ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

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Weaving Students into Engineering, not Weeding Them Out

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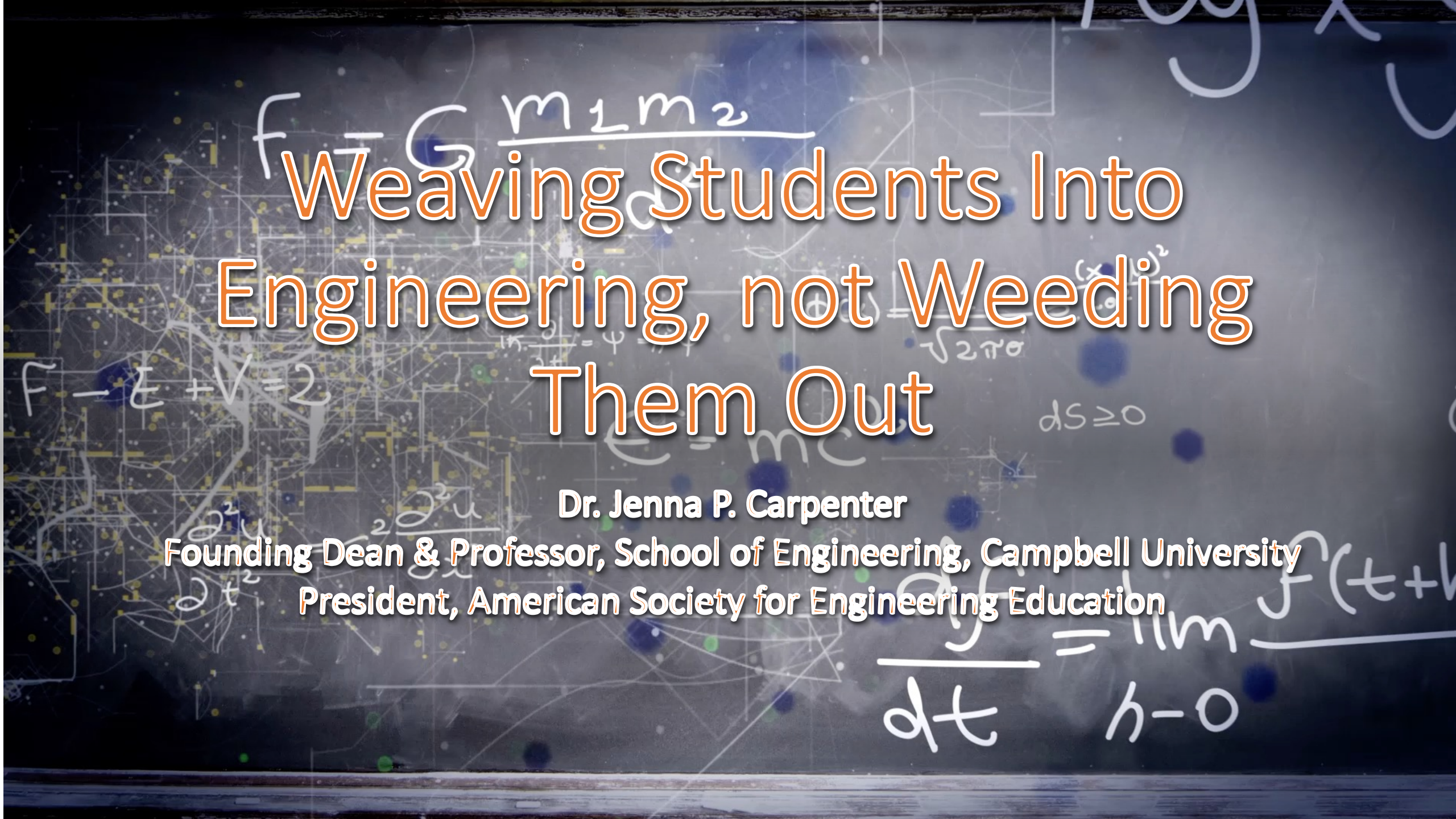

