NSF Engineering Education and Centers

Grantees Conference

ASEE

MEETING REPORT

SEPTEMBER 10 – 12, 2024

Westin Alexandria Old Town
Alexandria, VA

ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Founded in 1893, the American Society for Engineering Education (ASEE) is a global society of individual, institutional, and corporate members.

ASEE seeks to be the pre-eminent authority on the education of engineering professionals by advancing innovation, excellence, and access at all levels of education.

ASEE engages with engineering faculty, business leaders, college, and high school students, parents, and teachers to enhance the engineering workforce of the nation. We are the only professional society addressing opportunities and challenges spanning all engineering disciplines, working across the breadth of academic education, research, and public service.

- We support education at the institutional level by linking faculty and staff across disciplines to create enhanced student learning and discovery.
- We support education across institutions by identifying opportunities to share proven and promising instructional practices.
- We support education locally, regionally, and nationally by forging and reinforcing connections between academia, business, industry, and government.
- We support discovery and scholarship among educational researchers by providing opportunities to share and build upon findings.
- We support innovation by fostering the translation of educational research into improved teaching practices.
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2024 NSF Engineering Education and Centers Grantees Conference Meeting Report

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Engineering Education and Centers (EEC) Deputy Division Director Kemi Ladeji-Osias provided guidance and feedback in the early planning stages of the conference and helped inform the conference structure and agenda.

EEC Program Directors Matthew Verleger, Alice Pawley, Patricia Simmons, Amelia Greer, and Jesus Soriano Molla further assisted with conference planning. The conference speakers and attendees, with their contributions over two days of sessions and discussions, provided the substance of this report.

This report was prepared by Alexandra Sharpe and edited by Rachel Koroloff. Quality Evaluation Designs oversaw conference evaluation activities, developed the post-conference evaluation survey, conducted qualitative and quantitative analysis of the post-conference survey, and composed the conference evaluation report. Darcelle Larkin served as event photographer.

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EXECUTIVE SUMMARY

The 2024 National Science Foundation (NSF) Engineering Education and Centers (EEC) Grantees Conference, held on September 10 – 12, 2024 in Alexandria, VA, provided a forum for more than 200 Principal Investigators (PIs) and team leaders to learn, explore, and share ideas promoting innovation in engineering education research and practice.

The conference was organized around the broader theme of "leveraging momentum" which encouraged participants to reflect on the recent past and look towards the future to envision how the engineering education community can leverage momentum to continue effecting positive change in education, research, and practice.

Grantees from the following EEC programs were in attendance: (a) Broadening Participation in Engineering (BPE), (b) Engineering Education, including Research in the Formation of Engineers (RFE) and Research Initiation in Engineering Formation (RIEF), (c) Faculty Early Career Development Program (CAREER), (d) Research Experiences for Teachers (RET); (e) Research Experiences for Undergraduates (REU); and (f) Revolutionizing Engineering Departments (RED).

The conference had three major objectives: 1) to foster knowledge sharing across the network of grantees in attendance, 2) to cultivate personal and professional relationships, collaborations, and partnerships, and 3) to prompt discussions about state-of-the-art and ongoing division-level research efforts.

Results from the post-conference evaluation survey, which was completed by 62% of attendees, indicated that the conference was a success, providing overall value to attendees, and offering worthwhile networking and learning opportunities.

Open-ended responses emphasized the value of formal and informal networking opportunities and the chance to interact directly with NSF Program Officers and gain insights into NSF logistics, specifically related to supplemental funding and guidance on what to do after receiving an award. The highest-rated conference session was the NSF-led Breakout Session by Cluster, with an average rating of 3.47 out of 4.00.

Despite high marks for overall value and organization, survey responses indicated that attendees wished to have additional opportunities for networking with both NSF Program Officers and peers. Additionally, respondents suggested revamping concurrent session logistics, reducing and/or restructuring sessions for optimal engagement, increasing interactive elements across all sessions, and improving the alignment of concurrent session topics with conference objectives.

BACKGROUND

The Engineering Education and Centers (EEC) is a division within NSF's Directorate for Engineering (ENG) that is divided into four program clusters:

1. Broadening Participation in Engineering
2. Centers and Networks
3. Engineering Education
4. Engineering Workforce Development

The goal of the EEC Grantees Conference is to bring together Principal Investigators (PIs) and team leaders with EEC awards to learn, explore, and share ideas aimed at promoting innovation in engineering education research and practice. Attendees represent the following range of programs:

- Broadening Participation in Engineering (BPE)
- Engineering Education, including Research in the Formation of Engineers (RFE) and Research Initiation in Engineering Formation (RIEF)
- Faculty Early Career Development Program (CAREER)
- Research Experiences for Teachers (RET)
- Research Experiences for Undergraduates (REU), and
- Revolutionizing Engineering Departments (RED)

Beyond sharing ideas and best practices, there was a broader theme for the 2024 conference: "leveraging momentum." From the COVID-19 pandemic to the introduction of generative AI, engineering educators have responded to the challenges and shifts of recent years with ingenuity and innovation, working to revitalize curricula and prepare students for new workplace realities. In parallel, there is an increasing focus on engineering for social justice and centering faculty and student mental health throughout our organizational systems and structures.

As educators and researchers reflect on the recent past and look towards the future, how can the engineering education community leverage momentum to continue effecting positive change in education, research, and practice? What changes should be reevaluated or re-designed? What new questions should be asked?

The conference provided an opportunity for EEC grantees to gather and reflect on questions such as these to interrogate current engineering curriculum, along with individual and collective efforts at addressing these questions with a caring and human-centered approach. Sub-themes included:

1. Re-envisioning the use of digital infrastructures to increase access and engagement for faculty and students, while navigating challenges of digital fatigue and isolation.
2. Working towards a human-centered approach to engineering education and research by creating and leveraging synergies, prioritizing systems thinking and interdisciplinarity, addressing ethics and the potential harm in research and new technologies, and building new collaborations with fields outside STEM.
3. Renovating the curricula to address technological and cultural challenges while considering ways to better prepare students to engage in an increasingly global and inclusive engineering workforce.
4. Incorporating the principles of diversity, equity, inclusion, social justice, and belonging into training and practice while supporting the authenticity and autonomy of engineering education and research.
5. Maintaining dedication to placing faculty and student mental health and well-being at the center of new systems of care and acknowledging that student and faculty mental health are connected.
6. Creating new pathways to generate and share power in the classroom without relying on older hierarchies and traditional ways of establishing authority.

CONFERENCE FORMAT

The 2024 NSF EEC Grantees Conference program included plenary sessions, concurrent sessions led by grantees, and breakout sessions facilitated by NSF Program Officers. The program also included poster sessions, two networking receptions, and other opportunities for networking and knowledge-sharing.

Two plenary sessions addressed pressing topics in engineering education. Dr. Monica F. Cox, Distinguished Professor of Engineering and Engineering Education at The Ohio State University, entitled her session “Leveraging Change: From Performative Diversity to Authentic Equity and Accompliceship.” Cox’s talk emphasized the importance of equity in leadership and decision-making, urging attendees to reflect on their impact on others. She shared her personal and professional journey, stating, “I began to shift my mind, and I started asking, what does liberation really look like for me?” Cox distinguished between being an advocate and an accomplice, explaining that while an advocate may call for help, an accomplice “is going to bleed with [you].” She closed with a call to action, reminding the audience that systemic change requires courage and community: “I believe the people in this room can change the entire system as we know it, if you just speak up and choose to do it.”

A plenary panel entitled “Artificial Intelligence (AI) & Ethics in Engineering Education” featured Dhireesha Kudithipudi, Robert F. McDermott Chair in Engineering and Professor of Electrical and Computer Engineering at the University of Texas at San Antonio, Evan Peck, Associate Professor of Information Science at the University of Colorado Boulder, and Lefteri Tsoukalas, Professor of Nuclear Engineering at Purdue University. Moderated by Jason Borenstein, Program Director, Directorate for SBE (Social & Behavioral Economics) and Lead, Ethical and Responsible Research (ER2) Program at NSF, the session addressed how AI is reshaping engineering education and the need for ethical considerations in its design and deployment. The panelists emphasized that ethics must be integrated early in curricula, because, Peck warned, “If we wait until their junior year for an ethics course, they separate it in their minds.” The discussion highlighted key concerns like bias, accountability, and decision-making in autonomous systems, with Kudithipudi questioning, “If that failure costs a life, is the system truly ethical?” The panelists stressed that ethics must be interdisciplinary and deeply embedded in AI education, with Peck concluding, “We cannot treat ethics as an add-on. It must be ingrained in how we teach and build AI.”

Opening Remarks on Days 1 and 2 were led by NSF EEC Deputy Division Director Kemi Ladeji-Osias, who described the full scope of the division’s efforts, discussed ongoing division goals, and celebrated recent funding accomplishments, and NSF Assistant Director for the Directorate for Engineering Susan Margulies, who spoke on the urgency of creating and increasing public awareness of engineering and provided additional details on the history of the NSF Directorate for Engineering and funding opportunities within the Directorate and EEC Division.

Three blocks of concurrent sessions took place on Wednesday, September 11, each with five workshop-style presentations led by grantees. These sessions revolved around the “leveraging momentum” conference theme, with specific topics including designing positive and productive engineering education research project teams, best practices for inclusive teaching, prioritizing faculty well-being to promote culture change around mental health in engineering, creating dissemination opportunities for RET site participants, and using peer-led study groups to increase student performance and engagement. Several sessions explored considerations and strategies for utilizing AI and generative AI in engineering education practices, addressing research, teaching, and learning. Interactive breakouts led by NSF Program Directors took place on Thursday, September 12, broken down by EEC program cluster.

Two poster sessions, one of which was a joint poster session with RED grantees attending the concurrent 2024 NSF RED Consortium Meeting, showcased research from more than 100 EEC PIs and team leaders. Networking breaks and two formal networking receptions provided opportunities for attendees to discuss their work, share ideas, and form collaborations. The opening networking reception, held Tuesday, September 10, was a joint reception for both EEC Grantees Conference and RED Consortium Meeting attendees. The second networking reception, held Wednesday, September 11, included a special poster session for the 19 attending REU and RET site participants.

The 19 invited REU and RET site participants pose for a photo.

OPENING REMARKS

DAY 1 OPENING REMARKS

Speaker: Kemi Ladeji-Osias, Deputy Division Director, Engineering Education and Centers (EEC), *National Science Foundation*

Kemi Ladeji-Osias's remarks focused on sharing background information on the NSF Directorate for Engineering (ENG), providing more information on the Engineering Education and Centers (EEC) Division, and celebrating some recent funding accomplishments. After greeting attendees, Ladeji-Osias spoke on the mission of NSF to "promote the progress of science, to advance the national health, prosperity, and welfare, and to secure the national defense." The main way that NSF achieves this is by "funding exciting and innovative projects" — and 95% of the funding that the foundation receives goes directly out into the community to fund projects like the ones represented at the 2024 NSF EEC Grantees Conference.

The mission of the ENG Directorate is to transform the world through the tools of engineering and drive discovery, inspire innovation, enrich the education of the next generation, and accelerate access to engineering broadly. One key Directorate goal is to ensure that the nation maintains leadership in transformational engineering approaches to problems with societal impact. NSF proposals often require submitters to discuss the broader impacts of their work, which helps NSF demonstrate what they are doing in society. NSF also seeks to expand opportunities for people and catalyze partnerships.

Kemi Ladeji-Osias delivers Opening Remarks.

Ladeji-Osias then spoke on some strategic priorities for the ENG Directorate, with topic areas including clean energy, climate change, bioeconomy, microelectronics, and next generation wireless and cross-cutting issues including broadening participation in engineering, equity, justice, sustainability, and translation. In the last fiscal year, the ENG Directorate released a number of Dear Colleague letters. Dear Colleague letters are intended to draw attention to a specific topic area that NSF is interested in funding. The letters released by the ENG Directorate are viewed as emerging research areas of particular focus and interest to the engineering community.

