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Engineering PLUS Alliance stEm PEER Academy for Faculty and Administrators: Transforming the National Engineering Education Landscape for Women and BIPOC Students

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Introduction

The Engineering PLUS Alliance is one of 17 National Science Foundation (NSF) INCLUDES Alliances of higher education institutions and the only INCLUDES Alliance focused on engineering. The NSF INCLUDES Alliance is a nationwide initiative designed to build United States leadership in science, technology, engineering and mathematics (STEM) by increasing the participation of individuals from groups that have been historically underrepresented in STEM. The Engineering PLUS Alliance seeks to strengthen and expand the future engineering workforce by supporting the recruitment and persistence of Black, Indigenous and People of Color (BIPOC) and female students in engineering. Despite significant investments by government agencies, universities, foundations and industries that rely on the skills and talents of engineers, BIPOC and women are underrepresented in the engineering workforce. Engineering depends on team collaboration, and research shows that diverse groups are typically more effective than homogeneous teams when complex problem solving are critical goals [1]. The United States must educate a diverse engineering workforce to address the complex technological challenges faced by our society. Greater diversity in the STEM workforce will result in a new generation of engineering talent and leadership to secure our nation's future and long-term competitiveness.

While there has been progress in increasing the number and percent of women and BIPOC graduates since 2011, engineering is still a discipline graduating predominantly male students [2]. BIPOC students drop off the engineering pathway at key transition points receiving only 6% of engineering PhD degrees [2]. Women are also underrepresented among graduate degree recipients [2]. As a community of educators and professional engineers, we are not addressing the problem systemically, i.e., we are not addressing the root causes that contribute to the heart of the problem. Moreover, our current efforts to broaden participation in engineering fail to consistently leverage evidence-based, high impact practices and redress obstacles, all of which are necessary to catalyze institutional change at scale [3] [4].

The Engineering PLUS Alliance posits that networked communities are needed to build an inclusive infrastructure that will drive the transformative, systemic and sustainable change needed to achieve 100,000 undergraduate and 30,000 graduate engineering degrees awarded annually to BIPOC and women students by 2026. Although many organizations, non-profits, grant projects, and universities have been working toward this change for decades, their efforts may be siloed and disconnected from one another. To achieve such transformative, systemic, and sustainable change, the Engineering PLUS Alliance team aims to recruit engineering institutions and community colleges into regional hubs, including current regional Louis Stokes Alliance for Minority Participation (LSAMP) networks, and train hundreds of stEm PEERs (Practitioners Enhancing Engineering Regionally) change agents (Fellows) across the

United States (where the E in stEm is capitalized to emphasize Engineering). To accomplish this, we seek to *accelerate* the development and implementation of evidenced-based interventions through the initiation and support of a professional learning community of "stEm PEER" Fellows, who will be equipped to design, implement, and assess evidence-based and inclusive practices at their respective institutions. In other words, the stEm PEER Academy was designed to *leverage* the wealth of best practices from established research and networks to provide the collaborative infrastructure needed to support sustainability and scale-up of proven strategies *and* foster an innovative culture that can achieve transformative change.

Background

stEm PEER Academy Fellows

The stEm PEER Academy was designed to empower, resource and support a national network of 100+ stEm PEER Fellows, or educational change agents, to accelerate the implementation of high-impact evidence-based practices at their own community college, public or private institutions. To do this, the Fellows engage with program experts, researchers, practitioners and each other to deepen their knowledge of challenges and successful strategies to guide their initiatives and transform the national engineering landscape. The stEm PEER Academy was intended as a 2-year professional development and research experience to support the design and implementation of an engineering-focused "Implementation Project". Each Fellow has developed their own Implementation Project based on their respective needs and infrastructure of their home institutions. It is our intention that Fellows will share and expand their Implementation Projects with others across institutions and hubs in order to scale up their high impact, evidence-based practices in significant and sustainable ways in order to achieve the target graduation rates by 2026 and beyond.