Weaving Students Into Engineering, not Weeding Them Out

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Outline

- **A Brief History of Engineering Education in the US**
- **The Weed Out Philosophy**
- **How does weeding out show up in our programs?**
- **Why and Why now?**
- **Initiative Progress To Date**
- **Questions?**

Brief History of Engineering Education in the US

- Early engineers were more practice driven, with a balance of theory (science) and practice by the late 1800's
- After WWI, incorporation of complex mathematical analysis and topics like materials, mechanics, dynamics
- WWII + Cold War + Space Race pushed engineering *away from* application & practice & *toward* theory, math, engineering science
- By 1980's hands-on training had dropped significantly
- National Science Foundation-funded university Coalitions in the 1990's tried to bring some of the hands-on approach back to the curriculum

Brief History of Engineering Education in the US

For much of its history, engineering has worked to weed out all but the *perceived* brightest and best, with the belief that the majority of students did not have what it takes to make an engineer.

We have broadened our view of which students have potential to become engineers and dropped some of the more overt practices designed to weed out, but *many of the structures, policies, mindsets, traditions, and approaches used in engineering education today still perpetuate the weed out philosophy.*

How Does Weeding Out Show Up?

In how we recruit, admit, retain, and graduate students! Preparation & background are a consequence of **opportunity**, not ability:

- family wealth, education, and social status
- higher quality K12 education
- stronger math and science preparation
- K12 extracurricular experiences
- family legacies of college-going that understand how to prepare for and get admitted to selective institutions/programs
- Tutoring, SAT/ACT prep courses, and repeated test-taking to boost scores

Our system is designed to filter for opportunity.

How Does Weeding Out Show Up?

- Expecting stellar background knowledge of all students
- Curving grades (which forces some people to flunk, not matter how much they know)
- Cramming in too much material too quickly (with little depth, conceptual mastery)
- Heavy focus on memorization and rote problem solving
- Heavy focus on theory with little application or context
- Primary reliance on lecture with no hands-on, team-based activities or application experiences
- One-and-done grading that doesn't provide opportunities to learn and grow

The Weave In Philosophy

- It is time update our notions of teaching and learning. *We know better*.
- We need student-centered cultures that embrace both the assets that students bring with them to college, together with personalized pathways and on-ramps that foster success and persistence versus forced attrition.

Why?

It is the right thing to do, period.

Why?

Koning, Samila, Ferguson, Science, June 2021.

It is unacceptable (& foolish!) to waste our nation's engineering talent.

The number of inventions in the US would be 4X higher if historically marginalized groups contributed at the same rate as men from high income families.

All women teams are 35% more likely to focus on inventions for women's health.

Gilda Barabino, President, Olin College, NAE
PUE Workshop, April 2022

Why now?

"The 'lost Einsteins' are the missing geniuses...whose talents are being wasted by a flawed and unfair educational system."
Rachel, Sylvester, Columnist
The London Times

