito Mendoza
Associate Professor,
New York City College of Technology

Dr. Rosa Zavala
Professor and Chair, Medgar Evers College

2024 ASEE Middle Atlantic Section Conference



HARNESING THE POWER OF GENERATIVE AI IN ENGINEERING EDUCATION

Prof. Benito Mendoza, PhD
Computer Engineering Technology
New York City College of Technology

Prof. Rosa Zavala, PhD
Physics and Computer Science
Medgar Evers College

Artificial intelligence (AI) has rapidly gained attention across academia and industry, particularly after the release of models like ChatGPT. In this workshop, you will learn the basics of Generative AI (GenAI) and how it differs from traditional AI and machine learning models. This workshop will equip you with practical strategies for integrating GenAI into your teaching, research, and innovation efforts while promoting ethical and responsible AI usage.

BRING YOUR COMPUTER!

Friday, October 25
3:00 PM – 5:00 PM
Famingdale State College
RSVP Please!

ASEE

Farmingdale State College
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ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Engineering Design Experience via Exploring Mechanical Anisotropy of 3D-printed Structures

Marco Hermida, State University of New York at New Paltz
Ping-Chuan Wang, State University of New York at New Paltz
Dr. Nancy Campos, SUNY New Paltz
Bianca Bermudez, State University of New York at New Paltz
Shaima Herzallah, State University of New York at New Paltz
Tenmetey Tetteh-Nartey, State University of New York at New Paltz

3D-printing, an additive manufacturing method, involves layer-by-layer deposition of materials. Unlike traditionally manufactured materials, the mechanical strength of 3D-printed structures is highly dependent on the printing orientation due to the weak interface between deposited layers. Two five-week long summer research projects were designed and implemented to explore mechanical anisotropy, engaging teams of undergraduate mechanical engineering students at different stages of their college degree with diverse technical maturity. Research teams were tasked with providing 3D-printing design guidance to minimize unexpected failure, which involves activities from developing experiments within resource constraints, acquiring measurement data, and conducting statistical analysis. Through assessing potential failure modes and iterations in specimen-test designs, the research projects provided an effective platform to allow hands-on learning experience where students used various course knowledge in mechanics, probability/statistics, and finite element modeling to achieve the objective. In this paper, we present how the mechanical integrity of 3D-printed structures depends on the printing orientation and its implications in predicting failure probability under mass production. Also, considerations and implementation of the intensive and immersive summer research programs in enriching engineering curriculum will be discussed for further development and adaptation.

Paper ID #43059

Pedagogy in undergraduate cosmic ray research projects with hands-on explanation of engineering versus engineering technology for community college students

Dr. Raul Armendariz, City University of New York, Queensborough Community College
Corey Stalerman
Prof. Tak Cheung

A cosmic ray research project with the detection of high energy muon showers can serve as a hands-on explanation to the question of "What is the difference between engineering and engineering technology" asked by community college students. Conducting a variety of student projects in parallel within a semester is necessitated by the complexity of the muon shower detection technology, already documented by several detection centers around the Globe. Our unique community college setup includes the remote tracking of the Sun by a muon telescope moving along the ecliptic, and the inclusion of high school students in the Outreach mission of our community college. The pedagogy analyzes a student engineering project as having three components, namely, engineering science, engineering math, and engineering technology. The science aspect of data analysis would span from correlational study of the solar activity with measured cosmic ray flux to the analytical study of ultrahigh-energy cosmic ray (UHECR) data and Alice Collaboration pion decay data, depending on the students' backgrounds. The engineering designs in terms of the measurement science of photomultiplier and counting circuit are covered in the first few practical lessons on the designs of data collection. The engineering math aspect typically spans from Landau distribution analysis to Monte Carlo muon trajectory simulation, consistent with the different math requirements in the ABET accredited programs. The building skills of detection and tracking systems are compulsory as the engineering technology component in the pedagogy. The compulsory component is consistent with the engineering technician job requirements listed on indeed dot com and the relatively larger enrollment of engineering technology students in our community college. The variation of the percentage of each of the three pedagogical components (science, math, technology) to fulfill the DEI mission in an open-admission community college setting is presented with assessment. Expansion of the pedagogy for medical related student projects as orthopedic robots is discussed, consistent with the relatively high demands from the high school students in our Outreach and DEI mission in an urban community college setting.

Preparing community college and high school students for inertial confinement fusion jobs in engineering and technology

Arkadiy Portnoy, City University of New York, Queensborough Community College
Dr. Sunil Dehipawala, City University of New York, Queensborough Community College
Prof. Tak Cheung

The University of Rochester Laser Energetic Lab demonstrated the control of plasma instability in the condition of inertial confinement fusion in April 2023 and secured a 500 million dollars cooperative agreement with the US Department of Energy's National Nuclear Security Administration by December 2023, with new emphasis training for technicians, engineers, operators, etc. As an open-admission community college with DEI focus in an urban setting in New York State, a fusion-learning pedagogy was initiated to recruit and prepare students interested in fusion energy jobs, including those STEM students enrolled in the NYS CSTEP program. The pedagogy consists of experimental experience in laser alignment and Michelson interferometer techniques at Physics II E&M level. Subsequently DOE awarded 100 million dollars to Rochester in the 2024 budget, for the implementation of broadband laser driven fusion with workforce development. The updated pedagogy consists of project experience in target alignment precision and AI driven simulation, consistent with the products of the partner companies in the Rochester Fusion Consortium. The AI driven plasma simulation component was found to be better received by the students, in comparison to the target alignment component using the standard Kalman filter algorithm in Control Theory. The modification of the implementation to the high school students in Outreach program is presented, together with suggestions for improving the first assessment. Recruitment for out-of-state high school students via the NYS Excelsior scholarship pathway and the articulation agreement strategies to facilitate community college students interested in laser driven fusion jobs are discussed.

ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Assessment of radiation learning in Physics-Two Course using the US Guidelines for nuclear engineer and technician careers

Dr. Raul Armendariz, City University of New York, Queensborough Community College
Corey Stalerman
Prof. Tak Cheung
Dr. Sunil Dehipawala, City University of New York, Queensborough Community College

The learning of radiation in terms of the radiation absorption law, radiation energy spectrum, muon examination of nuclear waste, etc., have been deployed in a standard Physics-Two course with students in a community college setting. The syllabus extension to include modern topics and radiation content is necessitated due to the offering of a radiation certificate program, a collaboration of our Community College with the Brookhaven National Lab Nuclear Education and Training Program. The radiation certificate program requires two radiation courses to be taught before the fundamental Physics-Two contents. The model-based pedagogy in Physics -Two was designed to complement the phenomenon-based pedagogy in the prior RAD-1 and RAD-2 courses. The Physics-Two syllabus was adjusted with simplification in topics such as acoustic oscillation, magnetic inductor, etc. to provide additional coverage for the contents in quantum modeling, radiation, absorption, muonic technology applications, etc. The grading and assessment pedagogy followed the standard practice, as summarized conveniently by the University of South Carolina (https://sc.edu/about/offices_and_divisions/cte/teaching_resources/grading_assessment_toolbox/what_is_grade/index.php). The assessment result showed that the learning of the modern topics was not affected by the simplification of the learning of sound and magnetism topics in classical physics. The skills described by the US Bureau of Labor Statistics Occupation Outlook Handbooks for nuclear engineers and technicians were also evaluated. The nuclear engineer skills in analysis and logical thinking were compared to the nuclear technician skills in computer and critical thinking in the context of Bloom's taxonomy. The recitation content relationship to job description on Indeed.com is discussed.

