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Grassroots Approach to Advancing Inclusion, Diversity, Equity, and Access in Engineering

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Ellen Wang Althaus, PhD (she/her) is a collaborative and innovative leader forging new initiatives and building alliances to foster diversity, equity, and inclusion (DEI) in science, technology, engineering, and mathematics (STEM) disciplines.

In her current role as Assistant Dean for Strategic Diversity, Equity, and Inclusion Initiatives in the Grainger College of Engineering at the University of Illinois Urbana-Champaign she • Leads the strategy enhancing the Grainger College of Engineering (GCOE)'s commitment to diversity, equity, inclusion, and access. • Develops robust structures to support faculty and staff appropriately to ensure an equitable, inclusive, and supportive workplace and learning community. • Collaborates with the Associate Dean (AD) to 1) define strategic priorities and examine policies, and 2) develop DEI goals and objectives for the College and its units. • Utilizes data collection and analysis to identify challenges, enhance transparency, establish accountability measures, propose effective solutions, and define metrics for evaluating progress within the college's units and other assigned areas. • Leads and oversees the development and implementation of programs, activities, and other initiatives to educate the community on diversity, inclusion, and belonging, and to increase diversity within GCOE.

Prior to joining Grainger Engineering, she launched and developed new initiatives in inaugural roles at the Sloan University Center of Exemplary Mentoring (UCEM) and in the Chemistry department to recruit, mentor, and graduate women and underrepresented racial/ethnic minority PhD students. She holds degrees in chemistry from Carleton College (B.A.), and Northwestern University (M.S. and Ph.D.).

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Abstract:
Diversity initiatives are often established in a top-down approach, wherein visions, missions, and priorities are dictated by institutional leadership. While it is important to demonstrate institutional commitment, establish a high-level strategy of various policies and practices, and communicate the value of diversity and inclusivity, the actual implementation of these ideas is often less impactful due to the lack of perspectives from those who are primarily affected. Thus, by incorporating a bottom-up approach to enhance diversity and inclusion, there is an opportunity for those on the ground to infuse their ideas and inform leadership on the issues. The Grainger College of Engineering at the University of Illinois Urbana-Champaign has recognized the importance of having both approaches working together and has invested in a program that empowers individuals within the engineering community to significantly contribute to inclusion, diversity, equity, and access (IDEA). The Grassroots Initiatives to Address Needs Together (GIANT) program awards seed funding of up to $13,000 to teams led by students, postdocs, staff, and faculty to propose and implement research-based initiatives that address issues in IDEA. Teams are expected to collaborate with a specific population (e.g., the general public, K-12 students of diverse backgrounds, undergraduate students, graduate students, postdocs, staff, and/or faculty within the college) to jointly identify a need (e.g., recruitment, mentoring, development, retention, and/or engagement of individuals from underrepresented groups in STEM, K-12 outreach and STEM pipeline development, integration of IDEA in engineering education, etc.). To address these needs, teams develop a research question, propose and implement project activities, measure the outcomes, document best practices, and publish the results. Since 2020, the program has awarded over $565,000 and has provided mentorship to support forty-one (41) projects that have engaged over 200 individuals within the college and the local community. This paper describes the program in detail, including the research areas and outcomes of selected funded projects.

Introduction:

Systemic change to improve diversity, equity, and inclusion (DEI) in science, technology, engineering, and math (STEM) across institutions of higher education has been a national priority for decades, evidenced by the significant investments in programs designed to address barriers to access and success of students from racial and ethnic minority groups [1]. Despite best efforts, disparities remain in the completion of STEM degrees by historically marginalized students. The National Center for Science and Engineering Statistics (NCSES) reports that in 2021, 28.1% of all bachelor's degrees in science & engineering (S&E) were awarded to Black/African American (9.2%), Hispanic/Latino, (18.3%), Native Hawaiian or Other Pacific Islander (0.2%), and American Indian/Alaska Native students (0.4%), whereas 55.9% of bachelor's degrees were awarded to White students. At the graduate level, 19.4% of all doctoral degrees in S&E were awarded to Black/African American (9.2%), Hispanic/Latino (9.7%), Native Hawaiian or Other Pacific Islander (0.1%) and American Indian/Alaska Native (0.4%) students, in contrast to 67% awarded to White students [2]. In comparison to the demographics of the U.S. population ages 20-34 (Black/African American (14.3%), Hispanic/Latino, (21.7%), Native Hawaiian or Other Pacific Islander (0.2%), and American Indian/Alaska Native students (0.8%), White (53.7%), the degrees awarded to these racial/ethnic populations are generally not representative [2]. The demographics of the U.S population is becoming increasingly more diverse with projections that 50% of the U.S. population ages 18 years and under will consist of