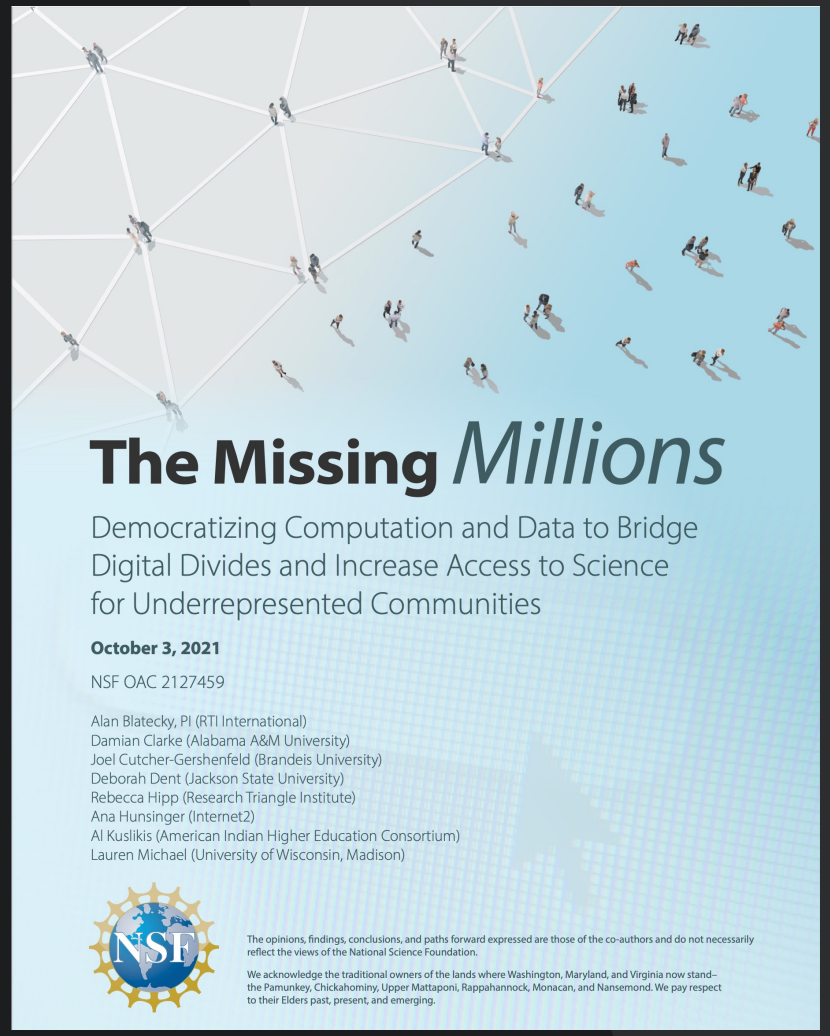
Critical mass of interest around access, equity, belonging, global awareness, & social justice

The opportunity an engineering degree provides to increase economic & social mobility of families and communities for generations

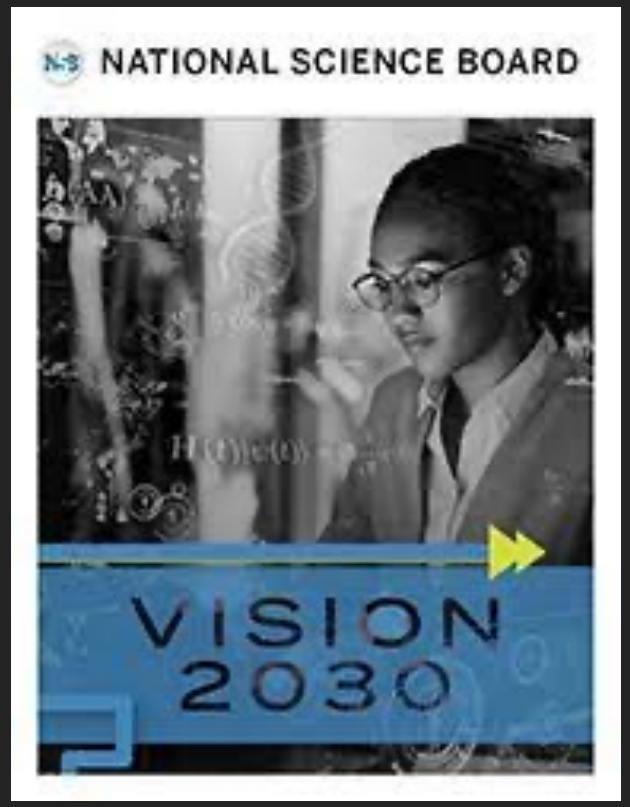
Limiting who gets to do engineering (and design influential & wide-spread technologies) yields poor decisions that negatively impact our lives, our safety, & our well-being

Bell, A., et al., "Who Becomes an Inventor in America? The Importance of Exposure to Innovation," The Equality of Opportunity Project.

Why now?



- Diverse perspectives improve innovation, design & ability to solve complex problems
- Increasing/changing workforce needs demand a larger & more diverse engineering workforce
- Declining birth rates mean fewer high school graduates – which demands expanding the pool of potential engineering majors
- Increases in historically marginalized populations that engineering has done a poor job of recruiting & graduating PLUS a decline in the populations we typically attract (men + traditional aged students)



For the Science & Engineering Workforce to represent the US population in 2030:

- the number of women would have to double
- the number of African Americans would have to increase by 2.5 X
- the number of Hispanics would have to triple

Why now?