Syllabus Review Assessment: Technical Contract Review

Dr. Tracey Carbonetto, Pennsylvania State University, Allentown

Syllabus Review Assessment: Technical Contract Review

Early career engineers are expected to perform technical contract reviews; many did not have any exposure to this type of task within the engineering undergraduate curriculum. Yet, engineering students recognize course syllabi represent bilateral contracts between the instructor and student (Ulmer, 2018). Instructors often build assignments around syllabus review to ensure students understand the contract's stipulations. "Students read the syllabus to determine the extent to which their expectations will be fulfilled in terms of content and to gauge whether they have the necessary resources and skills to acquire an adequate level of knowledge and competencies." (Rubio & Llopis-Albert, 2022) A novel approach to deepening this understanding and explicitly expressing expectations while teaching the concepts of contract review incorporating the syllabus produced increased acknowledgment of aspects of the course including learning objectives and prerequisite knowledge. This increase was evidenced through a decrease in communication between students and instructors concerning misunderstanding surrounding the syllabus and in course evaluation comments directed at confusion in components of the syllabus. Further, technical contract review in the form of this assignment guided students in detail-oriented practices including compliance providing benefit to further academic progress and future engineering roles. Students acquired knowledge through assessment allowing them to associate terms of the syllabus to terms of a conventional contract such as observables, conditions, precise description, and formal representation. (Farmer & Hu, 2018). A scaffolded, self-reflective, and self-learned assessment directed students in a detailed review of the syllabus. The data from this study cannot be generalized in predicting success in an engineering course; however, previous studies show that students who have an increased understanding of course objectives and expectations have increased learning outcome success (Ulmer, 2018). The data from this study does indicate that utilization of a technical contract review framework for a syllabus review results in better understanding of the components of the course. The study was not intended to result in an improved syllabus; however, the syllabus review assignment may uncover lack of clarity to which the instructor could address.

References:

Farmer, W., & Hu, Q. (2018). FCL: A formal language for writing contracts. Advances in intelligent

systems and computing, 561.

Rubio, F., & Llopis-Albert, C. (2022). Best practices in syllabus design and course planning applied

to mechanical engineering subjects. Multidisciplinary Journal for Education, Social and Technological Sciences,9(2).

Ulmer, J. M. (2018). Evolving characteristics of today's applied engineering college-level

educator: 2013 to 2017. The Journal of Technology Studies, 44(1), 28–40.

Empowering Electrical Engineers: Project-Based Learning for Environmental Sustainability

Dr. Uma Balaji, Fairfield University

Energy demand continues to rise annually. As we prepare electrical engineering students for the workforce, the curriculum primarily emphasizes the design of reliable electrical and electronic systems, power generation, and energy distribution, often placing less focus on the environmental impacts of energy consumption. To promote energy security, some schools offer courses on renewable energy resources and generation as optional electives. However, when this option is unavailable due to departmental resource constraints, raising awareness and encouraging students to engage with this global issue in their own way becomes a valuable alternative. Students are generally receptive to reading topical materials related to their courses and thinking critically about the broader impacts of technology on the environment and sustainability, especially when such problems or projects are integrated into the course for even a small percentage of the overall grade. This approach has been implemented in an electric circuits course, where project-based assignment is designed to encourage students to advocate for clean energy production or safe environmental practices, fostering a sustainable future. The primary goal of the projects is to empower students with knowledge of the current technological landscape and to motivate them to contribute to environmental protection. The project-based assignment will be shared, illustrating how they have been used to inspire students. Additionally, an analysis of student perceptions of these assignments and their impact on developing ethical values and a sense of responsibility will be presented.

Mathematicians and Scientists Teaching Engineering Courses: Practices, Advantages, and Concerns

Dr. Aiman Said Kuzmar, P. E., Islamic University of Madina, Saudi Arabia

Engineering is highly intertwined with science and mathematics. The connection between the three fields of engineering; and mathematics and science is illustrated based on the commonly known and ABET definitions of mathematics and science with those of engineering. An evidence of this connectivity lies in STEM which is a recent field that has been highly visible in the last twenty years. It stands for science, technology, engineering and mathematics. Students have been noticeably swayed away from these crossing disciplines for various reasons. STEM was partially created to attract students back to these careers again.

Discussions are made based on the fact that although engineering has many definitions in the literature, all of them point to a common description. Engineering is basically the application of mathematics and science to solve society's real life problems. Design is a, or perhaps the, key aspect of engineering. This is exactly why engineering students have to take several mathematical courses that can be as high as four or even more at some institutes. They have to take other courses in natural sciences like physics, chemistry, geology, and even biology in some cases, as well. They also must take courses in social sciences. The purpose of such requirements is to have a body of knowledge in mathematics and science sufficient enough to apply in their engineering courses and later in their professional careers.

The general framework of the engineering curriculum is illustrated with examples in the context of the topic of this article. Mathematics and science courses almost entirely make up the 1st year and continue partially in the 2nd year in a typical engineering curriculum. The curriculum starts to include basic engineering courses in the 2nd year. Advanced and specialized engineering courses are in the 3rd and 4th years. This is in line with ABET and other global accreditation requirements. Scientists and mathematicians follow different paths.

This clearly shows that having backgrounds in mathematics and science is a necessary condition for engineers, but it is definitely not sufficient. Engineers have to have many profound engineering courses on top of basic and advanced mathematics and science courses in their engineering curricula.

A scan was made regarding the topic of teaching engineering courses by mathematicians and scientists rather than engineers. On one hand, it was found that mathematicians and scientists are enlisted in engineering departments at several elite universities. On the other hand, almost all institutes of higher education require a degree or more in engineering to be engineering instructors in their announcements. This is especially the case with community colleges. Universities in general leave the door a little bit open in this regard. For universities, the required academic credential to become an engineering instructor is crafted as an advanced degree in the intended engineering field or in "a closely related field." This closely related field can be interpreted as a similar engineering field, but it can also be expanded to include other fields like mathematics and science.

The paper looked critically but objectively at the topic of mathematicians and scientists teaching engineering courses. It discussed the practices, advantages, and concerns associated with this engineering education topic. Of course, the purpose of it is to promote engineering education.

Innovative Work-Holding Tool Designs for Enhanced Safety and Learning in Manufacturing Labs

Dr. Khosro Shirvani, State University of New York, College of Technology at Farmingdale
Dr. Alireza Dalili, State University of New York, College of Technology at Farmingdale

Manufacturing processes laboratory is one of the fundamental hands-on courses that mechanical engineering and mechanical engineering technology students are required to take in their first semester. The main purpose of this course is to introduce the mechanical engineering technology student to the principles and operation of mechanical equipment such as lathes, drill press, milling machines and measuring requirements and measuring instruments.

Individual laboratory projects are typically assigned to each student to reinforce the topics covered in the theory. Throughout these projects, students will be able to use a lathe machine along with proper machining procedures to manufacture mechanical components.

Operator safety is the top priority when working with a lathe machine. Therefore, any method to increase the operator safety is desirable. This paper demonstrates designing a novel work-holding tool to be used during turning lathe operation. The device, which is called Integrated Faceplate Dog (IFD), eliminates the need for using the traditional work-holding accessory (a lathe faceplate). As a result, students will work with the lathe machines much safer, it will enhance the final quality of the manufactured parts, and will greatly reduce the setup time. Overall, there are numerous educational outcomes: students will be able to produce better quality components in a shorter period of time.

Designing an AI-Enhanced Module for Robotics Education in Mechanical Engineering Technology

Dr. Wenhai Li, Farmingdale State College
Dr. Yue Hung, Farmingdale State College
Reiss Guttman
Sen Zhang, State University of New York, Oneonta
Ning Yu, State University of New York, Brockport

Introduction:

Artificial Intelligence (AI) is rapidly transforming various industries. At SUNY, we recognize the critical importance of introducing AI to our students and equipping them with the knowledge and skills necessary for future success. In a collaborative effort across four SUNY campuses, we are developing AI applications tailored to different disciplines. At the Farmingdale campus, the demand among students to learn how to integrate AI into mechanical systems is accelerating. However, there is a significant gap in AI education specifically designed for Mechanical Engineering Technology (MET) students, particularly those with limited backgrounds in mathematics and programming. Our proposed five-week module integrates foundational AI concepts with hands-on robotics applications, ensuring that MET graduates are prepared to lead and innovate in their field. This work is the result of the 2024 SUNY IITG grant.