minoritized individuals by 2042 [3]. This trend presents substantial opportunities to recruit diverse talent into STEM educational programs and the STEM workforce and assess factors that impede the recruitment and retention of racial/ethnic minoritized students in STEM pathways.

Organizational change is quite complex and requires dismantling harmful policies, recognizing one's biases, changing attitudes and behaviors, understanding the experiences of marginalized communities, and shifting the cultural climate of the institution [4]. There is no singular approach; however, it is widely accepted that multi-tiered approaches working in tandem are the best solutions. Many organizations have taken a top-down approach with priorities on "fixing the system," whereas others focus on "fixing the student." The National Academies of Sciences, Engineering, and Medicine has recommended nine frameworks that guide institutions towards advancing anti-racism, diversity, equity, and inclusion. Frameworks presented by Posselt and Kezar consider combining bottom-up, grassroots, initiatives with top-down efforts to induce systemic change [5], [6].

For this paper, the Kezar framework is the most closely related to the guiding strategies for the Grassroots Initiatives to Address Needs Together (GIANT) program implemented at The Grainger College of Engineering of the University of Illinois Urbana-Champaign. Kezar outlines three key actions that lead to systemic change: mobilize, implement, and institutionalize. Mobilization involves defining the need for change through data-driven evidence and galvanizing support for change and mobilizing leadership for collective action. Implementation involves piloting strategies, evaluating results, and making decisions on whether to scale up or down, and institutionalization involves disseminating results to broader communities and stakeholders [6]. The GIANT program empowers individuals at the grassroots level. We believe that the convergent approach to DEI will lead to systematic change.

Establishment of Institute for Inclusion, Diversity, Equity, and Access and GIANT Program

In 2019, the Institute for Inclusion, Diversity, Equity, and Access (IDEA), referred to as the IDEA Institute, was established in response to a recommendation from The Grainger College of Engineering Diversity Committee to form an institute which would be responsible for understanding the national and institutional landscape of DEI and evaluating the College's practices and policies that impact broadening participation among students, faculty, and staff. This research-based institute would also serve as the focal point for DEI activities. In practice, the IDEA Institute acts as a hub for innovation through social justice by encouraging and strengthening IDEA at all levels. Its membership includes students, faculty, postdocs, and staff within engineering and across campus as well as local community members.

At its core, the IDEA Institute (i) conducts scholarly research, including evaluating and integrating diversity in engineering, (ii) enables faculty, staff, and students to create and sustain initiatives, (iii) creates a platform for people to discuss their DEI efforts and practices to find collaborations and amplify impact, (iv) provides resources that foster diversity and inclusion, (v) uplifts the goals of campus student affinity groups, such as the National Society of Black Engineers (NSBE), Society of Women Engineers (SWE), Society of Hispanic Professional Engineers (SHPE), etc., and (vi) creates engineering-related mentorship opportunities for Black, Hispanic, and Indigenous K-12, undergraduate, and graduate-level students in the state of

Illinois.