In the last fiscal year, NSF received almost $9 billion in funding, and of that funding, $793 million went to the ENG Directorate. ENG received about 6,000 proposals and of that 6,000, 1,500 were awarded.

Ladeji-Osias drew attendees' attention to the number of people who are impacted by the work that has been funded. She noted, "we not only support researchers and faculty, but others who are involved in the research enterprise [including] a lot of students." REU and ERC programs contribute significantly to the number of students included and impacted by ENG funding.

The ENG Directorate has four divisions – the EEC Division, unlike the others, is not necessarily tied to a specific discipline. The EEC Division "tend[s] to fund projects that span disciplines, span the boundaries." The Division is comprised of four clusters, the largest being the Centers Cluster (which includes the Engineering Research Centers – ERCs – and the Industry-University Research Partnership Program – IUCRC). The other clusters are Engineering Education (EE), Workforce Development (which includes REU and RET), and Broadening Participation in Engineering (BPE). Ladeji-Osias provided a list of EEC staff, some of whom are new to the Division, and encouraged attendees to interact with them throughout the conference, noting that "you rarely get this close-knit of an opportunity to talk with people, not just to share ideas, but to tell us what exciting things are happening in your projects so that we can spread the word about what you are doing."

Ladeji-Osias provided more details on new EEC Division programs and opportunities, including a partnership with the Lemelson Foundation (NSF 24-028) focused on sustainability broadly and a new Revolutionizing Engineering Departments (RED) solicitation that offers a planning grant track that allows grantees to use $75K per year for up to two years to develop new partnerships and to plan for a RED proposal. She then highlighted some recently funded projects, including a research project at North Carolina A&T University around integrating sustainability into the industrial and systems engineering program; a project about the impact on the type of mentoring women receive, and how it influences their persistence in engineering; and several CAREER awards studying the influences on faculty pedagogies, K-12 assessment, and visual spatial skills.

Through the Research Experiences for Undergraduates (REU) program, the EEC Division supports undergraduates conducting research at a given site in the summer, eight to ten students per year. There are REU sites in almost every state, with a current total of 44 sites. These sites provide opportunities for students across the country to engage in engineering research. The Research Experiences for Teachers (RET) program offers a similar experience for community college and K-12 teachers – there are RET sites in slightly more than half of US states. NSF's Education and Training Application (ETAP) is a website that allows the hosting of REU and RET applications, available for REU and RET awardee teams. Students and teachers can use this resource as a one-stop shop to apply for REU and RET programs.

The goal of Broadening Participation in Engineering (BPE) is to ensure that engineering students reflect the full breadth of our nation in geography, ethnic background, and gender. There is a single solicitation for this program, which is relatively new, and the projects can range from conferences and fundamental research, all the way to centers that are impacting equity at the school or college level. Research priorities for BPE include developing scientific evidence to design effective programs that broaden participation; conducting research that spans from K-12 through the workforce; developing outcomes that are scalable, sustainable, and applicable in contexts outside of the original research; and using intersectional approaches and building connections to the INCLUDES National Network.

Ladeji-Osias then highlighted the Centers Program, which funds the Engineering Research Centers (ERC). The Centers have four pillars: convergent research, workforce development, culture of inclusion, and innovation ecosystem. Workforce development and culture of inclusion encompass the bulk of what most of the EEC Grantees Conference attendees already do. Also, the Centers have REU and RET programs embedded. She encouraged attendees to consider this as an expansion option, as they build their sites on research, and to contribute to or have a larger pool to study. Four new ERCs were just funded – each of them has at least three to four partner universities "and so they may be on your campuses, and as they are growing, they may find that they need the expertise that you have."

The Partnership Program funded by Industry-University Cooperative Research Centers (IUCRC) takes engineering research projects from early-stage research and readies them for commercial deployment. NSF funds the administration and management, and industry funds the research. So, the PI has to have strong connections with industry, and the industry input becomes very significant. This program has not funded any education programs yet, but that doesn't mean it's not possible in the future.

The Engineering Research Initiation Program (ERI) is for PIs at non-R1 institutions. This is a great funding mechanism for those who want to initiate research but aren't sure how to connect with NSF, as submitters are competing against others who have similar resources.

Ladeji-Osias closed her remarks by encouraging attendees to serve as reviewers. "Projects don't get funded without reviewers," she stated. "If you have not been reviewing, we ask you to please sign up to be a reviewer, help others get funded, and learn more about how we work and what we do."

DAY 2 OPENING REMARKS

Speaker: Susan Margulies, Assistant Director, Directorate for Engineering (ENG), *National Science Foundation*

Susan Margulies opened this session by talking about her own experience entering the field of engineering. When she was accepted into college, she "had no idea what it meant to be an engineer" but she jumped in and took the risk. By the end of her freshman year, she still didn't know what it meant to be an engineer, as her first year was spent taking chemistry, math, physics, and English. A discussion with an associate dean in the engineering school led her to continue with engineering. Margulies's sophomore year experience allowed her to apply and integrate what she had learned, and she was "energized by the camaraderie, by the group work, by the problem-focused learning." She was also able to participate in a research project that allowed her to see how engineers and physicians can work together to solve big problems and make a societal impact. These experiences made her stick with engineering. "We can't let up on the accelerator pedal because our students, once we attract them to engineering, we have to stick with it."

Margulies asserted that it is urgent to help create and increase public awareness of engineering. She issued a plea to attendees: "[Along with] the work that you are doing to attract, enrich, retain engineers, work on increasing public awareness of engineering and what engineers do. It's such an important outlet for students and for adults along the path."

She then pivoted to talk about NSF, which was celebrating its 74th anniversary. NSF is the only agency that funds all disciplines of science and engineering.

The ENG Directorate was created in 1981, envisioned to be in close ties with industry, so as to expand education initiatives for engineers. Several years ago, the Technology Innovation and Partnerships Directorate (TIP) was launched to focus on taking the next step, to create an ecosystem that takes important fundamental research and elevates it to the next level of use.

The ENG Directorate has funded awards to over 300 engineering schools. But engineering can happen outside engineering colleges. "We need to inspire those missing millions to find their path in engineering and in science." TIP is pushing forward on advancing technology, not just the research in science and engineering, but taking the step towards technology and innovation.

The ENG Directorate also funds research infrastructure projects, through initiatives like the Natural Hazards Engineering Research Infrastructure (NHERI) network. There are different types of infrastructure that engineers need and some can serve as places to inspire students to see engineering in practice. NSF funds supplements that bring faculty and their teams of students and trainees to the infrastructure, whether it's NSF-sponsored industry-located infrastructure or other federal agencies.

Margulies then spoke about the programs that comprise the EEC Division. These programs are "investments that [NSF is] making in how we attract, retain, and help engineers thrive and then spread the word." EEC programs fund research in how people

become engineers and "invest[s] in those diverse pathways that… create more and more options to meet students where they are."

The Workforce Development cluster funds pilot initiatives and research that provides insight into engineering concepts, innovation, and career paths. TeachEngineering.org is an important example. These are free downloadable engineering curricula for grades K-12. Most K-12 teachers do not have any engineering training, but they are relied on to inspire students to become engineers. "It's so important to give them that experience that connects what they're doing in the classroom, in their courses, with how it's applied in the next step of engineering problems and in societal impact." The RET program offers this opportunity. The REU program offers research experiences for undergraduates. These are available as supplements to existing awards as well as standalone sites. This is an area where other agencies really recognize the importance of turning that light on in students' eyes for encouraging them to take a career path, not solely in engineering in general.

At the graduate level, NSF offers the INTERN Program — Non-Academic Research Internships for Graduate Students. These are three-to-six-year experiences in a non-academic setting. This program has been enormously popular. The Engineering Postdoctoral Fellowship (eFellows) Program, directed by ASEE, is the complement to the INTERN Program. This program has funded over 65 fellows who want to go into academia, addressing the critical need for more faculty, especially for emerging and fast-growing industries like semiconductors and micro-electronics.

Broadening Participation in Engineering (BPE) offers four tracks. Track 1 is focused on hosting conferences. Track 2 is focused on research in broadening participation. Tracks 3 and 4 are relatively new. Track 3 is focused on inclusive mentoring hubs for engineering. Track 4 is Centers for Equity in Engineering (CEE), which requires that Deans serve as the PIs. NSF has awarded four different CEEs, taking different and exciting approaches to address the needs of their communities in Idaho, Kentucky, Nebraska, and New Mexico. Each of these centers connects to the nationwide INCLUDES network for engineers, which offers the chance to share best practices with other campuses and identify opportunities to not only learn from others, but to teach others and help them learn how successes on one campus can be translated to others.

After briefly discussing the Industry-University Research Partnerships Program (IUCRC), which boasts 80 centers and provides "excellent opportunities for… students to become engaged and to understand that rubber-to-the-road type of application of the work that they're doing on the academic setting" and the Engineering Research Centers (ERC), "the jewel in the crown of NSF" with 83 ERCS funded to date,

including four new ones, Margulies closed with final thoughts.

"This meeting is about bringing all of you together, to share your creative ideas, and to learn, learn from others about how you can inspire change on your campuses. We want to hear about your great ideas. Remember, continuous submission. We fund all those great ideas. Don't wait for a solicitation. Don't wait for a Dear Colleague letter. Reach out to us. We want to invest in the future of engineering by starting local with you."

PLENARY SESSIONS

LEVERAGING CHANGE: FROM PERFORMATIVE DIVERSITY TO AUTHENTIC EQUITY AND ACCOMPLICESHIP

Speaker: Monica F. Cox, Distinguished Professor of Engineering and Engineering Education, *The Ohio State University*

Monica Cox began her talk by reminding attendees that they are all leaders and encouraging them to think more about the decisions they are making, how they are making them, and the impact that those decisions have on other people. "No matter how great you are, whether you are a PI, a director of something, a leader, you still work with people. And those people have lives outside of your situation and equity should be focused throughout all of that."

Monica F. Cox addresses conference attendees in her plenary session on authentic equity.

Cox then spoke about her recent administrative experiences that forced her to think about equity. She was a founding department chair at her previous institution, beginning her role in January 2016. Over the course of four and a half years, she experienced several life-changing professional and personal experiences. Early in her role, she had to disband organizational structures and move from a center to departmental model, which led to questions about hierarchy, rules, and structures.

In 2017, her father passed away. In 2018, her engineering PhD program was approved. "So, life continued." 2020 brought the COVID-19 pandemic and, soon after, Cox lost her job. Her mother then passed away in 2022. She didn't tell people what was going on. "I just showed up." Grateful to have persevered, she pivoted her work to focus on her passion – equity. "I began to shift my mind, and I started asking, what does liberation really look like for me? How do I wake up every day in a space knowing that I can thrive, survive, and be in my right mind doing work that matters?"

Cox spoke more about the meaning of equity. Cox works as the director of diversity for Multiscale RECIPES for Sustainable Food Systems (NSF Award No. CBET-2115405), a cross-institutional research network that works across the food system to advance the science needed to make food systems sustainable, equitable, and resilient. Cox and her colleagues work to ensure that all individuals have fair access to the distribution of resources, opportunities, and support so that they can achieve their full potential regardless of their identities or backgrounds. They focus on recognizing, acknowledging, and addressing historic and systemic inequalities, considerations that center equity.

"Whose stories are believed? What about the complaints? Who responds to them? Who's being paid the most? Who is given multiple chances? Where are… bad behaviors not addressed? And who benefits from the policies in your organization? If you find that you cannot say across the board that the processes apply systematically to everyone, then you probably have an equity problem."

Cox explained the difference between an advocate and an accomplice – if you injure yourself, an advocate will call 911 for you. "Hey, get somebody else to do it." If you're an accomplice, "You're going to bleed with me. You're going to feel the pain. You're going to know that this hurt me. You're going to care about the hurt." To move from an advocate to an accomplice requires a change in mindset, authenticity, and accountability.