Educational Approach and Objectives:

This module will be integrated into the final five weeks of the robotics class, with each week comprising a lecture and a corresponding lab session:

Lecture Topics:

• Week 1: Introduction to Machine Learning (ML) - Covers the basics of ML, emphasizing applications in robotics and automation.

• Week 2: Classification & Regression - Explores AI algorithms used in robotics for tasks like object detection and sensor data analysis.

• Week 3: Neural Networks - Introduces neural networks and deep learning, focusing on applications in robotics.

• Week 4: Computer Vision & Natural Language Processing - Discusses CV and NLP fundamentals, highlighting their roles in robotics.

• Week 5: Reinforcement Learning - Covers core concepts and applications of reinforcement learning in robotics.

Lab Projects:

• Week 1: Remote Control Robot Arm with Python - Students will set up and control a robot arm using Python.

• Week 2: Automation using Computer Vision - Students will use Pixy2 sensors to automate a robotic pick-and-place operation.

• Week 3: Automation using Self-Trained Models - Students will train a model using Google Teachable Machine to automate a sorting operation.

• Week 4: Voice Controlled Robotic Arm - Students will develop a project to control the robot arm's pose using natural language.

• Week 5: Reinforcement Learning for Robotic Arms - Students will set up a simulation where a robot arm learns to improve its performance.

Significance and Goals:

This module provides MET students with a foundational understanding of AI and ML, focusing on practical applications in robotics. It is designed to integrate seamlessly into the existing curriculum, offering students the opportunity to become proficient AI practitioners. By aligning with industry trends, this module ensures that students are equipped with skills highly valued in the workforce, enhancing their job prospects in a rapidly evolving market.

Acknowledgments:

This project is supported by the SUNY Innovative Instruction Technology Grant (IITG).

Comparison of Undergraduate Engineering Students and High School Students Solving Authentic Problems

Dr. Gang Liu, University of Pittsburgh at Bradford

Solving authentic problems is complex progress consisting of understanding the problem, communicating with the sponsors, interpreting in scientific language, making project statements, figuring out the key factors, brainstorming possible solutions, screening down the most feasible solutions, initiating the design, optimizing the parameters with some compromises, iterating the whole progress, finalizing the best technical solution, and presenting the technical solutions to the sponsors. This progress might include building prototypes to demonstrate the feasibility of the design if required. To make these two groups comparable, the students are allowed to make proposals of their solutions with theoretical calculations, simulation, finite element analysis (FEA), computer-aided design (CAD), or just hand drawing with trial-and-error methods.

The differences between high school and college students were studied in many ways except how they address and attempt to solve authentic problems. The present paper investigated these two groups of students when they were challenged by authentic problems. Since the two groups are vastly different in their knowledge level of mathematics and physics, and their mental maturity, the present paper will only cover some comparable aspects, including the logic, steps, procedures, screening, group contribution, confidence, and seeking help from others.

The author of the present paper served as the instructor of senior capstone projects in Mechanical Engineering at a public university on the southeastern coast of the United States for many years and also had experience instructing high schoolers selected from more than 35 high schools to solve some authentic technical problems that came from daily life. The unique experience allowed the author to compare the differences between those two student groups and the findings could help the educators to understand the discrepancies in our curriculum transiting the high schooler to college study. The research result will give instructional suggestions for the future early STEM curriculum development, and also the current college engineering revolution.

Evaluation of Mathematical Building Blocks Impacting STEM Majors' Ability to Solve Conceptual Power Series Questions

Dr. Emre Tokgoz, SUNY - Farmingdale State College

Solving power series questions in calculus requires demonstration of the associated sub-concept knowledge and the ability to progress from one content to another for deriving the desired outcome. In this building blocks of calculus concepts, furthering algebraic question solutions is a process of advancing from one sub-concept to another. For instance, a student who is trying to solve a question that requires to determine the derivative of a function's power series term-by-term would need to know how to apply derivative formulas term-by-term, be able to simplify and calculate algebraic expressions, and demonstrate cognitive ability to design a solution that integrates sub-concepts simultaneously. Failing to advance the solution in one of the sub-concepts as a part of the traditional paper-pencil solutions would be a failure in determination of the entire solution. The goal of this research is to investigate the impact of any sub-concept that impacts STEM students' responses to the research question. This investigation requires to focus on the building blocks of several concepts to determine a solution to a power series and differentiation related question by demonstrating an understanding of concepts such as algebraic and derivative calculations, power series, infinity, factorials, and functions' equality.

Written responses of 18 senior undergraduate and graduate mathematics and engineering students' responses to a power series research question are initially collected after attaining Institutional Review Board approval. A follow-up video recorded interview with each participant is conducted upon the written response collection. The data is analyzed by introducing a new evaluation method called Conceptual Learning Distribution (CLD) along with the application of Triangulation evaluation introduced by the author on the same data set. Qualitative (participants' interview responses) and quantitative (statistics used after applying APOS theory) results are evaluated in this work by using the written questionnaire and video recorded interview responses. STEM educators and researchers can benefit from the results attained from this work by possibly adapting the CLD as a method of student performance evaluation and apply it as a research methodology for determining comprehension levels of mathematical concepts.

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Understanding STEM Students' Conceptual Derivative Knowledge Through Analysis of Sub-concept Cognition

Dr. Emre Tokgoz, SUNY - Farmingdale State College

The derivative of mathematical functions is one of the central concepts in engineering applications, therefore investigating engineering students' ways to understand the derivative concept and ability to respond derivative related questions is an interest of STEM educators and pedagogical researchers. The nature of a calculus question with multiple sub-concepts can make it a difficult task to solve the problem for students, therefore a closer look at STEM students' missing conceptual knowledge through their responses to a complex calculus question and analyzing it pedagogically appears as a necessity to improve teaching practices.

In this work, we use empirical data to analyze and evaluate engineering and mathematics students' comprehension of the derivative concept. The empirical data is collected from 20 undergraduate STEM majors who were enrolled at a mid-sized university located on the Northeast side of the United States. This IRB approved research's participants are compensated for their written responses to the following research question and the follow up video recorded oral interviews.

Is h(x)=sin(|x|) a differentiable function for all real numbers in the domain? Please explain the domain of the function if it is differentiable. If it is not differentiable please explain why.

The calculus sub-concepts used for evaluation included the following:

• Differentiability.

• Function domain.

• Composition of functions.

• Graph of a trigonometric function.

• Absolute value function.

There were two types of data collected during the research period: The first type, quantitative data, consisted of pre- and post-interview responses of the participants. The pre-interview written response was the solution of the participant to the question prior to the video recorded interview. The post-interview response was the written response of the participant during the oral interview in the case the participant wanted to add or change the existing answer. The oral interview was video recorded and conducted to ask more questions on written responses to investigate the research participants' conceptual understanding of the research question related concepts.

The research team used Action-Process-Object-Schema (APOS) theory as well as the concept image and concept definition of derivative to analyze the collected data. Asiala et al. applied the APOS to mathematical topics in 1996, and this theory was explained as the combined knowledge of a student in a specific subject based on Piaget's philosophy from 1970s. Participants' concept image and concept definition perception used by Tall (1981) is also used in this research for analysis of the data. The qualitative data consisted of the transcription of the video recorded interviews. Overall, qualitative and quantitative analysis of the data indicated participants' weakness in establishing a connection between the concept image and concept definition of the derivative concept while the main weakness in sub-concept knowledge was observed to be the absolute value function knowledge to determine the derivative of the sine function.