One of the premier programs of the IDEA Institute is the GIANT Program, which is a seed grant program that provides an opportunity for Institute members to research DEI issues they are passionate about in a way that is otherwise not possible. The GIANT program is modeled after the Strategic Instructional Innovations Program (SIIP) for faculty-led teaching initiatives [7] but is modified to focus on DEI topics and allows students, postdocs, and staff to propose and lead projects. Central to the GIANT program is: (i) proposing evidence-based strategies fostering DEI in STEM, (ii) conducting research and collecting data on effectiveness of projects, and (iii) equipping members of a STEM organization with professional skills and tools to propose and conduct a mini grant program. Systemic change and organizational learning strategies in STEM higher education are critical to preparing a diverse STEM workforce [8], [9], but these multi-level changes take time. The aim of the GIANT program is to mobilize stakeholders at the grassroots level and to pilot new ideas promoting DEI in STEM, which are grounded in research to determine what approaches are worth continuing. Sometimes the best ideas come from the lower tiers of an organization, and not from the top [10].

This program also brings together groups of people at all levels from various departments, student organizations, and the local community to propose solutions that improve equity, inclusivity, accessibility, and diversity. The IDEA Institute awards seed funding of up to $13,000 for one year to proposals that present strong evidence to solve a specific need, demonstrate plans to measure the outcomes, document best practices, and publish the results. Successful projects may apply for a second year of funding to expand their effort. Occasionally, a project generates the necessary preliminary data to formulate a successful proposal to an external funding agency that expands the initiative to a larger population. Proposals are accepted from teams of people that desire to actively collaborate with a specific population, e.g., the general public, K-12 students from diverse backgrounds, undergraduate or graduate students, postdocs, staff, and/or faculty within the college. General areas of interest include but are not limited to: (i) recruitment, mentoring, development, retention, and/or engagement of individuals from underrepresented groups in STEM, (ii) integration of inclusion, diversity, equity, or access in engineering education, (iii) K-12 outreach and development of inclusive pathways into STEM, (iv) public policy and/or engagement of the general public, (v) continuing education, cooperative education, and engineering workforce development, and (vi) scholarly research into best practices and effective methods to institutionalize these best practices. In some years, research proposals on special topics were encouraged, such as to: (i) reduce or eliminate inequities in remote and online education, (ii) actively address racism, especially if the effort is aligned to recommendations from a prior task force, (iii) focus on staff and/or faculty as the specific population, (iv) focus on vocational schools, community colleges, and/or minority serving institutions as the specific populations, (v) build connections with industry, include industrial collaborators, and/or consider research questions from an industry context, or (vi) have impact across the state of Illinois or in strategic engagement in the local Champaign-Urbana community and surrounding areas.

Funding for this program as well as for the IDEA Institute overall is sourced via the annual returns on the endowed gift associated with the naming of The Grainger College of Engineering. In 2022 and 2023, gifts from the Illinois-IBM Accelerator Discovery Institute (IIDAI) [11] and

Higher Educational Initiative in Semiconductors (HIVE) [12] to the Institute co-funded eight of the projects.

Program Structure

Proposal Preparation and Selection Process

The structure of the proposals is similar to those of external funding agencies that require research questions, supporting activities, evaluation and assessment, and impact statements. The principal investigator of a proposed project must be a member of The Grainger College of Engineering (e.g., a student, postdoc, staff, or faculty). However, the team may comprise a mix of students, postdocs, staff, and faculty from any department on campus as well as people from external community organizations. The proposal consists of a two-page narrative, budget, and budget justification. Detailed templates for the narrative, budget spreadsheet, and justification are provided to proposers to guide those who are less familiar with proposal writing (e.g., students, postdocs, and staff). For example, the narrative template includes specific sections and guiding questions in each to enable proposers to address the selection criteria: (i) *needs statement* describes the need that the project addresses, target population, current landscape, literature review of best practices for addressing the needs, and desired outcomes; (ii) *theory of action* outlines the proposed activities and implementation plan; (iii) *theory of change* explains why the proposed activities will lead to the desired outcomes; (iv) *research statement* states the question(s) that will be investigated and how they will guide the project activities, data to be collected, and the dissemination plan for project outcomes including the target conferences and journals in which to present and publish; (v) *impact statement* conveys how the project outcomes will impact the target population; (vi) *evaluation and assessment* outlines the qualitative and/or quantitative metrics to assess the effectiveness of the project; and (vii) *plan for sustainability* explains how the project outcomes will lead to external funding from federal agencies, industry, or private donors and/or be institutionalized within The Grainger College of Engineering. We believe that the brevity of the proposal narrative (2-page limit including references) and standardization of the proposal package via templates not only enable a wider base of members to submit their ideas but also enable reviewers to spend less time reading and more time providing constructive feedback.