"How will your actions produce systemic change? Are you centering yourself? Are you centering other people? How are you an accomplice for someone without them knowing that you are or without getting the credit for it? What's the level of risk that's involved with your actions? Is there dissonance in your organization or in your group? And what might hinder you from executing these roles effectively?".

Cox then presented an intersectional mentoring model co-developed with her former dean Ayanna Howard. This model

introduced non-technical mentors — the people who can talk to you when you're grieving, when you're trying to transition, when you're having some type of visa issue, etc. The program had a community-based cohort model where mentors and mentees met weekly to talk about real things. Cox believes that "because of that transparency, [they] were able to move forward and to prepare scholars who are… going to transform the landscape."

To close her talk, Cox shared a quote from bell hooks: "True resistance begins with people confronting pain and wanting to do something to change it." Looking back, Cox had several paths she could have taken. "There was a time when I could have given in and allowed the status quo to exist… [but] I was put in this position for a reason, and I've been given the grace to push against this system, to disrupt."

Cox acknowledged that the road is lonely as an accomplice, often harsh, and sometimes thankless, but it is worth it when you think about the legacy of the work you do. "If I leave you with nothing else, this is what I'm going to say. We need more people to do this. And we need to build communities where we are supported, where we do not feel that we are alone and abandoned, where we are not ridiculed, and humiliated, and thrown out of systems because we dare expect them to be what they say they are supposed to be… I believe the people in this room can change the entire system as we know it, if you just speak up and choose to do it. So, as I always say, I've got you. You're not alone."

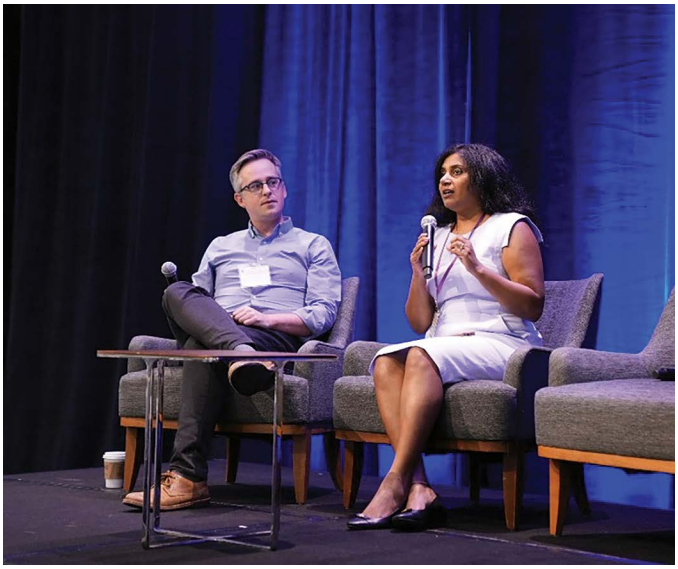
ARTIFICIAL INTELLIGENCE (AI) & ETHICS IN ENGINEERING EDUCATION

Panelists:

- Dhireesha Kudithipudi, Robert F. McDermott Chair in Engineering, Professor of Electrical and Computer Engineering, *The University of Texas at San Antonio*
- Evan Peck, Associate Professor of Information Science, *University of Colorado Boulder*
- Lefteri Tsoukalas, Professor of Nuclear Engineering, *Purdue University*
- Jason Borenstein, Program Director, Directorate for SBE (Social & Behavioral Economics) and Lead, Ethical and Responsible Research (ER2) Program, *National Science Foundation* (Moderator)

Artificial intelligence (AI) is transforming engineering education, raising crucial ethical concerns about its design, deployment, and societal impact. In this plenary session, a panel of experts, including Dhireesha Kudithipudi, Evan Peck, and Lefteri Tsoukalas, shared insights on integrating ethics into AI curricula and research.

The panel first discussed considerations for integrating ethics into engineering education. Ethical considerations must be embedded early in engineering education to shape students' perspectives before habits are formed. Peck emphasized, "If we wait until their junior year for an ethics course, they separate it in their minds as well. We must tie ethics into technical competencies from the start."



Panelists Evan Peck and Dhireesha Kudithipudi discuss the ethics of using AI in engineering education.

Kudithipudi echoed this, discussing how her AI curriculum at The University of Texas at San Antonio incorporates case studies on bias, data representation, and sustainability. One example involved working with the San Antonio Medical Foundation to analyze the impact of AI on underrepresented populations.

The panelists then highlighted key concerns in AI ethics, including accountability, bias, and decision-making in autonomous systems. Peck described a troubling trend, stating, “Even my brightest students—who took ethics courses—failed to recognize privacy issues in their AI-driven projects. It was completely invisible to them.”

Tsoukalas, drawing from nuclear engineering, noted that ethical challenges in AI parallel those in regulated industries. He stressed the need for ethical design from inception, questioning, “Who is responsible for AI’s failures — engineers, companies, or policymakers?”. A key debate centered on whether AI decisions can be truly ethical or merely optimized for efficiency. Kudithipudi warned, “A model may be 99.9% accurate, but what about the 0.1% failure? If that failure costs a life, is the system truly ethical?”

Peck added that public trust in AI is crucial, referencing societal skepticism toward self-driving cars despite their statistical safety. He argued that tech companies often struggle to communicate AI’s benefits effectively, stating that “if you frame AI ethics purely through numbers and graphs, the public won’t trust it. Ethics is about human experiences, not just data.”

The panelists agreed that AI ethics must be interdisciplinary, engaging engineers, ethicists, and policymakers. Ethics should not be an afterthought but a core principle in AI education and research. As Peck concluded, “We cannot treat ethics as an add-on. It must be ingrained in how we teach and build AI.”

CONCURRENT SESSIONS

The following concurrent sessions took place on Wednesday, September 11 and are listed alphabetically by session title.

CREATING EFFECTIVE DISSEMINATION OPPORTUNITIES FOR RET PROGRAMS

Speakers:

- Marianna Quinn, Assistant Director for Science Education, *Rice University*
- Isaias Cerda, Rice University, Associate Director for Science Education, *Rice University*

During this session, speakers Mariana Quinn and Isaias Cerda provided an overview of their successful RET program at Rice University.

Rice University hosts a summer RET each year for teachers from fifth to twelfth grade. They spend seven weeks at any Rice University lab (ranging from bioengineering to material sciences to nanotechnology). The focus of the experience is the teachers' work in the labs. Teachers are provided not only technical support throughout the experience, but emotional support as well, as "being in the lab sometimes can be challenging and stressful, especially jumping in for such a short amount of time into [unfamiliar] research." While the lab experience occurs during the summer, the RET program spans a year.

During the fall, three workshops are held where teachers are coached on how to take their research into the classroom. In the end, they are not only encouraged to engage their own students, but also students in the greater Houston area. The program also encourages teachers to have different dissemination opportunities. "Because we don't want them to just stay as just a single teacher within their classroom, but also, we want them to become leaders instead, within their school and within their community."

Recruitment for Rice's RET program runs from January – April. They can receive as many as 100 applications, of which they select 12 teachers. The application asks for a resume and a letter of intent. Applicants are also asked to interview with the Rice team. "Those interviews help… develop a teacher profile for the hosting PI. So, if we have nine or 12 labs, those 12 labs are going to have a good idea of who the teacher is before they even step into the research lab the first day." PIs and mentors are also engaged during the recruitment process.

Each year, Rice hosts the Research Symposium for Teachers, which is open to K-12 teachers, instructional staff, and administrators. Invitees include teachers from all districts around the Houston area, other PIs, and other universities and campuses. This is the capstone of the RET summer research. The teachers develop a poster of their specific, targeted assignment in the research lab. It's a great opportunity for faculty to disseminate what they are doing in their labs to teachers and the broader community as well. Along with the posters, teachers are invited to host break-out sessions where they showcase their own engineering design activity that was

inspired by their research and can be taken back to their classes.

The teachers are offered support during the summer to prepare their posters. The Rice Office of Communications instructs the teachers on how to create a poster. The teachers are also provided with coaching on how to disseminate information effectively. The teachers are encouraged to ask their mentors for feedback. "Feedback can be kind of scary, but it is much needed, especially when you are brand new to the research. The mentor's feedback is very, very important." They are also encouraged to present to their PI and ask for feedback before the event. Quinn and Cerda host a "feedback event" before the Symposium where they provide feedback on both poster appearance and how the teachers plan to present and approach the presentation.

Quinn and Cerda then pivoted to talk about the R-STEM Academy (formerly called the Nano Academy), a series of one-day workshops for second through twelfth grade students to participate in STEM lessons. For this program, two teachers from the Rice RET program work together in one classroom, paired according to range of grade level. They are given 90 minutes to present the engineering design lesson they developed throughout the fall workshops. The students are surveyed to assess what they learned. With support, teachers prepare whiteboard videos with the goal of helping them understand their research and show their students what they have done during the program – these videos are posted online in the Rice nanoHUB. Rice also has a partnership with TeachEngineering.org. In order to post a lesson on TeachEngineering.org, you must have actually done the lesson with students. The R-STEM Academy helps make this happen.

COLLABORATIVELY DESIGNING A DIGITAL ENGINEERING TRANSFER STUDENT DASHBOARD

Speaker: Kristin Frady, Associate Professor of Educational and Organizational Leadership and Engineering and Science Education, *Clemson University*

Led by Kristin Frady, this session sought to leverage research done by a CAREER grant to identify engineering-specific nuances of transfer student capital, existing digital transfer student resources, and the collective knowledge of engineering education researchers and practitioners assembled at the 2024 NSF EEC Grantees Conference to inform the development, pilot, and deployment of an Engineering Transfer Student Dashboard. Frady opened the session by providing an overview of her CAREER grant and acknowledging the contributions of PhD student Randi Sims, who has worked with her on this project since the beginning.

What's unique about Frady's set of research is that it looks at pre-transfer students, a group that is largely ignored by transfer research. Additionally, Frady's research strives not to look at transfer students as a lump sum, noting that "for undergraduate education, transfer students tend to be more diverse... So, with that increased diversity, we do an even bigger injustice by looking at them all as transfer students."

Frady's research utilized the Laanan-Transfer Student Capital (TSC) theory and then

conducted a systematic literature review to see what was out there in the world of STEM and engineering education student transfer research. Frady learned there were several transfer student capital surveys in existence – but they were all designed for post-transfer students.

With Frady's grant now in its third year, she has taken transfer student capital theory and tried to boil it down to something that's more consumable. Frady hopes that her research will inform others about how to do better evidence-based practices for transfer students and specifically think about how to customize the research. How do we break the mindset of 'this is a lump of transfer students?' How do we look at this as a transfer student that has these specific aspects?

After conducting several rounds of surveys, Frady streamlined and reorganized the survey into more of a diagnostic tool, which was deployed in fall 2024. What Frady wants to look at is "How do you go in and plug in something into this diagnostic tool that can see where you are?... Hopefully it's a model that can be built on based on where you are — how can we create an asset map for you?" In spring 2025, Frady plans to start working on a transfer student dashboard.

Frady conducted interviews with experts to get a better sense of what digital tools were out there, so there was no duplication. Available digital tools included degree planners, registration planners, and cost credit calculators, tools not specifically designed for transfer students. "So," noted Frady, "not only are we looking at transfer students in a lump, we're ... not even [really] looking at the needs of transfer students sometimes. We're assuming they're like a traditional undergraduate group."

In an engineering context, of all the research that Frady's team scraped from the journals and the interviews and surveys they've completed, they have learned to start grouping at a need level. So, they have identified three levels: a faculty-staff interaction level, an institutional level, and an individual level. Frady asked session attendees to break into three groups, each representing one of these levels. Groups discussed specific issues like transfer perceptions (How many people think they just can't do it? Only like three people ever get through the pipeline. Why do I try, right?), improving transfer perceptions, building community assets to encourage transfer (e.g., student engagement, peer-to-peer role modeling), and policies and practices in creating a culture that facilitates transfer.