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Incorporating Advanced Industry Practices into the Undergraduate Thermal System Design Course

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Abstract:

The extraordinary computing capabilities available in today's data centers and the high-performance demands in the automotive and aviation industries have escalated the need for advanced thermal management solutions. Traditional thermal system design courses at the undergraduate level, however, have largely remained focused on fundamental heat transfer theories and classical benchmark problems. This conventional approach leaves a significant gap between the knowledge students gain in the classroom and the practical skills they need to design realistic thermal systems in their professional careers.

The traditional thermal system design course, typically offered at the senior level, does not include modern heat transfer surfaces, such as those used in cutting-edge technologies like supersonic jet engines. These engines, for instance, utilize modern cooling technologies with thousands of heat transfer passages capable of reducing immense amounts of heat within microseconds. Such innovations, made possible by advances in additive manufacturing and 3D printing, allow for the creation of extraordinarily complex geometries, offering high heat transfer rates and surface area-to-volume ratios that are critical for effective thermal management.

Given this context, we have identified two primary reasons for the gap between academic learning and industry practice:

1. The latest innovative developments in thermal system design are not included in the current curriculum.

2. There is a lack of accessible commercial thermal system design software that allows students to engage in realistic problem-solving and gain hands-on experience.

To address these challenges, we propose a comprehensive redesign of the existing undergraduate thermal system design course. Our redesigned course will include a new two-week module focused on bridging this educational gap. This module will:

1. Introduce the Latest Industry Advances: Students will explore cutting-edge thermal management technologies, including triply periodic minimal surfaces (TPMS), topologically optimized surfaces, helical heat exchangers (HEXs), and manifold-microchannel HEXs. These topics reflect the current state of the art in industry, driven by innovations in additive manufacturing.

2. Incorporate Practical Design Experience with INSTED: To complement the theoretical knowledge, students will be introduced to INSTED, an intuitive, cloud-based thermal system design software developed by TTC Technologies. This tool is specifically designed to be user-friendly, allowing students to apply their learning by designing realistic thermal systems that reflect the complexities they will encounter in industry. Through hands-on projects, students will gain valuable experience in solving practical thermal design challenges, thereby better preparing them for their future careers.

This course redesign aims to equip students with both the theoretical foundation and the practical skills necessary to meet the evolving demands of the thermal systems industry. By incorporating the latest technological advancements and providing access to state-of-the-art design tools, we ensure that our graduates are not only knowledgeable but also capable of contributing effectively to their professional fields.

Implementation of short-term undergraduate psychoacoustics research project involving human subjects.

Dr. Heather Lai, State University of New York at New Paltz
Anne C Balant, State University of New York at New Paltz

This paper outlines the development and implementation of a five-week undergraduate psychoacoustics research project involving human subjects. It details the preparation and scaffolding necessary for students with limited research experience to complete the project within a compressed timeframe. The psychoacoustics project was completed by two undergraduate students as part of a summer research program targeting underrepresented minority undergraduate STEM students. In addition to providing valuable research experience, the project included the goal of helping the students develop an appreciation of the importance of human factors in research and engineering design, aligning with ABET outcomes 2 and 4.

The project described was a part of a larger research initiative related to wind farm acoustics. This initiative has three main components: data collection and characterization using artificial intelligence, perceptual analysis of the psychoacoustics of wind farm noise, and community engagement. The students were taught the principles of field research including outdoor acoustical measurements and psychoacoustic research involving listening studies with human participants. They participated in the data collection, design and completion of the psychoacoustic tests with human participants, and analysis of results.

The success of this project in the compressed timeframe was largely due to tools and structures that were in place from previous research, as well as careful advanced planning. Scaffolding of the student tasks within the five-week project were structured so that the students would have a role in decision making throughout the process. Faculty mentors provided oversight and technical guidance throughout the process, while the students were given the responsibility of drawing conclusions and determining how to best communicate their results. With strong faculty support and preparation, the students demonstrated autonomy in completing the project, successfully collecting, analyzing, and presenting data. This experience reinforced the value of psychoacoustic studies and encouraged consideration of human factors in engineering design.

LEVERAGING GENERATIVE AI TO ENHANCE ENGINEERING EDUCATION AT BOTH LOW-LEVEL AND HIGH-LEVEL STUDY

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Generative Artificial Intelligence (AI) has emerged as a transformative tool across diverse sectors, showcasing groundbreaking innovations such as ChatGPT, Dolly, and PopAI. As AI technologies continue to permeate education, discussions surrounding their pros and cons intensify. On the other hand, engineering students face multifaceted challenges, with lower-level classes requiring transitions to lifelong learning, critical thinking, and practical-theoretical integration, while higher-level classes demand knowledge expansion and adept application of theoretical concepts. Integrating practical projects into engineering education is a common and effective method to help students confront these challenges. However, students often grapple with constraints like time limitations, creative hurdles, knowledge gaps, asynchronous guidance, and narrow horizons. The integration of Generative AI presents novel solutions to these obstacles, enhancing project development and fostering heightened levels of creativity and efficiency. After implementing Generative AI technologies for two semesters, the outcomes are notably encouraging, with student projects exhibiting marked improvements in quality, depth, and originality, and the integration of AI tools fostering a culture of lifelong learning and innovation among students. Nonetheless, ethical considerations, notably concerning plagiarism, demand meticulous attention, with rigorous measures for detection and prevention imperative to uphold academic integrity. In conclusion, the integration of Generative AI signifies a paradigm shift in engineering education, enriching learning outcomes and nurturing innovation and lifelong learning, while steadfastly upholding academic integrity through rigorous ethical considerations.

Voices of Student Apprenticeship: Exploring the Unique Needs and Perspectives of Community College Students

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This paper explores student perspectives on a paid and credit-bearing technology apprenticeship program offered by a community college in a large metropolitan area. The program is offered in collaboration with a large non-profit organization that brings together local branches of Fortune 500 companies to offer apprenticeship positions in the software engineering technology field. The goal of this paper is to describe how technology apprentices enter existing Communities of Practice (CoP's) at their partner companies. In doing so, the paper will explore apprentices' perspectives on their company environments, work roles, team structure, and learning processes. By highlighting the insights of student apprentices, the authors hope to motivate further programmatic improvements, and to help others become familiar with the unique needs and perspectives of this student population. During the most recent cohort of the apprenticeship program, the authors recorded the feedback that apprentices shared, as well as their own observations of the program, which formed the foundation of this work The apprenticeship program described here has both high rates of student acceptance and high rates of conversion to full-time roles following the program, and thus can serve as a model program for others interested in promoting student apprenticeship.

Integrate the iPad, Apple Pencil, and Goodnotes, to enhance teaching effectiveness.

Prof. Arzu Susoglu, SUNY Farmingdale

Using multimedia such as slides, diagrams, charts and videos as visual aids during lectures has proved to be very effective in teaching. These tools not only help teachers stay organized but also improve students' learning experiences. Visual aids clarify complex information and help maintain student's attention.

Traditional notetaking, where students copied what teachers wrote on the board while adding their own notes, has successfully been replaced by slide show presentations. Over the past few decades, slide shows such as PowerPoint presentations, have been used to structure lectures, allowing students to write less and focus more on the content. This approach also enables teachers to concentrate more on their teaching, adding notes as they go through the slides, and incorporate additional strategies such as discussions and group work. These materials can then be saved and shared with students afterward.

Although a clicker might help, a teacher must stay close to the computer to add notes to the slides while teaching. In addition, the teacher is responsible to then save the annotated slides and reshare it with students.