Beginning in Fall 2021, engineering-affiliated faculty and administrator applicants from post-secondary institutions across the country were invited to apply through various communication channels and networks. Part of the application included 2 question prompts to be answered in a short essay: "What is one evidence-based strategy or program that you believe has the potential to be most beneficial for women and BIPOC engineering students? and "How could you implement this strategy at your own institution?" Since the nature of this work cannot be attempted in isolation, applicants also required the support of their institutional leadership (supervisor, department chair or Dean) in the form of a support letter. Applicants' essay responses were reviewed for relevance to the target population while letters of recommendation from their leadership were reviewed for institutional commitment and support. Out of 27 applications, seventeen (17) fellows were finally selected for the first cohort based on potential to affect change. The majority of Fellows were non-White (11 out of 17) including 6 Black, 2 Asian, 2 Hispanic and 1 American Indian/Alaska Native (Figure 1). Fourteen (14) out of 17 Fellows were female (Figure 2).

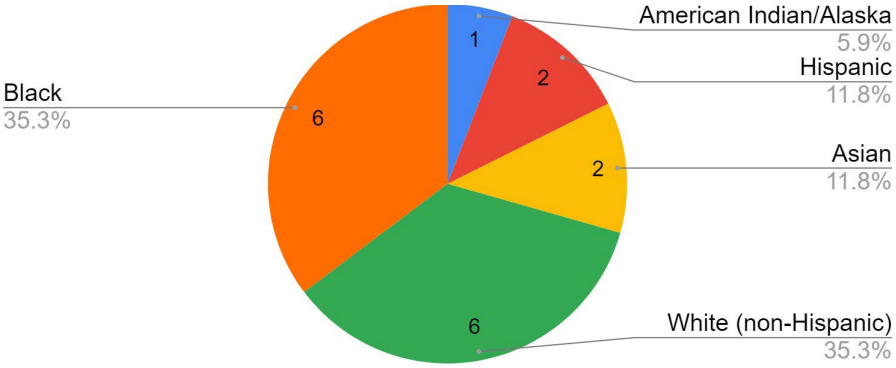

Figure 1. Race and ethnicity demographics of 1st stEm PEER Fellows (n=17).

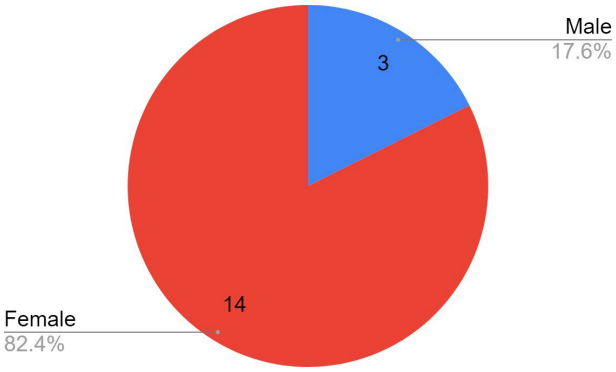

Figure 2. Gender demographics of 1st stEm PEER Fellows (n=17).

As for roles at their institutions at the time of their applications, 7 out of 17 Fellows were faculty, 5 were directors or deans, 3 were program managers and 2 were researchers. Two (2) faculty have since been promoted to a department chair, director or dean position with direct responsibilities for DEI and/or retention. About half of the Fellows work at public universities (9 out of 17) while 4 work at community colleges and 4 work at private universities (Figure 3). At the time of their applications, Fellows had worked about 4.5 years on average in their positions, with a range of less than 1 year to at most 11 years.

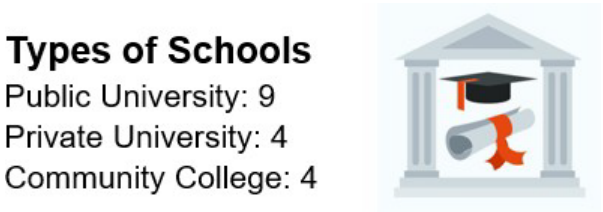

Figure 3. Types of Schools of 1st stEm PEER Academy Fellows (n=17).

Four Objectives and Five Deliverables

Throughout the 2-year engagement, stEm PEER Academy has been designed to deepen Fellows' knowledge and understanding of the challenges and successful strategies that can transform engineering education in significant and meaningful ways. Specifically, stEm PEER Academy was designed to meet four key objectives to empower Fellows and the stEm PEER community:

Objective #1: Understand the engineering education pathway landscape with an emphasis on diversity, equity and inclusion (DEI).