CONVERSATIONS WE ARE NOT HAVING: HOW TO DESIGN POSITIVE AND PRODUCTIVE PROJECT TEAMS IN EER?

Speakers:

- Courtney Faber, Assistant Professor of Engineering Education, *University at Buffalo*
- Alexandra Coso Strong, Associate Professor of Systems Engineering, *Cornell University*

In this session, Courtney Faber and Alexandra Coso Strong explored the essential but often overlooked topic of designing and leading effective research teams in engineering education. Faber and Coso Strong emphasized that while teamwork is crucial for academic success, faculty are rarely trained in how to build and sustain productive collaborations. The session aimed to provide practical strategies for fostering positive team dynamics, improving communication, and ensuring that all members feel valued.

The discussion was structured around four key considerations for fostering strong and effective research teams:

1. Establishing Shared Norms and Expectations: A clear, mutually agreed-upon vision helps teams avoid misalignment and conflicts. One participant reflected, "We all had different needs for the project, so we had multiple conversations to align our individual goals with a shared vision." Faber and Coso Strong encouraged attendees to explicitly discuss project goals, work expectations, and decision-making processes from the outset. This includes addressing how work will be divided, how communication will be handled, and how authorship on research papers will be determined.
2. Defining Shared Spaces for Communication: Effective communication is fundamental to successful collaborations. The session highlighted how teams can use shared agendas, collaborative document editing, and structured meeting formats to enhance transparency and engagement. Faber noted, "Venue matters—how and where we meet shapes the types of conversations we can have." Some teams found that using a shared digital workspace, such as Google Docs or OneDrive, improved coordination, while others preferred rotating meeting facilitators to distribute leadership responsibilities evenly. Participants also discussed challenges related to institutional differences in digital tools and data storage requirements, which can complicate cross-institution collaborations.
3. Valuing Individual Team Members: Recognizing and celebrating team members' contributions fosters motivation and psychological safety. The facilitators stressed the importance of acknowledging both professional and personal achievements. Strong shared, "We intentionally take time to celebrate wins—whether it's submitting a paper, running a 5K, or even perfecting a recipe." Participants agreed that small gestures, such as recognizing milestones or offering words of encouragement, can greatly

enhance team morale. Creating space for personal check-ins during meetings was also cited as a way to promote well-being and a sense of community.

4. Incorporating Reflection and Continuous Improvement: Successful teams engage in regular reflection to assess their progress and adjust strategies as needed. One participant remarked, "We started using anonymous feedback to evaluate our processes, and it completely transformed how we collaborate." End-of-semester reflections, post-project reviews, and informal discussions were identified as valuable tools for maintaining a positive and productive work environment.

The session concluded with participants making "provisional commitments" to implement one change in their own teams. Examples included setting up structured feedback loops, improving meeting facilitation, and integrating more social interactions into professional settings. As Faber summarized, "Strong teams don't just happen—they require intentional effort and regular reflection."

DEVELOPING THE ENGINEERING IDENTITIES OF UNDERGRADUATE STUDENTS: LEVERAGING MOMENTUM FROM AN INTERDISCIPLINARY REU SITE

Speakers:

- Elise Cain, Assistant Professor of Leadership, Technology and Human Development, *Georgia Southern University*
- Valentin Soloiu, Allen E. Paulson Distinguished Chair of Renewable Energy and Professor of Mechanical Engineering, *Georgia Southern University*
- Regina McCurdy, Assistant Professor of Science Education, *Georgia Southern University*

This session, led by Elise Cain, Valentin Soloiu, and Regina McCurdy, examined how Georgia Southern University's summer-term, interdisciplinary REU Site "Propulsion, Aerodynamics, Materials and Controls of Aerial Vehicles" fostered students' self-perception as engineers and enhanced their professional trajectories.

REU programs play a crucial role in shaping students' engineering identities by providing hands-on experiences, mentorship, and interdisciplinary collaboration. Soloiu emphasized the importance of strategic program evaluation in sustaining REU funding, stating, "You can do stellar research with students in the lab, but if the evaluator doesn't convey the message to NSF, you will never get another one."

Two attendees network during one of the conference's grantee-led poster sessions.

Georgia Southern's REU program provides students with hands-on research in mechanical and aerospace engineering; industry and cultural visits (e.g., Gulfstream Aerospace, Air Force bases); and structured mentoring from faculty and graduate students. The program's interdisciplinary nature serves as key attraction. One student noted, "I came from a school without an aerospace program, but this REU gave me a real-world research experience I couldn't get anywhere else."

The program enhances students' engineering identities by providing meaningful, team-based research experiences and fostering a sense of belonging. One student described the impact of collaborative learning: "The teamwork aspect of this program was huge—learning from my peers and mentors helped me see myself as an engineer in a new way."

Additionally, participants engaged in real-world problem-solving, which helped them connect their studies to broader engineering challenges. Another student shared, "Seeing how engineering is applied in industry helped me realize the real impact of what I'm learning."

The program actively recruits students from underrepresented backgrounds, particularly those from community colleges and institutions with fewer research opportunities. Many students credited the REU with changing their academic and career trajectories. One former student participant reflected, "I was a community college student and a dropout before returning to school. This REU changed my entire trajectory. It made me see what was possible beyond textbooks."

Faculty emphasized that direct outreach to community college faculty was essential in recruitment, as students often don't seek out REUs on their own. Cain highlighted this, noting, "Students don't always look for these opportunities. Faculty recommendations play a huge role in connecting them to REUs."

Cain concluded the session by stating, "Students already have an evolving engineering identity. Our role is to nurture and strengthen it through meaningful experiences."

EMPOWERING K-14 STEM FACULTY TO IMPROVE STUDENTS' LEARNING AND ENGAGEMENT USING GENERATIVE AI

Speaker: MD Sarder, Director and Professor of Logistics Systems Engineering and Systems Engineering, *Bowling Green State University*

MD Sarder began his session by addressing the historical skepticism surrounding new technologies. "At some point, math teachers protested against calculators. Now, no one questions their usefulness." The same concerns are emerging with AI, with some educators fearing it may diminish critical thinking while others see its potential to revolutionize teaching.

AI presents multiple opportunities for STEM education. Regarding curriculum and lesson planning, AI can generate structured lesson plans, suggest learning outcomes aligned with Bloom's Taxonomy, and even help draft syllabi. One educator shared, "I asked AI to create learning outcomes for a 2000-level thermodynamics course, and it saved me hours." This allows faculty to focus on refining content rather than starting from scratch. AI can also act as a personalized tutor, helping students with concept reinforcement. Faculty can set AI to prompt critical thinking by asking, "Have you thought about this approach?" This approach fosters deeper learning, particularly in complex subjects like engineering and mathematics. In terms of assessment and feedback, AI can generate quizzes and practice tests, and even assist in grading written assignments. One faculty member shared, "I uploaded a textbook chapter and asked AI to generate 50 questions. It was a game changer." AI can also help bridge knowledge gaps. Many students struggle with retaining prerequisite material. AI can provide customized refresher lessons, helping students catch up without requiring additional faculty intervention.

While AI offers significant advantages, the session also addressed potential drawbacks, including bias in AI responses (AI-generated content is based on existing literature, which can include biases); plagiarism concerns that raise questions about academic integrity; concerns about student over-reliance on AI (rather than developing independent problem-solving skills); and data privacy risks (some institutions prohibit uploading proprietary information into AI tools, as these tools may retain and share sensitive data).

Rather than banning AI, Sarder emphasized the need for responsible integration into education. "Blocking AI won't work—students are already using it. Instead, we must teach them how to use it responsibly." AI should be positioned as a supplement, not a replacement, for critical thinking and creativity.

The session concluded with a call for educators to lead the charge in AI literacy, ensuring students harness its benefits while navigating its challenges ethically. AI is reshaping education, and the key to success lies in guiding its responsible and effective use.

FROM SURVIVING TO THRIVING: HOW FACULTY PRIORITIZATION OF WELL-BEING CAN DRIVE CULTURE CHANGE AROUND MENTAL HEALTH IN ENGINEERING

Speakers:

- Sarah Wilson, Assistant Professor of Chemical Engineering, *University of Kentucky*
- Karin Jensen, Assistant Professor of Biomedical Engineering and Engineering Education, *University of Michigan*

This session, led by Sarah Wilson and Karin Jensen, focused on the mental health and well-being of faculty in engineering academia, emphasizing the need for systemic change to foster a healthier academic culture. The discussion highlighted the increasing prevalence of mental health distress among both students and faculty, the cultural norms that perpetuate stress, and strategies for improving well-being within academic institutions.

Wilson and Jensen introduced well-being as more than the absence of mental illness, defining it as a state of happiness, contentment, and good physical and mental health. They pointed out that while conversations around student mental health have increased, faculty well-being is often overlooked, even though faculty play a critical role in shaping academic culture. “Our job is more than a full-time job, and yet, we act as if stress is just part of being an engineer.”

A key challenge discussed was the normalization of stress in engineering education, where both students and faculty often feel that sacrificing well-being is necessary for success. They shared a student quote that illustrated this mindset: “This amount of stress is normal for engineering students. Even though I’m stressed, I never think to seek help because everyone around me is also going through the same stress.” Similar attitudes were found among faculty, who often feel overwhelmed by workload expectations, unclear career benchmarks, and the pressure to meet research and funding goals.

Participants engaged in group discussions and a “gallery walk” activity to identify challenges and potential solutions. Key themes that emerged included:

- Unrealistic Workloads: Faculty cited excessive demands and lack of time for self-care as major barriers to well-being.
- Cultural Stigma Around Mental Health: Many expressed concerns that academia perpetuates a “suck it up” mentality, discouraging open conversations about stress.
- Hidden Labor and Lack of Institutional Support: Many faculty members engage in mentoring and student support that is not formally recognized or rewarded.

The session concluded with a discussion on how to shift academic culture to better prioritize well-being. Strategies included setting clear expectations, modeling healthy behaviors for students, and advocating for institutional policies that acknowledge and support mental health. Facilitators encouraged participants to take action, quoting Angela Davis: “I am no longer

accepting the things I cannot change. I am changing the things I cannot accept."

The session served as a call to action for engineering faculty to challenge harmful norms, foster supportive environments, and drive systemic change to promote long-term well-being in academia.

I WOULD NEVER! PREPARING THE ENGINEERING WORKFORCE TO RECOGNIZE THE GAP BETWEEN THEIR BELIEFS VERSUS BEHAVIORS IN ENGINEERING JUDGMENTS

Speakers:

- Cheryl Bodnar, Professor of Experiential Engineering Education, *Rowan University*
- Elif Eda Miskioğlu, Associate Professor of Chemical Engineering, *Bucknell University*

Led by Cheryl Bodnar and Elif Eda Miskioğlu, this session explored the gap between engineers' stated beliefs and their actual behaviors when making professional judgments.

The session began with an interactive scenario: an elderly woman falls while crossing the street, dropping her groceries. Participants were asked, "Would you stop to help?" Initially, the response was unanimous: "Everyone is going to be very kind and help this elderly woman pick up her groceries. We really appreciate that." However, as Bodnar and Miskioğlu introduced real-world constraints—such as professional obligations and personal commitments—the certainty of responses began to waver. "When you're making judgements, oftentimes it's not just a function of what you would like to do, but there's all these other external factors that come at you from all different directions."

Bodnar and Miskioğlu then presented a contextual framework with six competing criteria that impact engineering decision-making: leadership, production, relationships, safety, spending, and time. To illustrate these competing pressures, attendees engaged in a simulation game, "Contents Under Pressure." In this game, they took on the role of a chemical plant manager making real-time decisions amid an approaching hurricane. These choices ranged from prioritizing employee well-being to meeting production quotas, often exposing contradictions between espoused beliefs and actual behavior. "Our goal is not to 'narrow' the gap… rather, we're saying that for a lot of people, a gap exists, and if we aren't aware of it, we might be jumping into judgments without questioning."