This paper advocated the use of hand-held devices, such as the iPad Air or iPad Pro, paired with a smartpen, and a note-taking App like Goodnotes, to enhance teaching, particularly in design- and math- heavy courses. Additionally, it suggests that Goodnotes should be updated to be more teacher friendly. These tools enable teachers to review slides, draw diagrams and add handwritten or typed notes in various colors and fonds, edit, highlight, and use laser features - all while having the flexibility to move around and position themselves anywhere in the classroom.

Additionally, these tools allow teachers to share a link to the digital notebook they are working on, enabling students to view its content in real-time from any device at any location. Students can flexibly navigate any page of the notebook on their screens, while working on problems or in groups. Those who miss class will also have instant access to content. Teachers do not need to upload anything, sharing the link once and using the same notebook is sufficient.

Course development and assessment methods for Computer Aided Manufacturing Course

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John Bussani

This paper presents a detailed approach to the design, development, and student evaluation of a Computer-Aided Manufacturing (CAM) course, a core requirement in the Mechanical Engineering Technology and Manufacturing Engineering Technology programs at Farmingdale State College. The course uses MasterCAM, a commercial software, as the primary tool, and focuses on fundamental CAD modeling and toolpath programming. It not only covers essential software commands but also integrates best practices in machining into CNC programing, providing students with a comprehensive understanding of the CNC field. The course is designed to include hands-on experience, ensuring that students gain practical skills.

The paper discusses how the course materials bridge the gap between academic learning and the skills required by the industry, aligning the curriculum with typical industry settings. Various assessment methods, such as self-assessments and project-based evaluations, are outlined for evaluating student learning. Due to limited class time, executing each student's CNC program on a CNC machine may not be feasible; therefore, the paper also explores how setup sheets and simulations can be used to assess student work effectively.

Both the course curriculum and assessment methods can be adaptable for in-person and asynchronous online formats, ensuring accessibility and effectiveness across different learning environments. These methods lay the groundwork for future research to analyze the effectiveness of the curriculum and assessment strategies in achieving the desired learning outcomes.

Flexural Mechanical Properties and Microstructures of Three-Dimensional (3D) Printed Thermoplastics

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This study was undertaken to investigate flexural mechanical properties and microstructure effects of three-dimensional (3D) printed thermoplastics including acrylonitrile styrene acrylate (ASA), Polylactic Acid (PLA), and PolyJet material. Test specimens were manufactured using the three-dimensional printing technologies of Fused Deposition Modeling and Liquid Jet employed by four 3D printers. Specimens of rectangular plate shape were printed at a combination of raster angles of 0 degree, 45 degrees, and 90 degrees; orientations of flat and up; and structures with 10% fill and 50% fill. A universal testing machine was employed to determine stress and strain during a 3-point flexural bending test. Modulus of elasticity and flexural strength were determined and compared.

A Case Study on How to Implement Applied Learning as an Institutional Baccalaureate Graduation Requirement

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The definition of applied learning has broadened from hands-on assignments to assisting students to develop essential knowledge and skills through contextualized real-world learning to prepare for employment, community engagement, and further education through courses or co-curricular activities. Applied learning includes experiences such as practicum, undergraduate research, internships, clinical placement, civic engagement, service learning, cooperative learning, and independent/directed study. Research on applied learning in the classroom shows that it is an accepted method to reach student learning outcomes and increase student's ability to function effectively in their career, civic, and continued education during and beyond their undergraduate education. While there is research on the effectiveness of applied learning as a pedagogy, implementing applied learning across an institution with various disciplines needs investigation. The goal of this paper is to provide a case study with quantitative and qualitative data using document analysis, give an outline of the SUNY Applied Learning Initiative, and show how Farmingdale State College implemented applied learning as an undergraduate graduation requirement further to the State University of New York (SUNY) Applied Learning Initiative. To date, the Farmingdale State College Applied Learning Review Board has approved 159 applied learning courses (both full and enhanced courses) and 144 non-credit co-curricular applied learning activities [1]. Since the 2018 launch of the Nexus Center for Applied Learning and Career Development, 56 of their applied learning co-curricular experiences have been approved [2]. In addition, the Carnegie Foundation selected Farmingdale State College for the 2020 Community Engagement Classification Title [3]. The results of this study will provide institutions with an understanding and shared resources on how to incorporate applied learning throughout a school of engineering, across campus, or potentially as a baccalaureate graduation requirement.

Comparative Analysis of Human versus AI-Generated Codes Regarding the Challenges Faced by Students in Innovation Competitions and Programs

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In the dynamic field of educational technology, there is an increasing emphasis on incorporating artificial intelligence (AI) into educational settings. Through interviews with mentors and students, this study compares the effectiveness and reliability of AI-generated qualitative codes with human-generated codes in addressing student challenges during Innovation Competitions and Programs (ICPs), such as hackathons, ide competitions, and pitch competitions. While ICPs encourage creativity and innovation, participants often encounter significant challenges. The methodology involves analyzing qualitative responses to student challenges from students involved in the ICPs. Preliminary findings suggest that AI-generated codes offer improved efficiency and objectivity, while human evaluators provide crucial nuanced insights into student challenges. The results showed a high level of agreement between human and AI-generated overall themes that highlight student challenges during ICPs. However, a low agreement was found in mapping AI-generated codes to transcript files. Based on the identified codes and themes, several recommendations were made to make ICP more inclusive learning events for all students.

Introducing AI into an undergraduate Kinematics of Machines course

Dr. Heather Louise Lai, State University of New York at New Paltz

A first attempt at adding machine learning / AI into a 3rd year mechanical engineering Kinematics of machines course is discussed. The course, required for all mechanical engineering students, involves the kinematic analysis of linkages, gears and cams following a traditional course outline. The course has been modified to include more computer-related solution techniques, without increasing the required prerequisite knowledge of the students.

The portions of the course which are most significantly affected by this change are the sections related to analysis and syntheses of 4 bar mechanisms. Several topics including graphical methods for performing position, velocity and acceleration analysis of linkage have been truncated to make room for content related to computational computer-based methods.

The coding language used for the computer programming in this course is MATLAB. As computer programming is not a prerequisite for the course, the course scaffolding must include the basic structure for all the necessary programming code. A kinematics of machines textbook with extensive MATLAB code has been selected in order to provide guidance to the students. In addition to this, prebuilt sections of code will be made available, providing building blocks for the students to assemble and tailor their code to the specific characteristics of the linkage they are analyzing and the goals of their computations.

Vector loop analysis is used to develop position, velocity and acceleration analytical equations. Solution techniques for the vector loops will include traditional hand calculation based methods as well as several computer based computational methods. Code for performing Newtons' method is taught along with the use of more complex built in MATLAB functions such as fzero and the solve command. Optimization techniques for mechanism synthesis will also be added to the course, providing students with an opportunity to go beyond traditional trial and error methods and utilize MATLAB's optimization toolbox to improve on their designs. The use of machine learning in mechanism optimization will also be covered and used for simple examples. The extent that it can be used for more general problems is limited by access to algorithms and computational resources.

This is a work in progress, to be presented during the semester of the first implementation. The instructor's attempts will be described in order to prompt discussion related to the implementation of AI in traditional engineering courses.

Integrating AI in Engineering Education: A Five-Phase Framework for Responsible ChatGPT Use

Dr. Gonca Altuger-Genc, State University of New York, College of Technology at Farmingdale
Dr. Akin Tatoglu, University of Hartford

One of the challenges as the new technological advancements become part of everyday lives are to be able to incorporate and responsibly use them. The use of generative AI tools such as ChatGPT, started to become more common, especially in educational settings. One of the challenges is to understand how can we support students to be responsible generative AI users while highlighting the importance of original work and creativity. Another challenge is also how can faculty decide on the appropriate amount of AI usage in student assignments: what is acceptable and what will fall under plagiarism.