Institutions must figure out how to retain and educate the students they have today, not the students they had 20 years ago.

Conclusion?

Taken together – broadening both access and notions of success is *critical* to the future of engineering and engineering higher education.

It's time to welcome the nation's diverse array of students INTO engineering and provide the support and thriving environments + experiences that empower them to become outstanding engineers.

It is time to stop expecting college-ready students and become student-ready colleges.

Daniel Greenstein, NSF SSTEM Panel, 2019 Conference

It’s NOT about lowering standards or quality of graduates.

It’s about setting appropriate expectations and helping students meet those expectations

versus

expecting students to walk in the door already possessing the knowledge, skills and background required to do so.

Weaving Students In- Not Weeding them Out of Engineering Initiative

Goals:

- Enlist a cohort of national experts & stakeholders – across the engineering spectrum – to realize meaningful, significant improvement in the number & diversity of engineering graduates in the US through use of recruiting, admissions, retention best practices.
- Synthesize research & best practices to identify core initiatives that support success
- Identify programs that work for specific student audiences
- **Communicate evidence-based practices and partner with institutions to implement these.**

Action Plan

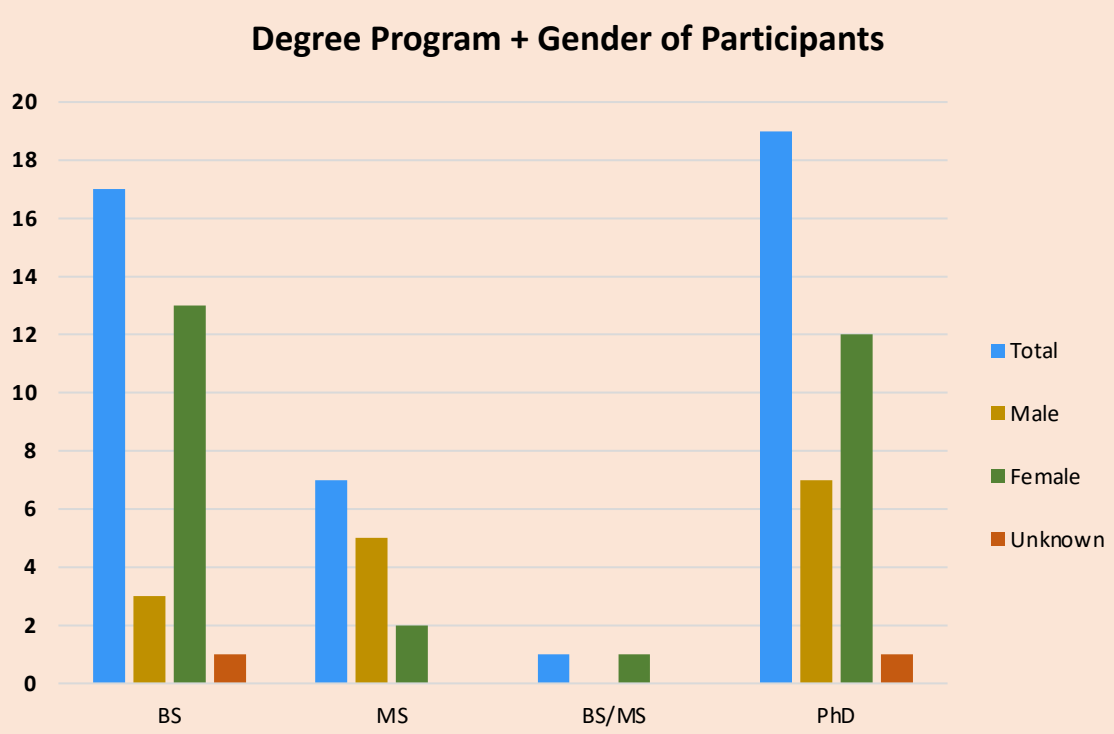
- Four brainstorming sessions with national experts in Spring 2022 to identify successful programs and initiatives, as well as areas for improvement
- Conversations with the Engineering Societies Education Pathways Roundtable Task Force on ways to partner
- Engineering Research Visioning Alliance-sponsored Listening Session in October to hear the voices of engineering students
- NSF-funded NAE-ASEE Conference in October to develop a framework of initiatives to support student success in recruiting/admissions, onboarding, skills development
- Pursuit of additional funding to roll out the framework and engage engineering programs and organizations to implement nationally