> This first objective focuses on the national engineering landscape, DEI principles, and a deep dive into data that is publicly available through the National Center for Education Statistics, specifically the Integrated Postsecondary Education Data System (IPEDS) [2]. Fellows are guided through the IPEDS website in order to explore data from their own institutions and regions in order to understand their own local landscape. For many of these Fellows, this data exercise may be their first exposure to disaggregated BIPOC and gender engineering graduation data from their own institutions.

Objective #2: Engage in models and interventions that empower women and BIPOC students to enroll and earn degrees at community colleges, public and private institutions.

> This second objective focuses on evidence-based and high-impact models and interventions such as retention strategies (wrap-around supports, mentoring, tutoring, living-learning communities, clubs and student organizations), first year engineering programs, women in engineering programs, pre-college programs, Summer Bridge programs, and successful transfer pathways (community college to 4-year institutions, undergraduate to graduate school). Publications such as the National Society of Black Engineers (NSBE) *Student Retention Toolkit* [5] are cited and shared with Fellows.

Objective #3: Build partnerships with stakeholders who are engaged in recruitment, admissions, retention, graduation, hiring and career development of women and BIPOC engineering students at their own institutions and in their regional hubs.

> This third objective focuses on building partnerships with stakeholders, such as LSAMP networks and new regional hubs, graduate schools at other institutions, and industry partners. Other stakeholders include national professional engineering societies such as ASEE, Society of Women Engineers (SWE), NSBE, National Action Council for Minorities in Engineering (NACME), American Indian Science and Engineering Society (AISES), and local and national funding agencies such as NSF, the Department of Homeland Security (DHS), and others.

Objective #4: Plan, implement, assess, and scale the Implementation Project.

This fourth objective focuses on each Fellow developing a plan for an Implementation Project that they propose to their own leadership and subsequently launch at their own institution. Examples of these projects include Summer Bridge, Living Learning Communities, mentoring programs, tutoring programs, and transfer pathways of community college students to 4-year programs and undergraduates to graduate school. While these types of programs are not new, the goal has always been for Fellows to scale up their Implementation Projects using the human capital of stEm PEER Academy leadership and regional hub partners and financial support (if applicable) from the Engineering PLUS Alliance and external funding sources.

Since the overall mission of stEm PEER Academy is to engage, enroll and graduate significantly more women and BIPOC engineers by 2026, five deliverables were identified to drive transformative, systemic, and sustainable change through action and measurable outcomes:

Deliverable #1: Collaboration and Networking

As part of the INCLUDES Alliance, Engineering PLUS and stEm PEER Academy were both designed to provide Fellows with unlimited opportunities to collaborate with each other, with colleagues at other institutions in their regional hubs, and with an extensive network of leaders in the engineering education landscape, including those at the helm of Engineering PLUS. Given the diverse engineering student population that Engineering PLUS targets, networking is a critical component, especially for our women and BIPOC Fellows. Therefore, these collaborations and personal interactions are desired and can be measured with evaluation instruments. Fortunately, evaluation data already show that Fellows are benefiting from such collaborations within stEm PEER Academy, within Engineering PLUS, and within their own institutions.

Deliverable #2: Data

One of the most important deliverables of stEm PEER Academy has been exploring publicly available data in the national engineering landscape to empower Fellows so they can leverage robust evidence in seeking greater access, participation and career success of women and BIPOC engineering students at their own institutions. This deliverable was launched in the very first session of the first stEm PEER Academy in June 2022 with an interactive data workshop administered by the Continuous Improvement Data Evaluation and Research (CIDER) team. Throughout stEm PEER Academy, the CAPE (Capacity Access Participation Experience) framework, originally developed for the computer science education field, has provided the lens for assessing equity not just as an outcome but as an integral element of an improved engineering education ecosystem [6]. This deliverable can be measured with evaluation instruments assessing Fellows' use of their

institution's IPEDS data.