To address these challenges and to encourage students to be creative while still be responsible using AI-based platforms, a series of examples and exercises are designed to be incorporated in the engineering and engineering technology courses. The goal of these examples is to teach students how can they use AI-based tools, such as ChatGPT, to improve their work, however also to teach them to not to solely rely on outcomes from ChatGPT. The examples also will provide students opportunity to be able to identify the relevance and reliability of the information they may get from AI-based tools. In this paper, the authors will share sample examples and implementation procedures for the examples along with assessment tools faculty can use to assess the examples.

Design of Web-based Engineering Courses to Enhance Student Learning

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In recent years, many universities are looking for alternatives to in-person teaching. Offering engineering courses in online formats: either fully web-based or hybrid format can be quite challenging. While some students still prefer in-person teaching for engineering courses, there are also significant benefits to online formats. For many universities/programs, it is a way of attracting nontraditional students as well as students from other universities since it generates additional student credit hours, which would not be possible with traditional in-person class. With this in mind, we started offering two engineering courses: one design class at the undergraduate level, and another materials class at the graduate level. Both the courses were offered during the summer semester to attract students who may not be on campus. I was the instructor as well as the developer of the web-based (asynchronous) course. While teaching courses in synchronous format (Zoom) during Covid_19 provided some insight into online teaching, moving into asynchronous format required significant additional effort. The web page for the course included recording of videos to convey important information, and supplemental materials with example problems, in addition to presentation slides. This paper provides challenges encountered strategies adopted to enhance student learning.

Helping Mathematically Under-Prepared Students Understand the Actual Trigonometric Functions

Mr. Daniel Blessner, Pennsylvania State University, Wilkes-Barre Campus

Making surveying engineering education accessible to mathematically under-prepared students entering college is difficult due to the demanding mathematical requirements the major demands. One area of difficulty is understanding the trigonometric functions. Part of the problem is that the trigonometric functions seem mysterious because they are only seen as keys on a calculator.

The trigonometric functions are classified as transcendental functions. A transcendental function cannot be written as a finite combination of algebraic expressions. The key word is FINITE. This fact in most cases eliminates the equation form from ever being seen by students. Students know them only by the word's sine, cosine, and tangent on a scientific calculator.

Below is the actual formula for sine function.

y = f(x) = sin(x) = x – x3/6 + x5/120

For simplicity, only the first three terms in the series will be used. Introducing students to these formulas will give the mathematically underprepared student the hands-on feel of working with familiar functions such as linear equations.

This paper is intended to help under-prepared students understand the trigonometric functions and the notation used to represent them. Most students don't realize that the f in f(x) is being replaced by sin, cos, and tan. It will then be explained that these formulas are programmed into their calculators and are accessible by the sin, cos, and tan keys on a calculator.

This paper will contain an abbreviated chapter that highlights these changes and can be included in any trigonometry course. It will contain several fully worked example problems. The problems will contain the use of the actual functions where students only use a calculator to calculate the first three terms given in the trigonometric formulas.

The effectiveness of using the actual truncated formulas will be measured in upcoming trigonometric classes with surveys.

Impact of a Femalized Architecture, Engineering, and Construction Kinesthetic Learning Model on the AEC Career Knowledge, Self-efficacy, and Outcome Expectations of African American Middle School Girls

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Engaging African American middle school girls in out-of-school-time (OST) Architecture, Engineering, and Construction (AEC) programs can significantly boost their knowledge and awareness of these traditionally male-dominated fields. This study applies Lent's Social Cognitive Career Theory (SCCT) and Bandura's self-efficacy theory to assess the impact of a femalized AEC kinesthetic learning model (fAEC-KLM) on the AEC career knowledge, self-efficacy, and outcome expectations of African American middle school girls. Fourteen (14) African American middle school girls from Guilford County, NC, participated in pre- and post-intervention interviews, evaluating how the fAEC-KLM model influenced their AEC career knowledge, self-efficacy, and outcome expectations. Thematic analysis and pattern coding conducted using NVIVO qualitative software revealed that key components of the fAEC-KLM such as lectures, peer interactions, and kinesthetic/experiential learning interacted with participants' learning experiences including prior OST educational programs, familial social support, deficient/adequate mathematical pedagogy, and pre-collegiate engineering education. These factors collectively enhanced participants' AEC career knowledge, bolstered their self-efficacy, and shaped their outcome expectations. The findings highlight the efficacy of targeted AEC activities within the fAEC-KLM in boosting career knowledge, self-efficacy, and outcome expectations, offering critical insights for developing OST programs that encourage African American middle school girls to pursue careers in AEC fields. These results emphasize the need for such initiatives to reduce the gender gap in STEM and AEC professions, contributing to broader efforts to diversify these vital sectors.

The Impact of AI Assistance on Student Learning: A Cross-Disciplinary Study in STEM Education

Prof. Matthew Fried, SUNY Farmingdale
Mohammad Alshibli

We examine the widespread use of AI in the form of Large Language Models (LLMs) as a tool for academic assistance. The study investigates whether students studying with AI assistance retain more information compared to those employing standard alternative approaches such as using a basic search engine, reviewing with a friend, or contemplating the material independently. The research reveals that while basic tasks and retention may benefit from AI assistance, outsized gains are lacking. Counterintuitively, specific tasks related to deep thinking and conceptual exploration are found to be better served with alternative approaches. We compare different features via hypothesis testing (p-values), ANOVA, logistic regression, and chi-square, highlighting relationships and the lack thereof. The data was collected across multiple colleges in various STEM disciplines, providing a robust cross-disciplinary perspective. Additionally, the paper discusses the influence of ethnic and cultural background, learning styles, technical talent, and other contributing factors to student success when utilizing LLMs.

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Relation between Out-of-Classroom Engagement Activities and Student Performance

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In this study, the relation between out of classroom engagement activities and student performances, measured through GPAs, for engineering undergraduate students in civil, environmental and naval engineering majors is assessed. Five different categories of events were identified– career development, community building, physical activity, academic support, and field trips. Attendance at each event was tracked and academic performance before and after each semester with activities was analyzed. In AY 2023–2024, the department hosted twenty-one undergraduate out-of-classroom activities. Among these, eleven were classified as career-related, three as department community development, one as physical activity, four as academic support events, and two as field trips. Out of the 249 students in the department, 199 attended at least one event. T-tests were used to identify statistically significant differences between attendance rates and performances among different cohorts of students. Senior students were more likely to attend events compared to juniors, sophomores, and first year students. There were no statistically significant differences between attendance rates of juniors, sophomores, and first year students. At the end of the Spring 2024 semester, students who attended at least one event had an average GPA that was significantly higher than those who did not attend any event. Furthermore, the average GPAs had a positive association with the number of events attended. These trends also held consistent when students were grouped as seniors, juniors, sophomores, and first year. Trends among groups such as participants in the co-op program and student athletes were also studied. Co-op and international students who attended at least one event appeared to have a higher GPA than those who did not attend any. However, these differences were not statistically significant, possibly due to small sample sizes. Student athletes, on the other hand, had almost the same average GPAs among those who attended events and those who did not. The data indicates participation in out of classroom engagement activities and student academic performances have a strong association. Tracking temporal trends over multiple years may provide valuable information that could aid in supporting increased student success.

Incorporating Applied Learning in a Mechanical Engineering Technology Senior Project Course

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Applied learning is a crucial part of the learning process, and allows the students to gain hands-on experience by completing projects, courses, or activities that are part of the curriculum. At Farmingdale State College, all baccalaureate program students fulfill 10 hours of minimum approved Applied Learning Graduation Requirement [1]. This allows students practice the knowledge and skills they gained through hands-on projects, or experiences as a part of their course work, or as a co-curricular support activity.