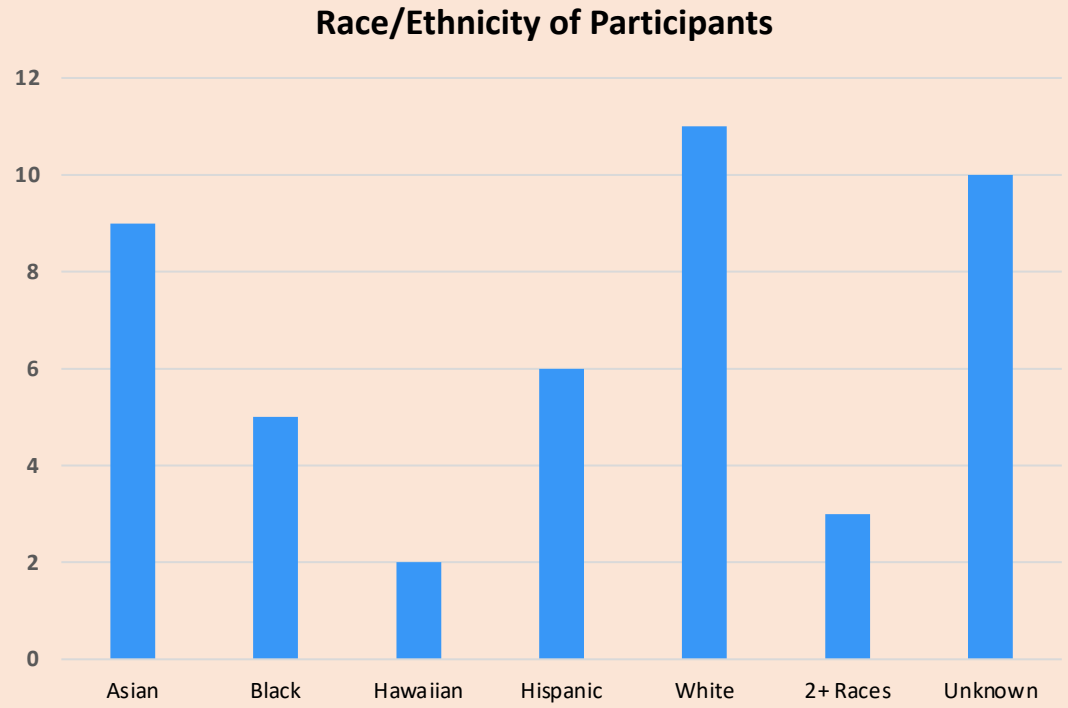
4 Brainstorming Sessions

- Approximately 50 engineering education experts from around the country, nominated by their peers
- Diverse range of institutions, roles, and areas of expertise represented
- Participants provided feedback on the overview, rationale, objective, and vision.
- Participants discussed strengths/successes/strategies or approaches that are working in advancing this vision, as well as areas of improvement/opportunity for weaving students into engineering.
- Detailed notes were taken of each session and common themes were identified across all four sessions: recruiting/admissions, onboarding, student skills development