Throughout the exercise, participants faced dilemmas such as assigning underqualified workers to tasks, handling interpersonal conflicts, and deciding whether to prioritize safety over efficiency. After an employee is injured, they must decide whether to allow them to go home or keep them working: "Employees can get hurt operating unfamiliar equipment. How relevant was that to your decision?" These judgment calls highlight the reality of competing priorities in professional settings.

The session concluded by emphasizing the importance of self-awareness in engineering judgment. While many engineers believe they will always prioritize ethical and safety considerations, real-world constraints often lead to different outcomes. “We all hold beliefs… but when we added additional context, additional complexity to the judgment, we shifted that response.”

Ultimately, Bodnar and Miskioğlu stressed the need for structured training that helps engineers recognize and reconcile the gap between their beliefs and behaviors, ensuring more thoughtful and ethical decision-making in practice.

LEVERAGING CHATGPT TO CULTIVATE CRITICAL THINKING THROUGH GLOBAL PERSPECTIVES AND SOCIAL RESPONSIBILITY IN SCIENCE AND ENGINEERING EDUCATION

Speaker: Sindia M. Rivera-Jiménez, Assistant Professor of Engineering Education, *University of Florida*

Sindia M. Rivera-Jiménez, whose background is in chemical engineering and engineering education, began her session by acknowledging her collaborator, Ana Maria Porras, who works in biomedical engineering. In Rivera-Jiménez’s research, she works with faculty professional development models to see if they can incorporate social responsibility topics in the classroom. Specifically, she teaches a class called Learning Theories and Instruction,

Invited RET site participant Rubiona Granger shares her research with a conference attendee.

during which she leverages ChatGPT to cultivate critical thinking among students. Critical thinking is a key skill for students to have, as they “need to make sure that they…are equipped to discern and evaluate information” when they enter the workforce. Critical thinking is also connected to society and broader impacts and thus connected to social responsibility and global perspectives.

Rivera-Jiménez has defined critical thinking as “the ability to analyze, evaluate, synthesize information; to make informed decisions essential for problem-solving, creativity, and innovation.” Defining the proposed outcome is key so you can scaffold your evaluation to be able to assess things related to that learning outcome.

Rivera-Jiménez acknowledges that integrating critical thinking, global awareness, and social responsibility into science and engineering curricula is challenging, due to a number of factors including curricular alignment, resource constraints, evaluation challenges, lack of time, and concerns over student engagement. But it’s important for students

to understand that what engineers do has an impact. “They need to understand, so they can [make] an educated decision in the future. So, you know, things can go wrong, and they need to understand why. Not because [only] we can do that as [engineers], but also because we can make decisions and change the future in our country.”

In conducting this work, Rivera-Jiménez emphasizes the importance of having boundaries, particularly when talking with AI – if not, “it’s going to go crazy or out of bounds.” In Rivera-Jiménez’s particular context, social responsibility is the ethical conduct and responsible decision-making within local or organizational context. Related terms could be social justice, environmental justice, or sustainability, all things that are embedded in social responsibility.

ChatGPT can be a powerful tool to encourage students to tackle complex issues from various perspectives. Rivera-Jiménez refers to ChatGPT as a “silent collaborator.” You can ask ChatGPT questions and maybe the answers are wrong. But at least you know they’re wrong, so you’re learning something through it. AI is limited because it lacks the contextual understanding of the information we provide, for example, the ability to understand the current specific context of your course, or the background knowledge of your student. It might help you write a case study, but most likely it’s going to generate a specific demographic that is dominant in engineering. So, you need to contextualize it. “No, I want this person to be a single man of color.” Right? “With a kid.” In these cases, it’s better if you know you’re an expert on a topic.

Rivera-Jiménez then shared some detailed examples of how to utilize ChatGPT to formulate problems, specifically case studies, (evoking a problem-based learning environment) through user contextualization and critical thinking. She has found that case studies are an easy way to have conversations in the classroom and to reiterate and reinforce concepts in the class and is her chosen approach to integrate social responsibility using critical thinking in the curriculum. The case studies then lend themselves to other activities, like reflection exercises and group conversations.

LEVERAGING PARTICIPATORY METHODS IN RESEARCH AND INTERVENTION DEVELOPMENT

Speakers:

- Jerrod Henderson, Assistant Professor of Chemical and Biomolecular Engineering, *University of Houston*
- Sarah Wilson, Assistant Professor of Chemical Engineering, *University of Kentucky*
- Sindia M. Rivera-Jiménez, Assistant Professor of Engineering Education, *University of Florida*

In this session, Jerrod Henderson, Sarah Wilson, and Sindia M. Rivera-Jiménez explored the role of participatory research methods in research and intervention development. Rivera-Jiménez explained that participatory research is “a systematic inquiry with those affected by the issues being studied, aimed at action and change.” The session introduced two participatory

methods that have been particularly impactful: Photovoice and Group Level Assessment (GLA).

Henderson provided an in-depth look at Photovoice, a research method that enables participants to document their lived experiences through photography. This approach is particularly effective in engaging underrepresented communities and providing them with a medium to share their narratives. Recognizing the need for more structured support systems, he incorporated Photovoice as a tool to amplify students' voices and empower them to navigate their academic and professional environments.

Photovoice not only allows participants to visually capture their realities but also encourages self-reflection and critical discussions. Henderson shared an example from his research where students were asked to photograph elements of their educational experience and later discuss their meanings in a group setting. To facilitate engagement, he introduced an innovative approach: "We started asking participants to assign hashtags to their photos. Many students are used to the Instagram age, where they're writing short phrases, so this felt natural to them." This method helped researchers analyze themes emerging from the collected images while ensuring the process remained participant-centered.

Henderson emphasized that Photovoice is not just about data collection—it is about empowerment and advocacy. He explained that in his research group, they strive to go beyond academic publications. "Part three is where many people don't go. They write the paper, and they're done. But in our work, we push for promoting change."

Wilson introduced Group Level Assessment (GLA) as another powerful participatory method. Unlike traditional research models, where experts develop interventions based on perceived needs, GLA actively involves participants—often students—in identifying challenges and proposing solutions. Wilson noted a common issue in academic interventions: "We assume that we know as researchers what students need. Then, when we go to implement these programs, they don't engage because we've missed the mark." GLA aims to prevent this disconnect by centering students as experts in their own experiences.

The GLA process involves multiple steps, starting with open-ended prompts that participants respond to in a focus group setting. As responses accumulate, participants collectively identify recurring themes and major challenges.

Once major themes are identified, the next step is solution development. Rather than having faculty or administrators dictate strategies, students themselves generate ideas for change. Wilson emphasized the importance of this approach, stating, "Students are the experts in their own lives. They know what they need better than we do." By including students in the decision-making process, interventions become more relevant, increasing the likelihood of engagement and success. GLA also allows

researchers to shift from individual-focused solutions to systems-level change.

Henderson and Wilson stressed that participatory methods are not just about gathering data but about empowering communities and ensuring that their voices shape the solutions being implemented. The session concluded with an interactive exercise, where attendees practiced applying Photovoice and GLA to research problems. The facilitators encouraged participants to explore these methods in their own work, emphasizing that participatory research is highly adaptable and can be used in diverse fields, from engineering education to community development. As Rivera-Jiménez summarized, participatory research is about more than just collecting information—it is about creating pathways for change: "This work is not just about generating knowledge. It is about action, collaboration, and transformation."

NEUROHUMANITIES: ADVANCING HUMAN-CENTERED AND INCLUSIVE ENGINEERING EDUCATION THROUGH INTEGRATED CONVERGENT RESEARCH, WORKFORCE DEVELOPMENT AND STEAM OUTREACH

Speakers:

- Aime Judith Aguilar-Herrera, Graduate Research Assistant, IUCRC BRAIN Student Group, *University of Houston IUCRC BRAIN*
- Jose Contreras-Vidal, Center Director and Professor, *University of Houston IUCRC BRAIN*
- Maxine Annel Pacheco-Ramírez, Research Assistant, *University of Houston*
- Yoshua Erenoldo Lima-Carmona, REU Site Participant, *University of Houston IUCRC BRAIN*

NeuroHumanities is an emerging interdisciplinary field that explores the intersection of neuroscience, arts, and technology to deepen the understanding of the brain and its connection to creative expression. A leading force in this space is the Building Reliable Advances and Innovations in Neurotechnology (BRAIN) center, an initiative funded through NSF's IUCRC program. The BRAIN center has seven member universities, a growing workforce development program for high school students and K-12 teachers, two REU sites – including a new one that

Adah Virginia Harding plays a song on the violin to illustrate how the BRAIN Center uses music to modulate brain activity and potentially treat neurological conditions.

works in collaboration with the Food and Drug Administration (FDA), and postbaccalaureate training in collaboration with the National Institutes of Health (NIH).

One of the center's major initiatives involves using music, movement, and other artistic modalities to modulate brain activity and potentially treat neurological conditions such as Alzheimer's disease and depression. The Sound Health Network, supported by the NIH and the National Endowment for the Arts, is investigating music-based interventions for dementia, while international collaborations such as the European Brain Initiative (EBRAINS) integrate machine learning and AI to study expressive movement, music, and brain health. These efforts aim to develop a roadmap for using arts-based interventions to enhance cognitive and emotional well-being.

A hallmark of this research is its emphasis on live, real-world demonstrations that merge artistic performance with scientific inquiry. Using mobile brain-body imaging, EEG sensors, and motion tracking, researchers analyze intra-brain synchronization during performances, offering groundbreaking insights into how artistic activities influence brain function.

The speakers introduced violinist Adah Virginia Harding, who played several pieces as part of a live demonstration during which attendees could see intra-brain synchronization of different regions of her brain. For one piece, Adah closed her eyes, which resulted in less activity in the vision part of the brain. For another piece, Adah kept her eyes open, which resulted in higher activity in the vision part of her brain. "It's really interesting how we can use art as a window of human experience, where we have still a controlled environment but in a real-world setup."

The speakers then spoke about the impact of this work. In the Diabelli 200 project, scientists studied the real-time brain synchrony between a pianist and a composer during a live performance, using artistic visualizations to create an immersive experience for audiences. The Meeting of Minds project brought together dancers, musicians, and scientists to capture brain, eye, and movement signals in real-time, visually representing inter-brain synchrony. This performance was showcased at the AI for Good conference in Geneva and a major theater in Houston, engaging over 7,000 attendees, including children who participated in interactive discussions about the fusion of arts and neuroscience.

Another groundbreaking project involved a month-long study in Bali, Indonesia, where researchers worked with Balinese musicians and artists to monitor neurochemical and brain electrical activity in performers and audiences. AI-generated visualizations incorporating traditional Balinese elements provided an immersive experience that illustrated the evolving relationship between cultural traditions and modern neurotechnology. This cross-cultural effort highlighted how ancient artistic practices can inform and shape the future of neuroscience research.

With over 580 artists, 46 scientists, 60 global performances, and thousands of attendees, the NeuroHumanities movement is revolutionizing understanding of creativity, cognition, and human connection. By bridging disciplines, fostering innovation, and integrating neuroscience with artistic expression, these initiatives are paving the way for new therapeutic applications and expanding the role of the arts in scientific discovery.

NUDGING NEW ENGINEERING FACULTY TO ADOPT BEST PRACTICES FOR INCLUSIVE TEACHING

Speaker: David Mays, Associate Professor of Civil Engineering, *University of Colorado Denver*

David Mays led this session which focused on encouraging new engineering faculty to integrate inclusive teaching practices. His initiative, part of the NSF-funded initiative Engineering is Not Neutral: Transforming Instruction through Collaboration and Engagement (ENTICE) (Award No. EEC-2040095), aims to shift faculty perspectives on diversity, equity, and inclusion (DEI) in engineering education.