The concept of Applied Learning is even more crucial in the senior level Mechanical Engineering Technology program courses. At the senior level, students have completed majority of their degree requirements and able to combine multiple different skills and knowledge they gained when they are solving a problem. To ensure students gain the proper applied learning experience and to fulfill the Applied Learning Graduation requirement, senior project course is selected as the designated applied learning course. Senior project course is 3 credit capstone project course, where students complete capstone projects from design/development stage to completion of analysis and prototype development and testing stage. This paper will highlight the applied learning activities and components incorporated in the senior project course along with course timelines, assessment process and student deliverables.

NSF S-STEM Funded iAM Program: Lessons Learned Implementing a Collaborative STEM Workshop for Community College and University Partners

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In alignment with the NSF Scholarships in Science, Technology, Engineering and Mathematics Program (S-STEM) [1], a Two-Year Community College, Nassau Community College (NCC) and four-year university, Hofstra University (HU) are within a five-mile radius of each other and are collaborating. The objective is to recruit academically talented low-income students through two pipelines, retain them through transparency of the hidden curriculum, and see them through to graduation in a STEM field from HU [2]. The Integrated and Achievement Mentoring (iAM) Program is a Track 3 (multi-institution) funded program built on the theoretical framework of legitimate peripheral participation [3] with an emphasis on inclusivity, community, and belonging [4]. To date, the Program has increased Scholar retention, academic performance, and engagement with student support services relative to peers [5].

As part of the Program, an annual faculty workshop was designed to catalyze and sustain collaborations between NCC and HU STEM faculty. The workshop consisted of interactive modules to facilitate directed discussions and produce deliverables. We will share the lessons learned, obstacles overcome, and the outcomes of the collaborative process of hosting this type of workshop. The paper documents the process used to identify workshop outcomes and design activities to achieve those outcomes. It outlines specific modules utilized in the workshop including Design Thinking, curriculum alignment, idea emergence, and coalescing into sustainable Working Groups. It further addresses our approach to answer the following questions associated with the workshop: 1) What are the critical processes required to create and sustain pedagogical collaboration across institutions? 2) To what extent does the Program influence a) curricula and pedagogy; b) communication and collaboration across institutions? A summary of initial results will be shared.

Designing hands-on labs for an electrical principles course as part of the mechanical engineering program

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Mechanical engineering students at Farmingdale State College take MET230: Electrical Principles as a core course to be completed as part of the Mechanical Engineering curriculum. Historically, the lab portion of this course has been focused on simulation experiments through National Instruments Multisim software. There have been no hands-on experiments which runs contrary to the college's stated goal of student success through applied learning. In this paper, I will outline hands-on labs that I have designed in order to enhance applied learning in MET230. The experiments require students to build breadboard-based circuits and think about how to arrange the components to achieve the desired circuit function. Measurements required as part of the lab procedure compel the students to think about the locations within the circuit that voltage and current readings need to be taken as well as understand the workings of the Multimeter. In order to preserve the value of Multisim simulations, the students are asked to simulate the circuits in Multisim as well in order to verify their measurements. Furthermore, they are required to refer to their theoretical understanding of the course concepts as they have to present calculations that correlate with their measurements. The lab guidelines for each lab will be outlined in this paper. Experiments and measurements that should be carried out by students as well as an analysis of how student learning will be enhanced through the addition of these hands-on experiments will be presented.

Writing skills can be improved using AI tools: An Analysis

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At the college level, some courses teach ’Technical Writing’ to engineering students at the undergraduate level. Typically, the writing component in the curriculum presents a significant challenge for undergraduate students as they work toward graduation. However, with the introduction of Artificial Intelligence tools for writing, students find it somewhat easier to produce written content for their courses.

Artificial Intelligence (AI) writing tools are sophisticated applications that harness artificial intelligence to enhance the writing process across various domains. These tools utilize advanced algorithms to automate the writing process, enabling users to create high-quality text with greater efficiency. Designed to cater to a broad audience, including students, professionals, and researchers, AI writing tools ensure the production of high-quality, coherent, and engaging texts while promoting adherence to stylistic and formatting guidelines. By automating repetitive writing tasks and facilitating creative exploration, these tools not only improve writing efficiency but also empower users to elevate their writing skills and output quality. As AI technology continues to evolve, these writing tools play a crucial role in transforming traditional writing practices, fostering creativity, and improving overall writing proficiency.

In today’s academic landscape, there is a wide range of AI-powered writing assistance tools available for use when working on reports or essays. Some commonly used tools include ChatGPT, Jasper AI, Grammarly, Copy.ai, Liner, Buffer’s AI Assistant, Writer, Sudowrite, Type, and SEOWind. The presence of AI tools in education is rapidly increasing, and educators need to acknowledge this trend. This paper outlines the various features of these writing tools available in the market and discusses how they can be beneficial for both students and teachers.

Balancing Theory, Programming, and Practical Application for Teaching of Finite Element Analysis Courses

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This study investigates the optimal combination of learning materials and teaching methods for a Finite Element Analysis (FEA) course within the Mechanical Engineering Program at SUNY New Paltz, New York. The challenge lies in balancing the teaching of FEA's mathematical theory and hand calculations, guiding students through basic FEA model programming, and training them in the use of commercial FEA software. Through student surveys, the study evaluates the effectiveness of various learning materials and pedagogical approaches. Findings indicate that while students recognize the importance of understanding the theoretical foundations of FEA, the complex mathematics involved presents significant challenges. Computer programming was identified as the most difficult aspect, whereas modeling with commercial software emerged as the most favored task. Despite some difficulties with teamwork, students expressed a strong preference for project-based learning and group work over individual study and traditional lecture-based approaches. The insights gained from this study provide a framework for structuring FEA courses to enhance critical skills, preparing engineering students for both academic and professional success.

Integrating Climate Change Into Engineering Education

Dr. Bryan James Higgs, University of the District of Columbia

Climate change is one of the major societal challenges of this century and students that graduate from engineering programs must be equipped and prepared to address this challenge. Addressing it will require broad societal changes with impacts that will reverberate through all engineering disciplines. Therefore, it is imperative that climate change and its associated impacts are integrated into engineering curriculum so that the future workforce will be ready. In civil engineering, the impacts will present challenges to the design and maintenance of critical infrastructure systems that support daily life. The key question then becomes ”how do we prepare students for careers that will be dominated by climate change and the associated societal changes that it will generate?” Adjusting the curriculum to include climate change requires careful consideration of the impacts that it would have on the students and therefore the impacts it would have on society. For the desired impact, the undergraduate and graduate level will need different considerations based on the fact that the two students are in different stages of their careers. At the undergraduate level students are preparing for entry-level engineering jobs which will then lead to more senior engineering jobs through experience gains as they advance in their careers. Also at the undergraduate level, curriculum is aligned to ABET student outcomes With one of the key criteria being the preparation of students to become lifelong learners. With this in mind, climate change considerations can be integrated into the existing undergraduate curriculum in civil engineering such that the students that graduate are aware of the impacts that climate change will be having on critical infrastructure systems. At The Graduate level, students are trying to advance their careers through gains and experience in particular disciplines. It is at the graduate level that new courses added to the curriculum can better prepare students to able to analyze and advocate for solutions that combat climate change and its impacts effectively. For graduate students to be fully prepared to address climate change, they need to be equipped with skills in two main areas: (1) risk and resilience and (2) game theory. Skills in risk and resilience are necessary to be able to properly analyze and decide on solutions that minimize the risk that climate change will have on critical infrastructure systems. Skills in game theory are necessary to be able to navigate the complexity that climate change represents which creates a highly uncertain and entirely dependent upon the choices that are made today and into the future. The introduction of course modules was focused on climate change into a selection of the courses in the undergraduate curriculum of civil engineering fostering the growth of the mindset of students to be able to take on the daunting challenge of climate change. The introduction of new courses in risk and resilience and Game Theory at the graduate level is producing engineers with the capabilities to address the challenges of climate change in new ways.