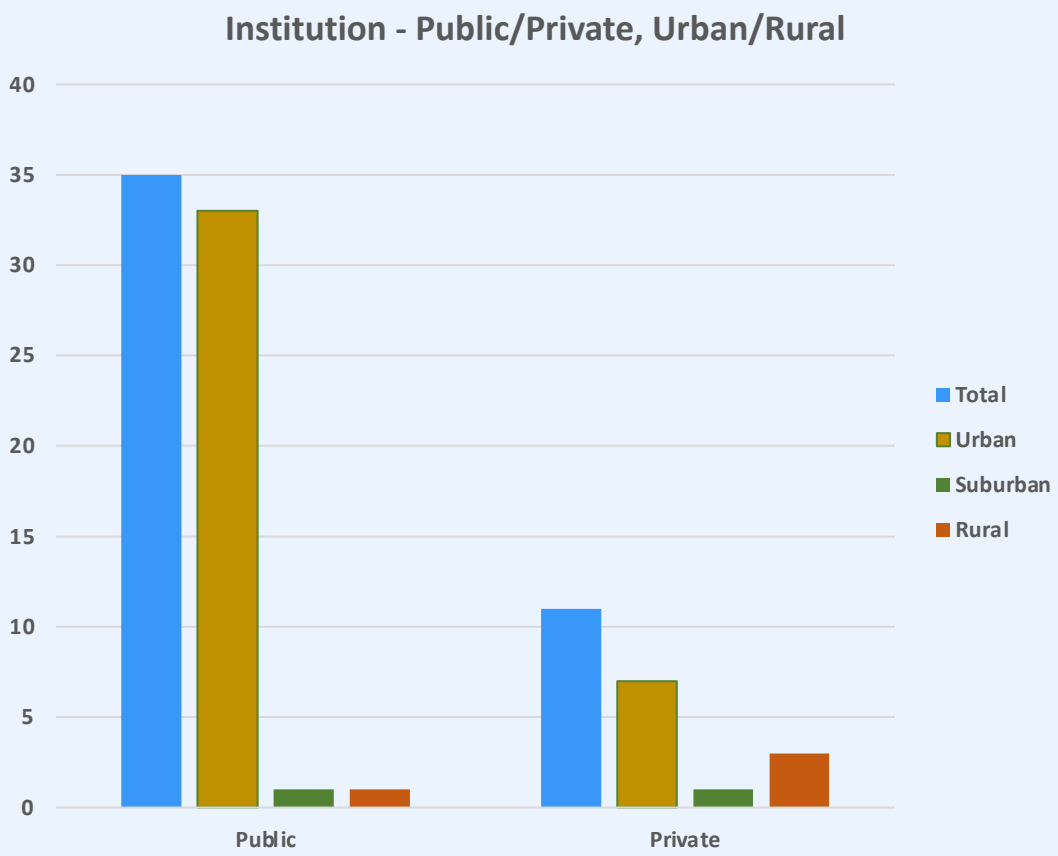
ERVA-ASEE Listening Session

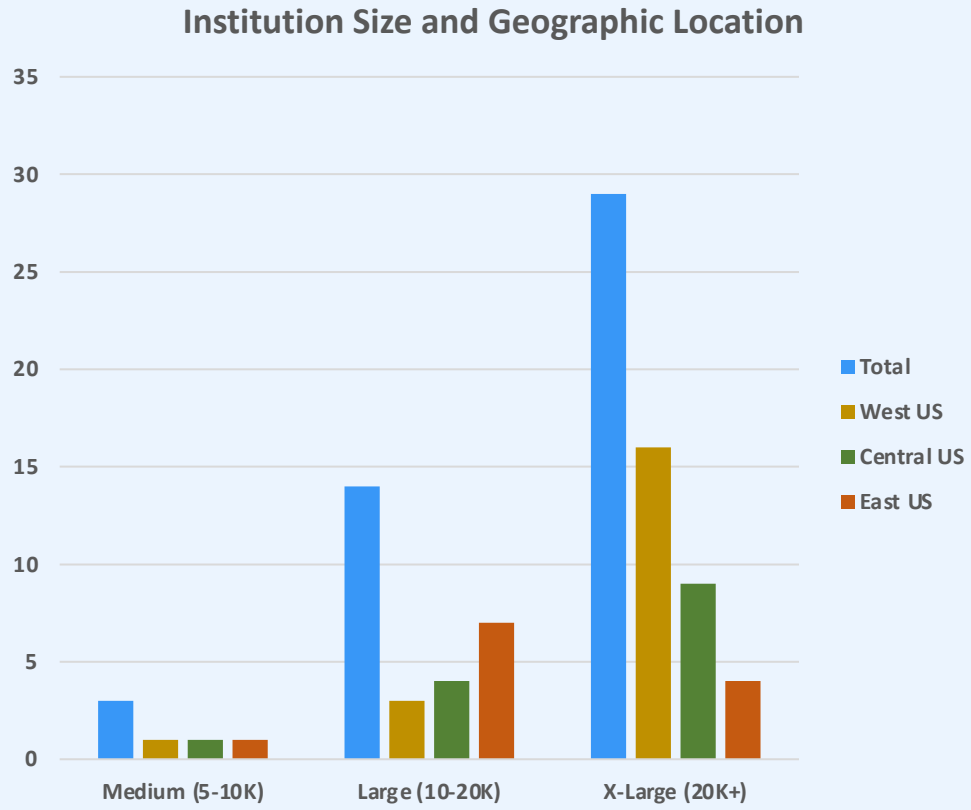
3-hour virtual session with 46 invited students