The initiative is structured as a faculty learning community, which initially spanned three years and is now in a no-cost extension. “We got together for breakfast once a month,” Mays explained, focusing on identity in year one, classroom practices in year two, and community building in year three. This structure aligns with the Colorado Equity Toolkit, which provides resources for fostering inclusivity.

A key principle of ENTICE is creating a safe space for faculty to ask difficult or uncomfortable questions about race, identity, and inclusion without fear of judgment. “Most of us in engineering have absolutely zero education in identity, or race, or gender,” Mays acknowledged. The goal is to foster open dialogue and self-reflection rather than impose mandates.

The program deliberately focuses on faculty, not students, recognizing that sustainable change starts with educators. “We are looking in the mirror and saying, what can we do as faculty to change the culture in our engineering college and make everybody feel welcome?” Instead of developing new pedagogical strategies, the initiative promotes the adoption of existing best practices. “There is so much great stuff. We don’t need to add more to that literature. What we need to do is take this and help more people adopt it.”

Central to the approach is nudging rather than coercion, drawing from the work of Thaler and Sunstein. “If you change the choice architecture, you can make people make better choices without forcing them or without bribing them.” The program also incorporates insights from *Thinking, Fast and Slow* (2011) by Daniel Kahneman, emphasizing the importance of slowing down decision-making to encourage deeper reflection.

One of the major interventions was designing a faculty summit rather than a retreat. This event, held in a park near Denver, brought together faculty, students, and alumni to discuss inclusivity in engineering education. A major outcome was a Welcome Academy for new faculty, structured around key questions: “What do new faculty need to know about DEI?” and “Can we make a lesson plan for a Welcome Academy for all the new faculty?”

Mays also emphasized the significance of institutional history, highlighting the displacement of communities through eminent domain to make way for the Denver campus. “Right here on this campus we have history that is very relevant to these issues of identity and power,” he noted, linking historical injustices to present-day inclusivity efforts.

The session concluded with a call for continued collaboration: “We’re nudging people, not forcing people… it’s a marathon, not a sprint.” The ENTICE initiative exemplifies a sustainable, faculty-led effort to embed inclusive practices in engineering education.

PEER-LED STUDY GROUPS (PLSGS) – A UNIQUE APPROACH TO SHARING POWER IN THE CLASSROOM AND ENHANCING STUDENT PERFORMANCE AND ENGAGEMENT

Speakers:

- Ryan Milcarek, Associate Professor, School for Engineering of Matter, Transport and Energy, *Arizona State University*
- Gary Lichtenstein, Founder and Principal, *Quality Evaluation Designs*

This session, led by Ryan Milcarek and Gary Lichtenstein, focused on peer-led study groups (PLSGs), which have emerged as a powerful tool in higher education, particularly in engineering disciplines. By shifting the classroom dynamic from instructor-led teaching to collaborative

problem-solving, PLSGs foster deeper learning, enhance student engagement, and improve academic outcomes.

In a PLSG, facilitators guide rather than dictate. They step in only when necessary, allowing students to grapple with difficult problems collaboratively. PLSGs have the potential to shift students' behavior and encourage them to take a more active role in their learning, as opposed to waiting for answers. "The students were the ones asking questions. Normally, the instructor asks the questions, but here, students are trying to figure it out."

Milcarek and Lichtenstein presented empirical data that highlights the success of PLSGs. Students participating in PLSGs performed nearly 10 points higher on average in final grades compared to those who did not participate. Pass rates for PLSG students stood at 91%, compared to 65% for non-participants. Particularly striking was the impact on transfer students, who are historically at higher risk of leaving engineering programs. The data showed that transfer students in PLSGs had 3.6 times higher odds of passing than those in traditional recitations. "These few points that are getting students over the line into the next semester… that has a huge implication. They stay with their cohort, they avoid retaking classes, and they persist in engineering."

Common concerns for implementing PLSGs include classroom setup and scalability. Some classrooms may not be structured to accommodate group discussions on whiteboards. However, instructors found creative solutions – one instructor bought small whiteboards and had TAs carry them around. This instructor noted that some students even preferred using personal boards at their desks.

Another challenge is ensuring facilitators are prepared. Training sessions focus on asking high-level questions rather than providing answers. Data showed that the more facilitators encouraged discussion, the higher the students' final grades.

Beyond academic performance, PLSGs cultivate a sense of belonging and confidence among students. One instructor shared a transformational student experience: "She would start every sentence with 'I'm not very smart, but…' and every time, she was right. By the third session, she stopped saying that. We saw, in real-time, her confidence grow."

This increase in self-efficacy directly correlates with student persistence in engineering. Research indicates that students who feel confident are far more likely to continue in their field.

PLSGs represent a shift in higher education, where collaborative learning leads to stronger academic performance, increased retention, and higher self-efficacy. The success of PLSGs in engineering courses demonstrates the potential of peer-led models across disciplines. "It's not just about solving a problem for a grade. It's about thinking like engineers and becoming engineers."

SIGNATURE PRACTICES FROM EXEMPLARY INSTITUTIONS FOSTERING RACIAL EQUITY IN ENGINEERING EDUCATION

Speaker: Jeremi London, Assistant Provost of Academic Opportunity and Belonging, Office of Undergraduate Education and Associate Professor of Mechanical Engineering, *Vanderbilt University*

Jeremi London began her session by explaining its two main goals:

1. Provide a forum for exchanging experiences and insights among change agents occupying roles focused on rectifying racial inequity at their institution amid a shifting political landscape undergirding racial equity work in higher education, and
2. Raise awareness of localized implications of anti-DEI legislation and exchange of maneuvering tactics used for sufficiently responding to these changes.

There are several strong arguments that are often used when people think about why it matters to promote equity. These include a) the benefit of having diverse perspectives at the table to come up with more innovative solutions, b) social justice considerations — if we promote more underrepresented students in engineering, we can uplift and contribute to social and economic mobility, and c) the parity argument, which is more or less just a numbers game, saying that if, for example, African Americans make up 12% or 13% of the population, what would happen if we saw those similar numbers in every major profession?

Speaker and EEC Grantee Jeremi London poses with her postdoc Meaghan Pearson.

London's study was motivated by the desire to help colleges of engineering get to parity. There is a litany of reasons as to why the numbers may be what they are, including lack of public awareness or understanding of engineering; lack of role models; underfunded and understaffed K-12 schools or extent to which students may be discouraged from taking advanced STEM courses; bias in the standardized exams or the admissions process; heavy financial burdens; and demotivating toxic environments.

This study, which aims to advance our understanding of some of the strategies that colleges of engineering are using to improve access to engineering, was a multi-case study of five institutions that are consistently named among the top producers of Black and Brown engineers – University of Central Florida, Florida International University, University of Maryland, University of Maryland, Baltimore County, and Morgan State University. London used a multi-case study because it let her explore a contemporary issue in the real-world context.

London consulted several frameworks for her study, including one by Acker, who discusses the culprits of inequity in the workplace. London used Acker's framework to draw parallels in higher education. She also utilized Kotter's theory which asserts that change happens in three phases – envisioning, implementing, and institutionalizing. London collected multiple forms of data that fed into each case study – including interviews with faculty and staff and publicly available data from websites, strategic reports, or other sources.

In terms of findings, London found that there's a time dimension to when inequity may or may not show up in a student's life — whether it's before they get to university, before they enter their major, and within their major. London's study also found that "much of the issues, much of the signature practices focused on rectifying inequity relates to who gets in and how they manage resources." Specific practices utilized by the institutions London studied include keeping tests as optional post-pandemic; applying a more holistic admissions process that uses multiple factors to decide if a student should get in; and micro-scholarships for high school seniors. London also found that inter and intra-institutional partnerships help make change happen and make it lasting. Initiatives that value accountability have the potential to shift institutional cultures – "accountability and leadership go hand in hand to promote equitable outcomes."

STRATEGIC SITE DESIGNS TO COLLABORATE EFFECTIVELY AND CREATE CULTURALLY RESPONSIVE RESEARCH EXPERIENCES

Speakers:

- Nicholas Oehm, Associate Professor, STEM Transformation Institute and Education, *Florida International University*
- Amanda Morrison, Arctic LTER Education Coordinator, *Authentic Research Experience for Teachers @ LTERs*

Led by Nicholas Oehm and Amanda Morrison, this session explored two RET models aimed at strengthening partnerships, expanding funding impact, and fostering culturally responsive research experiences. The goal was to highlight strategies that integrate RET programs into existing research structures, create leadership opportunities for teachers, and enhance professional development.

Oehm provided an overview of Florida International University's Coastal BIORET Site, the focus of which is coastal ecosystem resilience across Everglades wetlands, seagrass beds, urban canals, mangrove forests, and coral reefs. Program partners include Miami-Dade County Public Schools and Florida Coastal Everglades LTER. In Year 1 of the program, teachers engage in research alongside REU site participants (undergraduate students). In Year 2, the teachers take on mentorship roles, analyze data, and disseminate findings. The key outcomes of this program are increased teacher engagement in STEM research,

development of research-based classroom curricula, and sustained collaborations with scientists.

Morrison then spoke about the Authentic Research Experience for Teachers @ LTERs, which focuses on impact of environmental stressors (floods, droughts, heat waves) on biodiversity. This program is a multi-site collaboration across three Long-Term Ecological Research (LTER) sites. The program includes 12-hour data literacy training for teachers, summer research immersion (2 – 4 weeks) over two years, and the development of classroom activities and open-access educational products. Key outcomes include improved data literacy among teachers, classroom integration of real-world scientific data, and ongoing collaboration with researchers.

Oehm and Morrison emphasized several inclusive and equity-focused strategies for engaging teachers and researchers, including:

- Showing respect for cultural and linguistic differences in programming,
- Applying asset-based approaches that value teachers' lived experiences,
- Practicing flexible program design to accommodate teachers' needs, and
- Having frequent communication and feedback loops between teachers and research mentors.

RET programs can extend the reach of NSF-funded research by integrating teacher training and professional development. Collaboration with K-12 educators enhances science accessibility and student engagement. Providing leadership opportunities for teachers strengthens their long-term commitment to STEM education. A culturally responsive framework ensures broad participation and sustainability in research-driven education initiatives.

The session concluded with small-group discussions, prompting attendees to reflect on ways to apply culturally responsive practices in their own RET and REU programs. The overarching message: flexibility, collaboration, and inclusivity are key to building impactful, teacher-integrated research experiences.

USE OF GENERATIVE AI IN ENGINEERING EDUCATION PRACTICES

Speakers:

- Aditya Johri, Professor of Information Sciences & Technology, *George Mason University*
- Ashish Hingle, Doctoral student, *George Mason University*

In this session, Aditya Johri and his doctoral student Ashish Hingle explored the evolving role of generative AI in engineering education. They discussed the opportunities, challenges, and ethical considerations associated with AI tools like ChatGPT, DALL-E, and Copilot, emphasizing their growing influence in both academic and industry settings.

"We all talk about Generative AI a lot. Either we are very excited, or we are traumatized—one or the other," Johri remarked, capturing the mixed reactions to this rapidly advancing technology.

The speakers provided a historical overview of AI development, tracing its evolution from early rule-based systems to modern machine learning and neural networks. Generative AI, they explained, relies on large language models (LLMs) trained on vast datasets, including sources like Wikipedia, Reddit, and digitized books.

"What comes out of these models is not logic-based or accurate; it's simply pattern recognition and probability-driven predictions," Johri noted, cautioning against assuming AI-generated responses are always correct.

A common misconception among students is treating ChatGPT as a search engine, rather than a predictive model. Johri highlighted this: "Many students say, *'This is the best search engine I've ever used,' but it's not searching—it's generating predictions based on probabilities."*

The session explored various ways AI can support engineering education, including content creation and editing; research assistance; programming and technical support; and personalized learning. Despite these benefits, Johri cautioned: "If you don't know the domain, you can't judge AI's accuracy. Experts can use it well, but students who lack foundational knowledge struggle to differentiate between good and bad outputs."