Deliverable #3: Assessment

Another key deliverable is program evaluation, not just of stEm Peer Academy itself, but of Fellows' engagement in the Academy and of their own students' outcomes. The CIDER team provides extensive expertise in program evaluation and assessment at all levels of the Engineering PLUS Alliance. This paper reports results from formative evaluations of stEm PEER Academy and its Fellows' experiences between June 2022 - December 2022. These assessments by the CIDER team are also designed into other components of the Engineering PLUS Alliance and serve as deliverables which inform continuous improvements, stEm PEER Academy offerings, and Fellows' collective efforts.

Deliverable #4: Research

stEm PEER Academy's fourth deliverable is deepening Fellows' knowledge about foundational research in student retention and other evidence-based practices that engage, enroll and graduate women and BIPOC engineers. This deliverable pairs well with understanding the national engineering education landscape and the data that define the performance (or lack thereof) of engineering education programs in the United States, starting with each Fellows' home institution. Research publications regarding diverse, equitable and inclusive "best practices" in engineering education have been shared with Fellows and are continually updated and discussed as new research emerges [7 - 11].

Deliverable #5: Professional Learning

Finally, stEm PEER Academy's fifth deliverable is a toolbox of resources that guides Fellows' professional development such as developing Broader Impact identities, Broadening Participation efforts, proposal development, and writing research papers. For example, stEm PEER Academy prepared an NSF-aligned proposal guideline for Fellows to use for requesting implementation funding from Engineering PLUS to launch their own Implementation Projects. The purpose of this NSF-aligned proposal exercise was to provide Fellows with a more accessible and less intimidating proposal format for developing their Implementation Project, especially if they were navigating proposal writing for the first time. Several Fellows have taken advantage of this exercise while others already had experience (and success) submitting larger proposals to external funding agencies and corporate partners to support their Implementation Projects or similar initiatives. Regardless of Fellows' prior skills in securing external funding, they will need to recognize national funding opportunities that are aligned to their own institution's goals in order to scale up their own projects and for the Alliance to collectively achieve transformative, systemic, and sustainable change on a larger scale.

In summary, these four objectives and five deliverables define the purpose and outcomes of

stEm PEER Academy, respectively.

Summer Institute

stEm PEER Academy began with a 1 hour virtual orientation in May 2022 for introductions and initial discussion about the upcoming Summer Institute. This was the first meeting where Fellows and the Academy leadership team met each other "face-to-face" albeit virtual.

At the virtual summer institute, which spanned 4½ days in June 2022, Fellows explored the 4 aforementioned topics including the engineering education pathway landscape and evidence-based strategies that work for women and BIPOC students, all with an emphasis on diversity, equity, and inclusion (DEI). Workshop sessions on institutional data, student retention, resources (publications and professional societies), institutional change, first year engineering programs, Summer Bridge programs, women in engineering programs, funding, and writing proposals were facilitated by the principal investigators and invited speakers. To help Fellows begin to develop action plans, they were encouraged to keep a daily reflective journal about each session with personal notes, notable takeaways, resources, and action steps for their own use. To document their potential action plans, they were asked to prepare a 5-minute individual presentation (using a provided Google slide template) about themselves, their institution, what they learned from their "deep dive" data exercise, evidence-based practices that would impact their efforts, and their proposed Implementation Project. These presentations were delivered on the last day of the summer institute and saved in Basecamp for perpetual access. A collaborative Google Doc was provided for Fellows and Academy leadership to record comments, questions, notes and suggestions about each Fellow's presentation *in real-time* so that discussion and individual feedback could be captured, documented and considered.

The virtual summer institute was followed by monthly virtual meetings throughout the 2022 - 2023 academic year, which have focused on collaboration, discussion, actual program implementation, assessment and strategies for sustainable growth. These virtual monthly meetings are attended by most Fellows given their busy work and teaching schedules. Meeting minutes are shared on Basecamp for access to all.

Fellows' Implementation Projects

When Fellows first applied to stEm PEER Academy, they were asked to answer two (2) questions: "What is one evidence-based strategy or program that you believe has the potential to be most beneficial for women and BIPOC engineering students? and "How could you implement this strategy at your own institution?". Their answers were the foundation of their Implementation Projects which were initially developed during the summer institute. As Fellows participated in Academy sessions, starting with a deep dive into their own institution's IPEDS data [2], Academy leadership led Fellows to begin formulating ideas for a project they could actually implement back at their home institutions starting in Fall 2022.