ERVA-ASEE Listening Session





ERVA-ASEE Listening Session

5 Questions, Five Breakout Groups

1) What were the strengths of your early higher education/post-secondary experience? What supports helped you the most?

2) What barriers do post-secondary students face when participating in, experiencing, or learning about STEM concepts? What are your coping mechanisms to overcome these barriers?

3) How might these barriers further motivate or challenge students' pursuit of engineering in post-secondary education?

4) How could we get research off the pedestal and into something tangible in the real world?

5) How can we do a better way of describing engineering research in a way that students can relate to?

ERVA-ASEE Listening Session

Common Themes:

1) No major differences between the described barriers & opportunities based on educational level.

2. Fundamental human needs (financial, food, shelter security), and mental health support, are critical to student success at all levels.

3. Students consider access to/ability to be a part of an inclusive engineering community (peers, faculty, student organizations) to be valuable.

4. Students desire more opportunities to engage with/have access to industry (including projects) in the classroom.

5. Engineering research can gain traction with better connectivity to the public and K-12 outreach through real-world examples, demonstrations, and accessible communication.

ERVA-ASEE Listening Session

Other Common Takeaways:

1) Quality teaching and faculty who care, are engaged, adaptable, & approachable are key for success.

2. The lack of assistance in figuring out systems, processes, transfer, and how to get help is a major barrier/deterrent.

3. Weed out courses are a problem, as are stress, overwork, burnout, feeling overwhelmed, feeling unseen and unheard.

4. Lack of flexibility in curriculum and course scheduling (for students who work) is a barrier. Working also makes it hard to focus completely on school.