First time proposal submissions are classified as Phase I proposals. Active projects may submit proposals for additional funding to support a Phase II project. Phase II proposals must articulate Phase I outcomes and outline new approaches that expand on the Phase I project. Each Phase I proposal is assigned three independent reviewers. Phase II proposals undergo two reviews. Reviewers consist of faculty, staff, or students who are current or former grantees of the program, members of the IDEA Institute, and on occasion external collaborators. Proposals are scored based on scholarly rigor, approach, potential impact, sustainability plan, and receive an overall score. Projects are also evaluated on whether the proposed activities are commensurate with the budget plan. Reviewers are asked to provide constructive feedback that is shared with teams. Reviewers may also provide comments and concerns to the Institute leadership who make final selections and award notifications that are not shared with proposal teams. All project teams receive reviewer feedback and are asked to provide written responses to reviewer concerns expressed in the reviewer feedback.

To date, thirty-five (35) of the fifty (50) submitted phase I proposals and all six (6) of the submitted phase II proposals have been funded. All fourteen (14) of the student-led proposed projects have been funded. This is a high funding rate, especially for student-led projects. We believe this funding rate demonstrates a strong level of commitment from The Grainger College of Engineering to DEI grassroots efforts and encourages those who typically do not write proposals to consider leading a project.

Mentorship

Many students and staff are likely unfamiliar with or lack experience with proposing and running DEI initiatives. Therefore, a structured process has been developed to guide all proposers through both processes. Templates of all required documents (i.e., proposal narrative, budget and justification, faculty biosketches (if applicable)) are made publicly available. Additionally, an information session is hosted following the release of the proposal call to discuss the proposal package and answer any questions. IDEA Institute staff are also available to offer individualized support to teams during the proposal preparation process. In select cases, proposals have been tentatively approved pending revisions. This consideration is often extended to student-led teams. This practice is done to provide encouragement and support as students develop proposal writing skills and understanding of the review process.

Once projects have been awarded, teams receive mentorship from a GIANT program mentor and an Institute advisor. Mentors can be faculty, staff, or students who are Institute members and/or have previously participated in the GIANT program. Mentors provide advice on various aspects of project implementation, including but not limited to administrative processes, budget management, survey instrument design, institutional review board (IRB) approval process, data collection and analysis, evaluation, and other aspects as the project progresses. Advisors consult with teams on efforts towards sustainability and assist teams with identifying opportunities to obtain external funding to supplement and extend funding. Teams are also informed about opportunities to disseminate outcomes at engineering education conferences and publish in peer-reviewed journals.

Reporting

There are several opportunities for teams to provide informal and formal updates on the progress of their projects. Teams share brief updates on their projects during monthly IDEA Institute meetings, which have often led to new collaborations and the generation of shared resources. Mentors have regular meetings with teams throughout the year, and Institute staff will meet with each team each semester to evaluate progress in the implementation and budget expenditures. Each active team also presents a poster summarizing their project outcomes at the IDEA Institute Annual Conference, which is attended by many members in the broader college and university communities. This event helps in building community. Final reports are submitted at the completion of the one-year term for each project.

Outcomes

Since the first cohort in 2020, forty-one (41) projects have been funded totaling $565,000, including co-sponsorships from two external industry partners. Approximately one-third of funded projects have been led by faculty, staff, and students (Figure 1). The distribution of the project leadership demonstrates the enthusiasm and value of perspectives at all levels. Proposals