By the end of the virtual summer institute, two categories emerged from the 17 Fellows' potential Implementation Projects: recruitment/pre-college (n = 4) and retention (summer bridge n = 4, undergraduate women/BIPOC support n = 9). Some of the Fellows' initial ideas for their Implementation Projects would eventually pivot, based on discussions with their leadership back at their own institutions or due to shifting job responsibilities or priorities. Nonetheless, all projects remained within the scope of addressing women and BIPOC engineering student success pathways in some form or another. Details and progress of several Implementation Projects are discussed in the Results and What's Next sections.

Research Methods

With Institutional Review Board approval from Northeastern University, two online evaluations and one round of focus groups were conducted in 2022 with the first cohort of stEm PEER Academy Fellows. Evaluation instruments were designed to answer a set of evaluation questions framed around understanding how the work of the Fellows contributes to four key design elements of an INCLUDES Alliance as laid out by NSF solicitations for this grant program: 1) shared vision and strategy for broadening participation, 2) partnerships and infrastructure, 3) leadership and communication, and 4) potential for expansion, sustainability, and scale.

The first online evaluation was administered by the CIDER team immediately after the summer institute. Fellows' expectations and experiences were assessed with a brief qualitative and quantitative survey. This survey focused on their backgrounds and experiences in engineering education, their positions, their motivations for attending the Academy, overall satisfaction, future plans, anticipated outcomes, the extent to which those plans had been influenced by stEm PEER Academy, their ratings for each workshop session, and suggestions for improving future Academies. This formative feedback survey was sent to all 17 Fellows and completed by 15 for a response rate of approximately 88%, which is likely to be representative of the broader group.

Fellows were also invited to attend a virtual focus group on the Monday of the week that followed the summer institute. Nine (9) Fellows attended for a response rate of 53% which is less representative of the whole group than the survey, but still enabled deeper, qualitative exploration of key themes that emerged within the survey. The focus group focused on the most impactful elements of the Academy, Fellows' detailed experiences, and additional resources needed from Academy leaders for their future work. This focus group was administered by the CIDER team.

The second online evaluation was administered by the CIDER team in Fall 2022 after three virtual monthly networking meetings had been held during the semester. Fourteen (14) out of 17 Fellows completed this survey for a response rate of 82%. This yields a margin of error in the findings of ± 11% which means that responses were probably representative of those who

did not complete the survey. This qualitative and quantitative survey focused on Fellows' engagement with the Academy, current design and status of their Implementation Projects, impact of the Academy on the timing and scope of their projects, projected impacts on the type and number of targeted students, recommendations for Academy improvement, and their next steps.

Survey results were analyzed using descriptive statistics. Results were tabulated for easier viewing, and averages were computed for scaled response questions. Responses to open-ended questions were categorized thematically. The focus groups were recorded and transcribed and notes were also taken during these sessions. The transcripts were examined for common and divergent themes that emerged across respondents and illustrative quotations were extracted where relevant.

Results

Results from the *summer online evaluation* showed that the Fellows found their summer Academy experience to be generally positive and that it delivered on promises regarding knowledge and skills. Fellows expressed a high degree of passion for DEI in STEM education and attended the Academy primarily because of their interest in learning more about high-impact practices and how to apply them in their setting.

When describing the most impactful elements of the Academy during the *focus group*, respondents talked primarily about the value of collaborating with colleagues, as well as receiving concrete advice from the Academy mentors on how to begin their own efforts. One Fellow described this in detail, saying "*I think that, for me, this program established some self-efficacy that I can do things that will make change. It also was good to feel like there are people that are ready to … make positive differences to Engineering Education…This academy provided (1) self-efficacy, (2) network, (3) knowledge exchange*."

Also in the focus group, when thinking about additional resources or follow-up support they desired after the academy, Fellows primarily talked about three ideas:

1. Mentoring and/or regular meetings to answer questions and ensure steady progress on their projects.
2. More information and resources associated with NSF funding.
3. Providing their administrator colleagues with workshop materials and other information about the Academy.