Johri and his research team analyzed 116 university policies on generative AI use. They found that most encourage AI adoption and offer guidelines for integrating it into coursework. However, concerns about academic integrity, misinformation, and privacy risks remain prominent. They also found that faculty approaches vary – some instructors ban AI outright, while others encourage its use but require students to document their prompts and modifications.

Johri and Hingle stressed the importance of effective AI prompting. Hingle explained that few university syllabi provide guidance on proper AI usage, despite the availability of online courses, books, and research papers on prompt engineering. Key prompting strategies include providing clear instructions; using examples; iterating and refining prompts; and evaluating responses. "The real learning happens in designing the prompt itself — it forces students to logically break down problems and think critically," Hingle explained.

Generative AI is reshaping engineering education, offering efficiency and new learning methods. However, its integration requires critical evaluation, structured guidance, and ethical considerations. As Johri concluded, "We need to teach students how to use AI thoughtfully—so that it enhances, rather than replaces, real learning."

NSF-LED BREAKOUT SESSIONS

BROADENING PARTICIPATION IN ENGINEERING (BPE)

Speaker: Jesus Soriano Molla, Program Director, Engineering Education and Centers (EEC), *National Science Foundation*

The Broadening Participation in Engineering (BPE) program seeks to address diversity and inclusion challenges in engineering. During this session, led by Jesus Soriano Molla, attendees engaged in discussions on the impact of BPE programs, proposal strategies, and funding opportunities. Soriano Molla emphasized the importance of timely proposal submissions to prevent funding gaps that could disrupt research continuity. He warned, "One of the issues that concerns me the most regarding your work is whether you could face a funding gap. A funding gap results in a team dispersing, an increase in teaching duties, or other unintended consequences." To mitigate this, he encouraged strategic planning, reminding attendees that "having no deadlines means that you should not just be sleeping on it and not submit. It's a sense of urgency."

The BPE program offers four funding tracks. Track 1 offers $100,000 awards for planning grants or workshops. Track 2 offers awards up to $400,000 for BPE-related research and has no solicitation deadline. Track 3 funds inclusive mentoring hubs with awards up to $800,000. Track 4 funds Centers for Equity in Engineering (CEE), offering $1.2 million awards for Phase 1 CEEs and up to $4 million for Phase 2 CEEs. Soriano Molla noted that despite these opportunities, many researchers hesitate to apply.

Attendees discussed the institutional impact of BPE funding. One attendee from the Colorado School of Mines shared how the program had enabled the university to build a more inclusive environment. They explained, "The BPE funding has enabled us to do things we would never have been able to do, related to cultivating a culture of inclusion for our students… The NSF award gave us the federal prestige needed to bring programs together and drive change." Another attendee reinforced the significance of NSF funding in gaining institutional support, stating, "There's a lot of leverage buy-in that I get by being able to say, '*This is an NSF project*.' It really makes a significant difference when we try to recruit external mentors or get institutional support."

Despite these successes, several attendees highlighted challenges related to shifting political landscapes and institutional policies. One individual shared concerns about the language used in proposals, explaining, "The word 'equity' is not a good word right now at my university, but 'belonging' is acceptable. I need reviewers to understand that I'm using certain language strategically to align with my institution's stance." Soriano Molla reassured participants that NSF review panels are aware of these challenges and assess proposals based on their substance rather than specific terminology.

Looking toward the future, Soriano Molla emphasized the need for long-term planning and collaboration. He encouraged attendees to see themselves as part of a larger community, stating, "What I learned from this meeting today is that we are a community. I am going to challenge you to be a community—support each other. You are all working for the same reason, and we need to keep this momentum going." He also highlighted the importance of planning beyond the immediate funding cycle, reminding participants, "An NSF proposal is not a federal exam. It's a strategic planning exercise. What happens on Day 1? And more importantly, what happens on Day 100 when there's no more money? That's what we must think about."

ENGINEERING EDUCATION (RFE, RIEF, CAREER, AND RED)

Speakers:

- Alice Pawley, Program Director, Engineering Education and Centers (EEC), *National Science Foundation*
- Matthew Verleger, Program Director, Engineering Education and Centers (EEC), *National Science Foundation*

This session focused on funding opportunities for engineering education researchers and best practices for managing grants. Led by Alice Pawley, and Matthew Verleger, the session provided insights into available funding programs, navigating grant proposal submissions, and strategies for sustaining research projects.

The session began with an interactive discussion about the value of PI meetings like the EEC Grantees Conference. Attendees, including both first-time and experienced grantees, emphasized the opportunity for networking, learning about NSF funding mechanisms, and engaging in discussions that demystify the grant process. As one participant noted, "Having unfettered access to program officers allows us to ask questions we never get to ask elsewhere." Another added, "These meetings are about more than funding—they help us form collaborations and build a community."

Speaker and attendee Aditya Johri connects with NSF Program Officer Matthew Verleger during a grantee-led poster session.

Pawley and Verleger then spoke more about some program clusters within the EEC Division. Research in the Formation of Engineers (RFE) is focused on advancing knowledge in engineering education. Research Initiation in Engineering Formation (RIEF) is targeted towards new researchers in engineering education. Revolutionizing Engineering Departments (RED) is aimed at large-scale departmental transformation projects. CAREER Awards are designed to support early-career faculty engaged in high-impact research. Pawley highlighted that CAREER grants are "open to non-tenure-track faculty who conduct research," a lesser-known but critical aspect of funding eligibility.

Additionally, attendees were encouraged to explore co-funding opportunities across different NSF programs and directorates. The discussion emphasized that applicants should reach out to program officers to clarify the best fit for their proposals.

A significant portion of the session was dedicated to practical strategies for preparing successful grant proposals. Key recommendations included:

- Aligning proposals with NSF priorities: Ensuring that project goals clearly address NSF's mission.
- Using an organizing framework: Whether a logic model or a structured outline, frameworks help reviewers understand how the project meets solicitation criteria.
- Defining success realistically: "Your $200,000 grant won't change the world, so focus on achievable, measurable impacts."
- Considering broader impacts early: Reviewers evaluate not just research quality but also societal contributions.

Pawley also stressed the importance of avoiding common pitfalls, such as underestimating project timelines and failing to account for staff transitions.

Once a grant is awarded, managing it effectively is crucial. The session provided insights into:

- Annual Reports: Program officers use these to track progress. As Pawley noted, "We just need to see that progress is happening, even if it's not exactly as planned."
- Supplements: NSF offers supplemental funding opportunities, including support for Research Experiences for Undergraduates (REU) and parental leave coverage. These can increase a grant's impact.

- No-Cost Extensions: PIs were advised to request these at least 45 days before their grant ends to avoid funding disruptions.

The session also touched on the importance of leveraging NSF databases to search for previously funded projects and identify potential collaborators.

Attendees discussed several challenges, including limited workshop time at PI meetings and difficulties in managing simultaneous sessions. One participant suggested, "We need structured sessions on how to actually manage a grant once it's awarded—not just how to write a proposal." Another emphasized the need for a repository of past successful proposals to help new applicants understand best practices.

Additionally, concerns were raised about NSF reporting requirements, particularly the public accessibility of annual reports. While not automatically public, these reports can be requested under the Freedom of Information Act (FOIA). Attendees were encouraged to be mindful of the information they include while still providing honest reflections on challenges faced.

The session reinforced that NSF funding is not just about securing grants but about fostering a research community that advances engineering education. Attendees were urged to be proactive in seeking guidance, engaging with program officers, and contributing to discussions that shape the future of engineering education funding. As Pawley summarized, "NSF is here to support you—but we need your feedback to improve how we do that."

RESEARCH EXPERIENCES FOR TEACHERS (RET) AND RESEARCH EXPERIENCES FOR UNDERGRADUATES (REU)

Speaker: Patricia Simmons, Program Director, Engineering Education and Centers (EEC), *National Science Foundation*

This session focused on Research Experiences for Undergraduates (REU) and Research Experiences for Teachers (RET) programs, highlighting best practices, challenges, and strategies for successful implementation. Facilitated by Patricia Simmons, the session provided a platform for both new and experienced grantees to share insights and address common concerns.

The session emphasized the importance of mentorship and collaboration within the REU and RET communities. With many first-time REU/RET PIs in attendance, veterans were encouraged to "adopt a newbie" to foster knowledge exchange. As Simmons noted, "Your expertise, your experiences, and your questions are the key driving forces of this session." This approach ensured that experienced PIs could provide guidance on program administration and best practices.

A recurring theme expressed by attendees was the difficulty in recruiting students and teachers for these programs. Several key challenges were discussed:

- Timeliness of funding notifications: Some institutions receive funding confirmations too late in the year, making it difficult to recruit top candidates. One person shared, "We found out in May and had to scramble to fill positions before summer."
- Attracting underrepresented groups: Ensuring diversity in REU and RET cohorts remains a challenge. Some PIs highlighted partnerships with Minority-serving Institutions as a way to broaden participation.
- Retention and declination issues: Students and teachers often apply to multiple programs, leading to last-minute withdrawals. As one person noted, "We give them 10 days to accept, but some still back out late in the process."

PIs shared strategies and best practices for creating meaningful experiences for site participants, including integrating hand-on research, establishing strong mentorship models to ensure students and teachers receive the support they need (one attendee emphasized, "Good mentorship can make or break the experience,") and collaborating with industry and community organizations and businesses to enhance learning opportunities.

PIs also discussed common administrative hurdles in running REU and RET programs, like housing and travel logistics, budget constraints, and challenges with program evaluation and reporting (specifically, ensuring compliance with NSF reporting requirements while also collecting meaningful feedback for program improvement).

The session underscored the importance of proactive planning, early recruitment efforts, and leveraging institutional and industry partnerships to strengthen REU and RET programs. Attendees were encouraged to share resources and best practices beyond the session, reinforcing NSF's commitment to fostering a supportive research community. As Simmons concluded, "We're here to support you—don't hesitate to reach out and ask for advice."

TUESDAY, SEPTEMBER 10, 2024

TIME	EVENT
5:30 PM – 7:00 PM	**Opening Reception - EEC & RED Grantees**

WEDNESDAY, SEPTEMBER 11, 2024

TIME	EVENT
8:00 AM – 8:45 AM	**Welcome and Opening Remarks** • Jacqueline El-Sayed, CEO and Executive Director, *ASEE* • Kemi Ladeji-Osias, Deputy Division Director, Engineering Education and Centers (EEC), *NSF*
9:00 AM – 10:00 AM	**Poster Session A - EEC & RED Grantees**
10:30 AM – 11:30 AM	**Plenary Session I: Leveraging Change: From Performative Diversity to Authentic Equity and Accompliceship** • Monica F. Cox, Distinguished Professor of Engineering, Engineering Education, *The Ohio State University*
12:30 PM – 1:30 PM	**Poster Session B**

WEDNESDAY, SEPTEMBER 11, 2024 (CONTINUED)

TIME	EVENT
1:30 PM – 2:30 PM	**Concurrent Sessions I** • Conversations we are not having: How to design positive and productive project teams in EER? • Creating Effective Dissemination Opportunities for RET Programs • From surviving to thriving: How faculty prioritization of well-being can drive culture change around mental health in engineering • I would never! Preparing the Engineering Workforce to Recognize the Gap Between their Beliefs versus Behaviors in Engineering Judgments • Use of Generative AI in Engineering Education Practices
3:00 PM – 4:00 PM	**Concurrent Sessions II** • Developing the Engineering Identities of Undergraduate Students: Leveraging Momentum from an Interdisciplinary REU Site • Empowering K-14 STEM faculty to improve students' learning and engagement using generative AI • Leveraging Participatory Methods in Research and Intervention Development • Signature Practices from Exemplary Institutions Fostering Racial Equity in Engineering Education • NeuroHumanities: Advancing Human-Centered and Inclusive Engineering Education through Integrated Convergent Research, Workforce Development and STEAM Outreach