Fostering the Development of Engineering Skills Using Online Tools

Dr. Bryan James Higgs, University of the District of Columbia
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Engineering education is more than knowledge acquisition; it involves the development of a comprehensive set of skills which are valued in industry. A key example of this viewpoint is the process to becoming a professional engineer where potential engineers must demonstrate their skills and ability on two separate occasions (FE Exam and PE Exam) in order to be eligible to become a professional engineer. If the end goal of engineering education is to produce successful engineers, then the approach to engineering education must incorporate methods of skill development in order to effectively develop the desired skills in students before they join the workforce. Skill development focuses on the synergy of five key elements : (1) personal investment, (2) practice, (3) realistic expectations, (4) supportive environment, and (5) feedback. Of those elements, practice and feedback present the biggest challenge in implementation in engineering education because in order to truly be impactful the feedback must occur quickly and in a loop where students receive feedback and then engage in a new practice session that will need its own feedback once complete. Creating a single feedback loop would greatly improve student skill development, but come at the cost of double the time investment for the instructor. Additionally, the magnitude of the impact of feedback is highly dependent upon the time within which it is received. In traditional college course scheduling, feedback on homework is received at least two days after it is submitted. In this scenario, the value of the feedback is greatly diminished as too much time had passed between the practice session and the receipt of feedback. Through the use of online tools, feedback loops can be created for courses in engineering education where students can receive instant feedback on homeworks and quizzes which will then prompt them to immediately review their submission and thus greatly improve the impact of the feedback received. Furthermore, online tools can be used to create the opportunity for multiple attempts on homework and quizzes thus providing new opportunities for students to engage in the practice of their skills. This also generates a feedback loop that can be engaged multiple times where students can immediately apply what they learned from the review of their feedback into a new practice attempt, thus greatly improving the fostering of skills in engineering education.

Adjusting and Designing Assessments in Reducing the Negative Impact of the Artificial Intelligence: A Proposed Study of ChatGPT Usage in Introductory Java Programming Course

Dr. Nur Dean, Farmingdale State College, State University of New York
Dr. Xiaojin Ye, State University of New York, College of Technology at Farmingdale

Artificial intelligence (AI) plays a significant role in both teaching and learning, particularly in computer science courses. Educators are growing interest and concern about artificial intelligence tools like AI-powered chatbots. One of the serious concerns in the academic institution is cheating and weakening students' critical thinking abilities by using AI generated chatbots. This theoretical research proposes to investigate these issues by examining how students use AI-generated technology in assessments and how it affects their learning process. Particularly, this study aims to assess how AI impacts students' computational thinking and determine how technology impacts learning outcomes in computer science courses. The study will aid to create more efficient assessment by gathering and analyzing data from student interactions with AI during assessments. For this proposed research students will be recruited for the study from an introductory computer science course. Through a well-structured methodology involving pre-assessments, AI interaction, and post-assessments, this research intends to provide valuable data that can inform educational practices. This study aims to identify key challenges, such as potential cheating and diminished learning outcomes, while also exploring how AI can be ethically integrated into computer science education. The proposed findings will guide the redesign of assessments to mitigate risks while harnessing AI's benefits, ultimately providing educators with a framework to improve student assessment in an AI-enhanced academic environment.

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Research and Modelling of Diffusiophoretic Motion for Microplastic Filtration in Microchannel Flows.

Mr. Graham Werner, State University of New York at New Paltz
Dr. Kevin T. Shanley, State University of New York at New Paltz

This water filtration method involves separating microplastics from untreated water by inducing them to move perpendicular to the mean flow velocity within a long, thin microchannel. As untreated water flows through the channel, contaminants are concentrated through the action of diffusiophoresis, where, once the particles are separated, the flow can then be split into two streams, which differ in contaminant concentration. Diffusiophoresis defines the motion of colloidal particles, such as microplastics, driven by concentration gradients within a solution, leading to the migration of those particles. This study investigates the use of CO dissolution in water to create such a gradient, driving both electrophoresis by charged particles and chemiphoresis from the solute gradient created. The research explores the effectiveness of these mechanisms for the filtration of charged microplastic particles in microchannels, which shows potential as an economical water filtration method, especially for contaminants whose sizes are in the micrometer to nanometer range. Key parameters including channel geometry, mean flow velocity, solute concentration, and temperature are examined for their impact on filtration performance. Parametric studies reveal how these factors influence the movement of microplastic contaminants such as polystyrene, and a simple model is presented that characterizes the contaminant's phoretic motion in a microchannel flow to provide insights into optimizing diffusiophoretic filtration. While alternative filtration methods exist for small contaminants such as reverse osmosis (RO) and nanofiltration, diffusiophoretic filtration carries the unique benefit of not requiring physical membranes which can foul, and relies on low quantities of pressurized CO, which is an easily transportable and plentiful resource.

Applied Learning in a Human Performance course: A Case Study

Mr. Wenchao Zhu, Northeastern University
Miss Tianyi Zhou, University of Massachusetts Amherst
Prof. Yingzi Lin, Northeastern University

Engineering education should prepare students with the necessary skills to address ongoing industry concerns about skill deficiencies in engineering graduates. Traditional teaching approaches have led to increasing demands for restructuring, delivery, and assessment of engineering courses to better align with the changing demands of the field. In responses to these challenges, innovative courses are being developed to ensure that students gain both theoretical knowledge and practical skills essential for their future careers. This paper presents an in-depth exploration of a Human Performance course within the Mechanical and Industrial Engineering curriculum at a private research university in the United States. The course is designed to introduce human performance and human-machine systems which is critical to improve productivity, efficiency, safety, and quality of work life to students with interest in industries like transportation, healthcare, and manufacturing. Designed to bridge theoretical knowledge with real-world application, it uniquely combines an NSF-funded research on objective pain assessment and prediction with applied learning methodologies. Through a series of lectures and lab practices, students engage in hands-on experiences that involve analyzing real physiological signal data and designing a pain management application tailored to the needs of pain patients. These activities foster an educational experience that not only enhances technical expertise but also encourages critical thinking and problem-solving, key attributes that directly align with the demands and expectations of professional engineering careers after graduation. This paper starts with a literature review of education and learning within the context of human performance. Following this, the course is detailed in three key sections: lectures, laboratory practices, and projects. Each section illustrates how our research on pain assessment was integrated into the course materials, and how laboratory practices and projects were developed in the context of pain research. Additionally, the paper evaluates and discusses the impact of these learning experiences on student outcomes.

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Initiating Action Research to Broadening Participation in STEM: Experiences & Outcomes from CMU Robotics Institute

Ms. Rachel Burcin, Carnegie Mellon University Robotics Institute

Science and technology fuel innovation, generate economic opportunities, and play a vital role in national security. However, with rising competition for a skilled STEM workforce, significant barriers to entry, the ”missing millions” (Gershenfeld et al., 2021), and the persistent underrepresentation of marginalized communities in the U.S., collective efforts are urgently needed to broaden access to STEM education and training. Undergraduate research experiences, which have long been recognized as a high-impact educational practice (Kuh & Schneider, 2008), are essential for building and sustaining the nation’s research and scientific communities. This paper will present the experiences, emerging results, and discuss personal impacts of educators and undergraduate robotics & AI researchers at Carnegie Mellon University engaged in action research that aims to create a safe space to 1) investigate issues of equity, access, and opportunity in US educational landscapes and 2) directly engage in policy action and advocacy with stakeholders.

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