For approximately half of the Fellows, their next step was sharing information with others at their own institutions about their prospective projects and gaining buy-in, while the other half were prepared to take immediate and concrete action on their projects.

Fellows converged on recommended improvements for the Academy including:

1. A more detailed syllabus going into the Academy, thus providing the experience with more structure overall.
2. Spreading out the material over a longer period of time to make it easier to digest (or providing earlier access to it).
3. Creating more opportunities for communication and networking between Fellows.
4. Considering in-person sessions or an in-person Academy, in the future (which may already be in process for next year).

Results from the *Fall 2022 online evaluation* showed that the Fellows found the Academy to be a valuable and rewarding experience. They have been able to share ideas with one another, benefit from the knowledge and assistance of the Academy leaders and learn a great deal about high impact practices related to helping BIPOC and female students earn degrees in engineering. Although most are still in the process of setting up their Implementation Projects, not surprising given that only one semester has passed since they joined the Academy in June, most are well underway toward getting their projects off the ground. Most had come into the Academy with an idea for a project they wanted to do and being part of the Academy helped them refine and strengthen that project with more knowledge about high impact practices. For many, it also helped accelerate the implementation of their projects. The scope of these implementation projects varies, impacting students from K-12 to graduate school, with prospective audiences ranging from just a handful to several hundred.

As shown on Table 1, Fellows were highly engaged with the Academy. They found it to be very relevant, thought the meetings were very respectful of all participants, and valued the support provided by the stEm PEER Academy leaders. The only area where they didn't provide high marks was in working with one another on their projects, which is not surprising given that they are (for the most part) at different institutions and have limited time available for this work. In the comments clarifying responses to this question, many praised the program leadership for being so helpful and accessible.

Table 1. Agreement with statements about engagement in the stEm PEER Academy (n=14).

What I do as part of the stEm PEER Academy is relevant to other aspects of my work.	4.9
I feel comfortable expressing my opinions in group meetings.	4.6
I feel that all points of view are treated with equal respect in my group.	4.6
stEm PEER leaders are available to provide additional support and one-on-one meetings.	4.6
I believe that members of my group trust each other and feel able to say what is on their mind.	4.4
I am satisfied with how the stEm PEER Academy is working.	4.2
The group meetings are useful to me.	4.1
I frequently contribute ideas to the discussions within group meetings.	4.0
The stEm PEER Academy is progressing the way I hoped it would.	3.9
My satisfaction with my job is better because I am a stEm PEER.	3.9
I work closely with the other people in my group on activities related to engineering education.	3.4

Responses are on a scale from 1 = strongly disagree to 5 = strongly agree

Note: darker green shading indicates higher values

Of the fourteen Fall 2022 evaluation survey respondents, five said they had already started their implementation projects. Of these, one had implemented some of their proposals at their institutions. The others were collecting background information, meeting with their administration to set up the project, or waiting until the summer to run it—essentially, they were at the same point in their progress toward implementation as those who said they had not yet started.

Those who said they had NOT yet started were generally still in the research and design stage, though some had been working within their departments and with partners to set up activities. One Fellow who hadn't started their Implementation Project said "*We are currently in planning stages to implement the summer bridge program in Summer 2023*." Another Fellow in this category said "*I believe strongly in my original idea, which is evidence-based (and related to a NSF-funded project on which I work); I also had a second evidence-based project idea. I began a new role at my university last month (November) and the second idea may receive better support from my Dean. I am still working on buy-in on the second idea to move forwar*d."

All projects are specifically targeted at reaching female and/or BIPOC students, whether it be by encouraging them to participate in engineering or supporting their persistence and success once they are in such programs. The expected audiences for Implementation Project activities varied. While most planned on reaching undergraduates, the numbers ranged from less than ten to over 400 per project. Some also focused on K-12 students (to inspire them to pursue engineering in college), while others included graduate students or other faculty members. One Fellow commented about the impact of their project on increasing numbers of BIPOC and women engineering students: "*My project has helped create resources for Black students and improve their sense of belonging. Our long-term goal is to improve their numbers*."