NAE-ASEE WINWO Conference

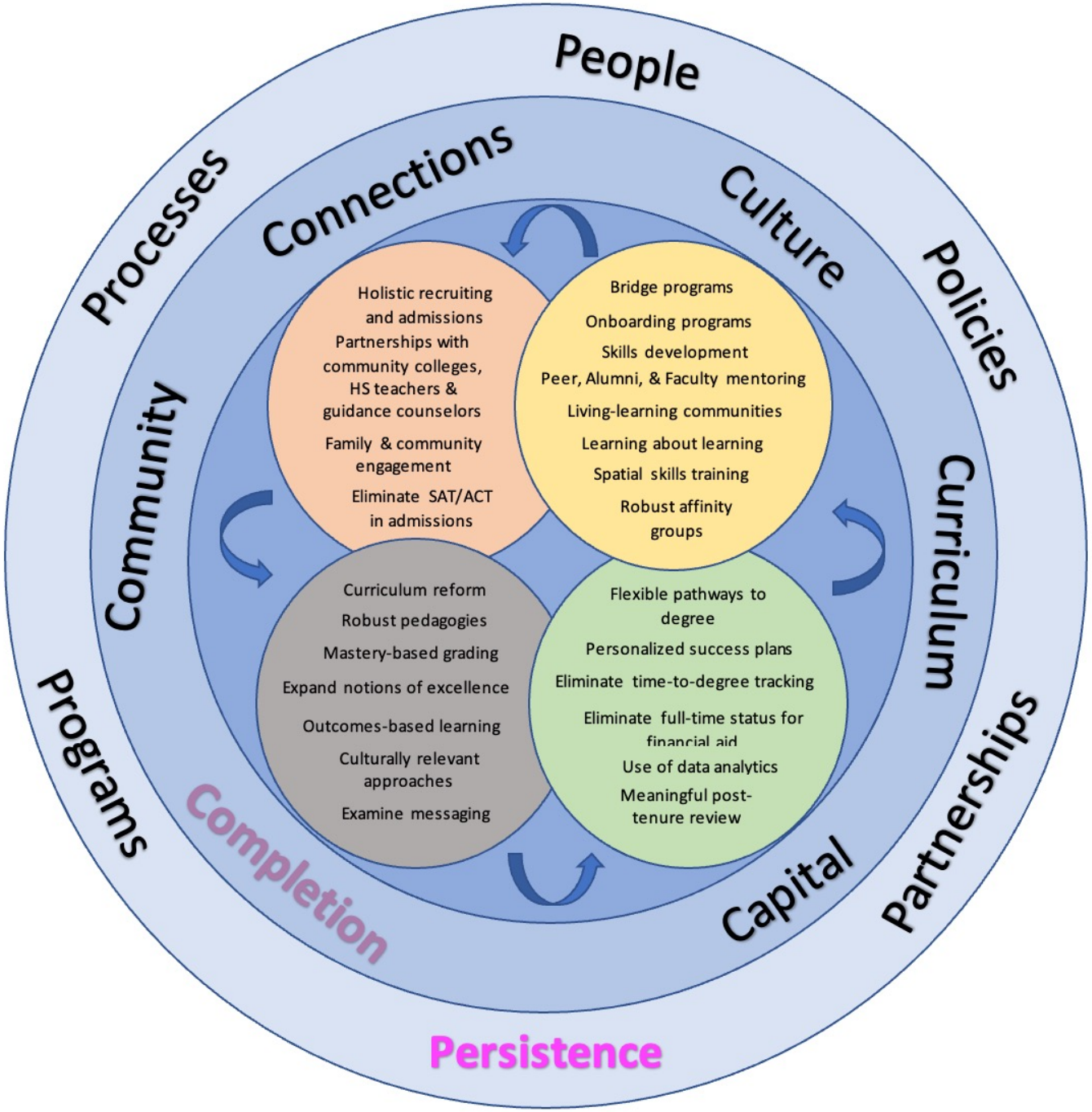
1. Fifty engineering education researchers, staff, & professional organization representatives were invited to the conference at the NAE.

2. Expert panels featuring evidence-based practices in recruiting/admissions, transfer pathways, historically marginalized groups, onboarding students, and student skills development.

3. Six breakout groups worked on developing a framework of best practices in these areas for various student audiences that could be reconfigured by different institutions to fit their mission, existing programs, and student audiences.

4. A draft framework was developed, incorporating the work of the breakout groups as well as the feedback from the ERVA Listening Session.

NAE-ASEE WINWO Conference Draft Framework

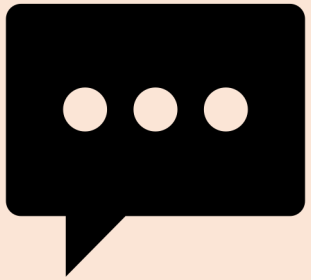


Draft Framework Feedback!

We’d love to get your feedback on the draft framework!

- What aspect(s) of the framework are not clear?
- What is missing from the framework?
- How can we communicate the detail more succinctly?
- What evidence-based practices do you know of that support one or more of the framework elements?
- What other ideas do you have for improving the draft framework?

Next Steps



1. This spring we are hosting six virtual feedback with various constituent groups (community college faculty, admissions experts, engineering education experts, etc.) to further refine the framework.

3. We are holding a workshop at the ASEE Annual Conference on Sunday to begin to think about how institutions might utilize the framework.

4. We will then write a second grant to support 2-3 rounds of pilot institutions as they use the framework, to guide development of processes for wider adoption.

How Can You Be Involved?

- Join one of our virtual feedback sessions or nominate people from your institution to help us refine and improve the draft framework, connect to evidence-based practices.
- Attend the Sunday Workshop at the ASEE Annual Conference to help us develop a plan for how interested institutions can use the framework.
- Talk with your administrators and faculty about becoming a pilot institution.
- Reach out with your ideas and input!

Questions?

You can reach me at:

carpenter@campbell.edu

Vision: To attract, retain, & graduate all of the diverse engineering talent in our nation.

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