BOARD # 367: Engineering PLUS: a NSF Eddie Bernice Johnson INCLUDES Alliance

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Research shows that teams with gender and racial diversity are highly effective when innovation and problem-solving are critical goals [1]. Despite a wealth of best practices published over the past several decades on how to broaden participation in engineering, and despite significant investments to increase diversity in the engineering workforce by the National Science Foundation, engineering industries, and universities, women currently comprise just 25% of all engineering and engineering technology bachelor's degrees awarded [2]. Black, Indigenous and People of Color (BIPOC) receive 22% of undergraduate engineering degrees [2], although they constitute 34% of the U.S. population [3]. Women and BIPOC engineering students encounter complex barriers to retention and degree attainment, including campus climates that are not inclusive and inadequate student support programs at some institutions.

The vision of the NSF Eddie Bernice Johnson INCLUDES (Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science) Engineering PLUS (Partnerships Launching Underrepresented Students) Alliance [4] is to achieve transformative, systemic and sustainable change that will increase the growth in the number of BIPOC and women obtaining undergraduate/graduate engineering degrees to 100,000/30,000 by 2026 and establish a future growth rate that can substantially close the participation gaps. Addressing barriers to women and BIPOC participation in engineering will require changing the systems that hold current policies and practices in place.

NSF's INCLUDES initiative "is a comprehensive, national effort to enhance U.S. leadership in science, technology, engineering, and mathematics (STEM) discovery and innovation". "Significant advancement of the INCLUDES Initiative's goals will result in a new generation of STEM talent and leadership to secure the Nation's future and long-term economic competitiveness". [5]

In August of 2021, the National Science Foundation provided $10 million in seed funding for 5 years to the Engineering PLUS Alliance. It is one of seventeen alliances of higher education institutions funded by NSF INCLUDES. Engineering PLUS is the only INCLUDES Alliance that focuses primarily on engineering and engineering technology. The Engineering PLUS Alliance is built around 6 key performance strategies including:

1. Backbone – the central coordinating team that provides the structural support and facilitation among the other 5 strategies.
2. Partnerships – participating institutions, professional societies and industry partners including the American Society for Engineering Education (ASEE), the GEM Consortium, NACME, NAMEPA, NSBE, AISES, SWE and other stakeholders.

3. Regional Hubs – a group of regional higher education institutions and their leaders that support STEM students, expand NSF LSAMP Alliances, and leverage high-impact practices and data-driven decision making that support students to degree completion.
4. stEm PEER Academy – a national network of stEm (E emphasizes engineering) PEER (Practitioners Enhancing Engineering Regionally) change agents, faculty and administrators who accelerate the implementation of high-impact, evidence-based education practices within their home institutions and beyond.
5. Sustainability – a team that ensures the long-term vision and viability of the Engineering PLUS Alliance and its mission beyond the immediate grant funding.
6. CIDER (Continuous Improvement through Data, Evaluation, and Research) – a multidisciplinary team of data scientists, researchers and evaluators that support and lead the data-focused research and evaluation activities of the Alliance.

Impacts

Implementation and scale of evidence-based practices across all partner institutions is central to this Alliance's efforts. stEm PEER Fellows, informed by data, are guided in their development of an Action Plan to support the design and scale of strategies that impact recruitment, retention and graduation rates of engineering students. Additionally, Fellows are guided to sustain their program efforts through private and federal funding. For example, Fellows have submitted and successfully secured NSF S-STEM, ADVANCE, LSAMP, BPE, IUSE and RIEF grants, to name a few.

Three cohorts of 71 Fellows from 57 different institutions (36 public, 16 private, 5 community colleges and 1 corporation) have been accepted into the Academy since May 2022. A fourth cohort cycle for 2025 is currently underway and should yield enough participants to surpass the original proposal's five-year goal of 100 total stEm PEER Fellows. Fellows are "creating cross-institutional transfer pathways and scholarship opportunities plus additional academic supports and learning communities that focus on fostering students' sense of belonging, identity and self-efficacy in their academic careers." [6] In fact, stEm PEER Fellows' projects are anticipated to impact over 3,400 undergraduate and graduate students and over 690 faculty in the next few years based on recent data.

Preliminary research indicates that stEm PEER Fellows have "demonstrated professional growth in their understanding of the national engineering education pathway landscape, utilizing data to inform their program efforts, elevating implementation and scale of evidence-based practices that alleviate students' barriers to success, and most importantly, building relationships that engage stakeholders at their own institutions, in their region and nationwide." [6] Formative evaluations administered by the CIDER team have collected important feedback from the

Fellows themselves and from the Academy leadership team, all of which have been used to improve the effectiveness of the Academy's initiatives and impact since 2022. [7, 8]

Regional collaboration is also essential to the implementation and scale of evidence-based practices. Engineering PLUS supports 3 regional hub networks and partnerships, in the Northeast, Midwest, and West Coast plus one pending "All Nations" hub led by the University of Montana. Hubs are currently collaborating with 84 institutional partners that seek to identify and collaboratively scale practices that support successful student engineering outcomes.

Partnerships with organizations such as ASEE, NSBE, SWE, GEM, NACME and the STEM Learning Ecosystem, have enhanced the professional development of stEm PEER Fellows in addition to informing regional collaborative efforts. Professional meetings have also served as a forum for recruitment, networking and dissemination of program efforts.

In summary, Engineering PLUS is in its fifth year with significant momentum. Sustainability and scale of evidence-based engineering education practices and the continued collaboration of individuals and organizations committed to implementation of these efforts is essential to ensure a strong U.S. STEM workforce.

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