Without the stEm PEER Academy, nine of the fourteen would still have implemented their projects, but most would have taken longer to implement and may have used less effective strategies. Only two would have had a different focus or topic, however. Twelve of the fourteen felt that they were unable to do all they would have liked to be able to do, because of inadequate funding. More funding would allow them to expand the program to more students, enhance what they could offer, and support more personnel to run it.

One Fellow who reported that they had more plans than funding to support their ideas said: "*I really would like to implement a Engineering Post-Bac program offered to undergraduates who recently (within the last two years) completed their BS degree in an Engineering discipline. Such a program would require student stipends, housing, and research appointments with dedicated faculty/labs for 9 - 12 months. This can be very costly. So I am considering how to identify targeted juniors to engage in faculty-mentored research and provide them with professional development, which include GRE prep, graduate school visitation trips, virtual meetings with graduate school coordinators, etc. to help in their*

preparation for graduate school."

The most valuable parts of the Academy were engaging with colleagues who were knowledgeable and dedicated to the same purpose, learning about various tools, practices, and strategies, and being taken seriously as a professional. Direct quotes include:

"I have received more support navigating the tricky world of grant applications from this program than I have in my institution!"

"The stEm PEER cohort idea is an amazing one; it is both a privilege and a challenge to be part of the inaugural group; we have amazing access and support AND we are the ones finding the rough spots that will be smoothed for subsequent cohorts."

"Feeling like I am taken seriously as a researcher and professional!"

"The most valuable part of participating has been connecting with [Fellows] who are working to improve the engineering ecosystem in a variety of ways and each bringing their own knowledge and expertise to share. It has reinvigorated my dedication to my work and given me a sense of urgency to be more intentional with what we do."

Two suggestions that came out of the Fall 2022 evaluation comments were:

1. Make sure Fellows understand that the best practice for broadening participation in engineering that they described at the beginning of the Academy could be expected to be the starting point for their Implementation Projects.
2. Provide more opportunities to think through the projects together in monthly networking meetings so that there might be more collaboration.

When asked what additional supports they would have liked from the Academy, they suggested the following:

1. Advice on how to find additional sources for funding.
2. Continuing to learn about high impact strategies.
3. More one-on-one meetings to help with effective project implementation.
4. Clearer information about the funding available for the Implementation Project and what it can be used for.

What's Next

As a result of the summer focus group discussions, Fellows suggested three improvements: 1) mentoring and/or regular meetings to answer questions and to ensure steady progress on their projects, 2) more information and resources associated with NSF funding, and 3) providing their administrator colleagues with workshop materials and other information about the Academy.

First, Academy leadership addressed the mentoring suggestion by inviting Fellows to one-on-one meetings starting in June/July 2022. These mentoring meetings had been part of the grant proposal and rollout plan all along so the suggestion was not a surprise. To date, one-on-one meetings and opportunities to participate in CIDER data workshops have totaled more than 40 hours and have involved at least 5 different Academy leadership individuals. While Fellows have been invited to reach out when they have questions or issues to resolve, the Academy leadership team has also been following up with Fellows who have not scheduled any 1-on-1 meetings to better understand their needs. This process is ongoing and will continue for the 2 year professional development timeframe.

Second, more information and resources about NSF funding have been shared with Fellows on Basecamp as funding solicitations are announced and discussed during monthly networking meetings with the group. Fellows have been encouraged to join the NSF Eddie Bernice Johnson INCLUDES Alliance Network so that they may receive timely announcements and notifications from all the other Alliances to learn what others are doing and where new opportunities are available. A future monthly networking meeting dedicated to NSF funding programs is planned for Spring 2023. As previously mentioned, the fifth deliverable of stEm PEER Academy involves Professional Learning so Academy leadership prepared an NSF-aligned proposal guideline for Fellows to use for requesting implementation funding from stEm PEER Academy to launch their own Implementation Projects. The purpose of this NSF-aligned proposal exercise was to provide Fellows with a more accessible yet NSF-aligned proposal format for developing their Implementation Project, especially if they were navigating proposal writing for the first time. Several Fellows have taken advantage of this exercise while others already had experience (and success) submitting larger proposals to external funding agencies and corporate partners to support their Implementation Projects or similar initiatives.