WEDNESDAY, SEPTEMBER 11, 2024 (CONTINUED)

TIME	EVENT
4:00 PM – 5:00 PM	**Concurrent Sessions III** • Collaboratively Designing a Digital Engineering Transfer Student Dashboard that Builds Engineering Transfer Student Capital and Transfer Success • Leveraging ChatGPT to Cultivate Critical Thinking Through Global Perspectives and Social Responsibility in Science and Engineering Education • Nudging New Engineering Faculty to Adopt Best Practices for Inclusive Teaching • Peer-led Study Groups (PLSGs) – A Unique Approach to Sharing Power in the Classroom and Enhancing Student Performance and Engagement • Strategic Site Designs to Collaborate Effectively and Create Culturally Responsive Research Experiences
5:00 PM – 6:30 PM	**Networking Reception & REU/RET Site Participant Poster Session**

THURSDAY, SEPTEMBER 12, 2024

TIME	EVENT
8:00 AM – 8:30 AM	**Opening Remarks** • Susan Margulies, Assistant Director, Directorate for Engineering, *NSF*
9:00 AM – 10:30 AM	NSF-Led Breakout Session by Cluster • Broadening Participation in Engineering (BPE) • Engineering Education (RFE, RIEF, CAREER, and RED) • Research Experiences for Teachers (RET) & Research Experiences for Undergraduates (REU)
11:00 AM – 12:00 PM	Plenary Session II: AI & Ethics in Engineering Education Panelists: • Dhireesha Kudithipudi, Robert F. McDermott Chair in Engineering, Professor, Electrical and Computer Engineering, *University of Texas at San Antonio* • Lefteri Tsoukalas, Professor, Nuclear Engineering, *Purdue University* • Evan Peck, Associate Professor, Information Science, *CU Boulder* • Jason Borenstein, Program Director, Directorate for SBE (Social & Behavioral Economics) and Lead, Ethical and Responsible Research (ER2) Program, *NSF (Moderator)*
12:00 PM – 12:15 PM	Closing Remarks • Jacqueline El-Sayed, Executive Director and CEO, *ASEE*

APPENDIX B: INVITED REU/RET SITE PARTICIPANTS

REU and RET PIs were invited to nominate an exceptional site participant to join this conference. These students and educators showcased their work and achievements with posters presented at the September 11 networking reception.

REU PARTICIPANTS

Muhammad Omer Farooq
Embry-Riddle Aeronautical University

Mariah Fulton
University of Southern Indiana

Talia Gafrick
University of Iowa

Andrea Hernández Guzmán
University of Puerto Rico at Mayaguez

Parry Harper
Northeastern University

Bren Hutchinson
Louisiana State University

Corbin Larsen
Southern Utah University

Kesley Lubin
Point Park University

Richard Nott
Colorado School of Mines

Maryom Rahman
New Jersey Institute of Technology

Stefan Tabaracu
University of Houston

Cailey Varnell
Austin College

Jada Vercosa
University of Connecticut

Matthew Ward
Delaware Technical Community College / University of Delaware

Khoa Weston
Trine University

RET PARTICIPANTS

Christina Cook
Tri-Village Local School District (New Madison, OH)

Ibrahim Eskikurt
Dove Science Academy High School OKC (Oklahoma City, OK)

Rubiona Grainger
Yellowstone College Prep (Houston, TX)

Duane Turner
North Shore 10th Grade Center (Houston, TX)

In consultation with the American Society for Engineering Education (ASEE), Quality Evaluation Designs (QED) designed a post-conference evaluation survey which was administered on the last day of the conference. The purpose of the survey was to understand if the conference objectives were achieved, as well as to obtain general feedback on overall satisfaction with the event and to make recommendations for future conferences. QED added demographic items and additional questions to explore customer segments. Of approximately 200 attendees, 123 survey responses were collected (62% response rate). The following report summarizes evaluation results. All data were collected in accordance with Salus IRB, which determined that all data collected as part of the evaluation did not constitute human subject research and that no IRB was required (Study ID 24060 – 01).

SUMMARY OF FINDINGS

PARTICIPANT DEMOGRAPHICS

In the survey, attendees were asked to provide demographic information about their gender and race/ethnicity. More than half (54%) of respondents identified as female. Slightly less than half (42%) of respondents identified as male. A small number of respondents preferred not to say (3%) or preferred to self-describe (1%). Half (50%) of respondents identified as White. Close to one-third of respondents (32%) identified as members of underrepresented ethnic/racial groups (14% as Black, 11% as Asian, and 7% as Hispanic). Additional respondents identified as Multiracial (16%) or preferred to self-describe (2%). Refer to Figure 1: Race/Ethnicity of Respondents.

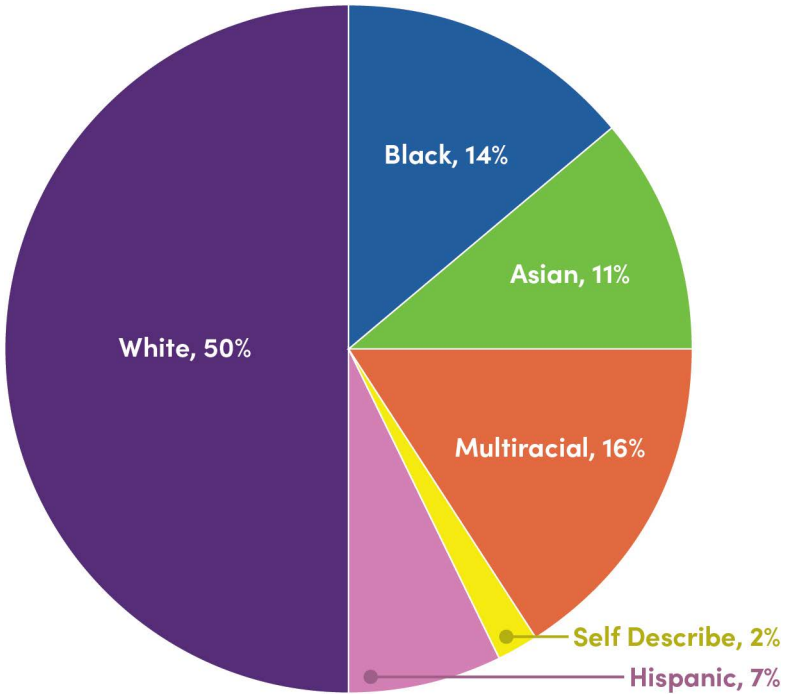


Figure 1: Race/Ethnicity of Respondents

CONFERENCE VALUE

Overall Value

Respondents rated the conference overall as very valuable, with an average score of 82.02/100.00, and 80 out of 109 participants noting that the conference was very much worth their time. This was also supported by 88% of participants indicating a desire to attend a future EEC Grantees Conference.

Attendees mentioned a wide variety of takeaways from the conference. Typically mentioned as a top takeaway was the insight into NSF logistics, specifically gaining a better understanding of supplemental funding, guidance on what to do after receiving an award, and enhanced knowledge of the overall NSF process. Other takeaways referenced the value of meeting with NSF Program Officers, particularly to work through potential project ideas. Attendees also frequently mentioned that they learned best practices for DEI, AI, and their REU programs. Finally, most frequently mentioned was the importance of networking and the supportive nature of the EEC community.

Session Value

Session values were rated on a scale of 1= not valuable, 2= somewhat valuable, 3= moderately valuable, and 4= extremely valuable (Figure 2: Value of Conference Sessions). Out of the sessions offered, the most valuable were NSF-led Breakout Sessions by Cluster, which received an average score of 3.47/4.00.

SESSION	AVERAGE
Day 0: Opening Networking Reception - EEC and RED Grantees	2.01
Day 1: Welcome and Opening Remarks (Jaqueline El-Sayed and Kemi Ladeji-Osias)	2.94
Day 1: Concurrent Sessions I	3.15
Day 1: Concurrent Sessions II	2.81
Day 1: Concurrent Sessions III	2.65
Day 1: Plenary Session I: Leveraging Change: From Performative Diversity to Authentic Equity and Accompliceship	2.86
Day 1: Poster Session A - EEC and RED Grantees	3.12
Day 1: Poster Session B	3.14
Day 1: Networking Reception & REU/RET Site Participation Poster Session	2.82
Day 2: NSF-Led Breakouts by Cluster	3.47
Day 2: Opening Remarks (Susan Margulies)	2.59
Day 2: Plenary Session II: AI & Ethics in Engineering Education	1.73

Figure 2: Value of Conference Sessions

The least valuable was Plenary Session II: AI & Ethics in Engineering Education, which received an average rating of 1.73/4.00. The average ratings of all sessions were between *somewhat valuable* and *moderately valuable* (2.77/4.00). The specific ratings were generally low for grantee-led concurrent sessions but high for NSF-led breakout sessions. Participants mentioned that they could not figure out the importance of some of the concurrent sessions and felt that they were not always sure how the sessions related to the goals of the conference.

As noted above, the NSF-led Breakout Sessions by Cluster was the highest rated conference session overall. Respondents referenced the value of meeting with NSF Program Officers both formally and informally. The majority (72%) of attendees reported that they interacted with NSF Program Officers. Of those who met with NSF Program Officers, 89% found their interactions to be helpful. While interactions with NSF Program Officers seemed to be frequent and valuable, attendees indicated that the conference *minimally addressed* issues related to award administration and management (2.12/4.00). These challenges included funding limitations (42.5%), concerns about grant management and handling administrative tasks (40%), as well as recruitment/buy-in of attendees (35%).

Feedback on concurrent sessions was mixed. Some respondents requested more concurrent sessions, with one suggesting "add more concurrent sessions!" and another stating "it would be great to have more time for the concurrent sessions or facilitated discussions about grants management." Others felt differently, stating that "three concurrent sessions in one day was too many".

Survey data cannot determine the extent to which discrepant perspectives are based on the sessions attended or topics offered. The descending ratings from Concurrent Sessions I to III may reflect session fatigue, which was mentioned in comments.

Networking Value

Networking was a major goal of the conference. From open-ended comments, networking and collaborating were identified as the most valuable aspects of the 2024 EEC Grantees Conference. While facilitated conversations such as breakout and discussion sessions were often mentioned, casual conversations that typically occur in conference formats like these were also referenced.

Almost all attendees (94%) met new colleagues at the 2024 EEC Grantees Conference. Prior attendees indicated that they made between 1 and 2 connections at previous EEC Grantees Conferences that have led to subsequent collaborations. Overall, the frequency and value of networking by all respondents were rated between good and excellent (3.56/4.00 and 3.57/4.00, respectively). While there were limited comments regarding connections established at the conference, some discussed getting to know NSF Program Officers as an outcome, and one respondent even mentioned that their connections "resulted in funded projects with new collaborators." When asked what they found most valuable about conference networking, respondents provided the following insights:

- "I am an early career faculty, and this has been the first smaller conference I have attended. I really appreciated the chance to connect with new and old colleagues in a meaningful way. The schedule really allowed for great introductions and

conversations that are harder to get to in larger conferences."

- "In-depth conversations with colleagues who are often busier at other EE conferences."
- "Reconnecting with colleagues I haven't seen in some time, including my Co-PI (in person). Networking with colleagues. Learning new thing and having new ideas sparked."
- "Making new connections, especially with other BPE grantees."

Organization and Logistics

In terms of conference organization and logistics, *Overall Organization and Conference Venue* received the highest ratings (3.50 and 3.49 out of 4.00, respectively), followed by *ASEE Conference Support Staff and Diversity of Speakers and Concurrent/Breakout Sessions Leaders* (with ratings of 3.46 and 3.45 out of 4.00, respectively).

The lowest rating was for *Food Options* (2.85 out of 4.00), with specific comments emphasizing the need for heartier breakfasts and noting the lack of suitable options for vegetarians. The second lowest rating was for the *Whova Meeting App* (2.98 out of 4.00), which respondents felt sent too many emails and didn't help them connect with other attendees.

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