Third, an acknowledgement letter was sent to each Fellow in Fall 2022 to share with their home institution's leadership team that recognizes each Fellow as a participant in stEm PEER Academy. This letter outlined the vision for the Engineering PLUS Alliance, the goal and purpose of stEm PEER Academy, including financial support to launch initiatives, and each Fellow's proposed Implementation Project. Summer Academy session recordings were also shared and published for Fellows who would like to revisit the summer sessions or invite their own colleagues and leadership team to watch too.

As a result of the Fall 2022 evaluation, Fellows suggested additional support, some that reiterated their recommendations in the summer, such as more one-on-one meetings to help with effective project implementation and help identifying additional sources of funding. In addition, Fellows suggested that monthly networking meetings provide more opportunities for the group to think through their projects together. As such, both the January and February 2023 monthly networking meetings were designed to facilitate group discussion and deeper dives into Fellows' progress on their projects. More one-on-one consultation meetings have been held since the start of the Spring 2023 semester and more are scheduled in the next few

months.

Finally, two recommendations from the Fellows focused on learning more about high-impact strategies and understanding expectations of their Implementation Projects more upfront. Based on their responses, it seems that most Fellows already came into the Academy with an idea of what they would like to accomplish. This is not surprising since their application asked about an evidence-based strategy they could implement at their own institution. However, some Fellows pivoted to different project ideas after they completed the first summer academy, either because of a job change or because they acknowledged an alternative higher-impact strategy. While it is possible that they already knew that their original idea (or new idea) was poised to address the key factor or one of the key factors that was preventing their institution from achieving their desired outcomes, Fellows have probably relied on intuition and the familiar resources they already have at their institutions. Although this intuition strategy has the ability to yield very positive results, it also has the possibility of achieving relatively little if it does not address the root cause of the most influential problem.

Therefore, when they implied in their comments that an assessment of what challenges their institutions are facing toward achieving their desired numbers of BIPOC and female graduates is overdue, perhaps the summer Academy, with additional support from the CIDER team, should take a closer look at the data from each of the institutions represented, focusing on the recruitment, persistence, performance and graduation data of BIPOC and female engineers. Then, once the data are better understood, a formal needs assessment and problem definition exercise could lead Fellows to brainstorm interventions that would directly address the root cause of the problem. This would help identify more targeted and desired outcomes of the Implementation Project and criteria for its success.

Conclusions

Considering all of the evaluation data and feedback from the Fellows and reflecting on how to improve the logistics, delivery and value of stEm PEER Academy for summer 2023, we propose the following improvements:

1. Distribute the summer Academy sessions over several half days and weeks instead of consecutive full days in any one week. This would allow more time for Fellows to process content and intentionally reflect on what they've learned. The new schedule covers the same number of hours and the same topics.

2. Provide a more detailed syllabus before the summer Academy to better outline the structure and expectations of the Implementation Project and the 2-year professional development timeframe.

3. Lead Fellows through a needs assessment and problem definition exercise by digging deeper into their institution's data at the beginning of the Academy. This would allow each

Fellow to leverage publicly available data about their institution to identify the most imperative areas to address.

4. Provide more opportunities for Fellows to collaborate together during the 1 hour virtual monthly networking meetings *and* in person at professional society meetings such as ASEE and CoNECD. Encourage Fellows to contact each other directly to engage in conversations about their challenges, successes and Implementation Projects.

Although there are many improvements that can be implemented to increase the success of stEm PEER Academy, this component of the Engineering PLUS Alliance has begun to achieve what it was designed to do: 1) *accelerate* the development and implementation of evidenced-based interventions through the initiation and support of a professional learning community of stEm PEER Fellows, and 2) *leverage* the wealth of best practices from established research and networks to provide the collaborative infrastructure needed for an innovative culture and transformative change. Our first cohort of Fellows have shared their experiences, expertise and innovative ideas with each other, their institutions, and with the Academy leadership team. We look forward to engaging with the next cohort of engineering education professionals to help us build an inclusive infrastructure that will drive the transformative, systemic and sustainable change needed to achieve 100,000 undergraduate and 30,000 graduate engineering degrees awarded annually to BIPOC and women students by 2026.

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