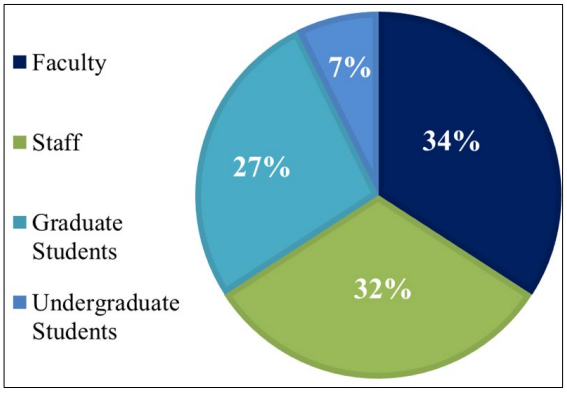
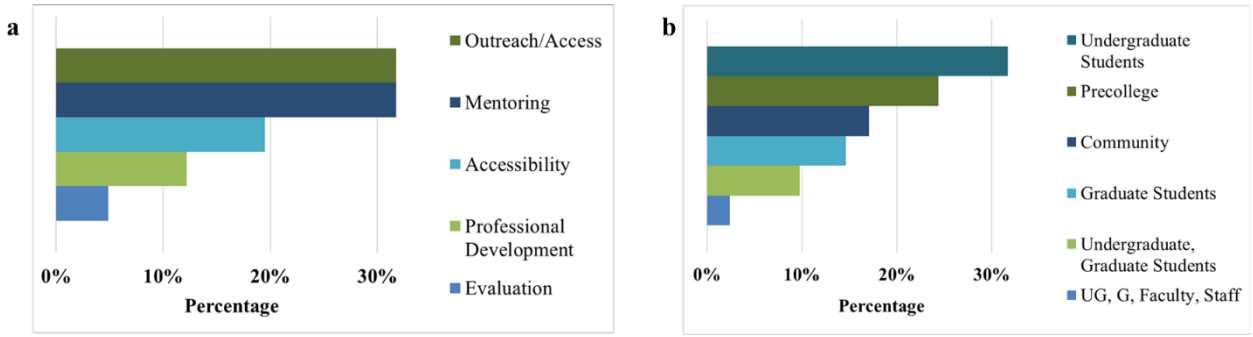


Figure 1: Demographic distribution of project team leaders

can range across any IDEA topic of interest by the project team. Of the funded projects, we have identified four broad themes. As illustrated in Figure 2, outreach and access (32%), mentoring (32%), accessibility (20%), professional development (12%), and evaluation (5%) with target populations that range from pre-college students and community organizations to college administrators. It should be noted that there is thematic overlap within many of the projects. For instance, several of the mentoring projects incorporate professional development such as workshops, panels, seminars, and other skill-development activities. Similarly, undergraduate and graduate students often facilitate activities for the outreach/access projects and mentor pre-college students about engineering, which can increase interest in engineering and motivate students to pursue engineering in the future.

Figure 2: Distribution of (a) focus areas and (b) target populations served by funded projects.



Each of the outreach- and access-focused projects target pre-college students. Approximately half of these projects partner with a local community organization such as the YMCA or Boys and Girls Club. These projects engage students in STEM activities for early exposure to engineering. Projects can focus on specific ranges such as K-8, K-12, grades 5-8, or grades 9-12. Mentoring-centered projects represent mentorship among various levels such as near peer mentoring between undergraduate and high school students, graduate and undergraduate students, graduate student peer mentoring, and mentoring of graduate students by faculty and college administrators. Professional development projects provide training to enhance specific skills (*e.g.,* research and academic skills, experiential learning opportunities, allyship, or inclusive language). Accessibility-focused projects develop tools in different modalities for more inclusive learning in classrooms or laboratory spaces, or for students with hearing impairments. Projects have also been funded to conduct evaluation on long-standing programs within the college to assess their impact on participants. Project descriptions and outcomes for selected projects are briefly detailed further in this paper.

The major expectation for all funded projects is to disseminate outcomes in engineering

education or related journals and conferences. To date, a total of 85 products have been disseminated, including 1 journal article, 18 conference proceedings and 25 external conference presentations at venues such as the American Society of Engineering Education (ASEE) national and local section conferences, Collaborative Network for Engineering and Computing Diversity (CoNECD), Frontiers, Institute of Electrical and Electronics Engineers (IEEE) Education Society, and 51 institutional research conferences such as the IDEA Institute Annual Conference and the University of Illinois Urbana-Champaign Undergraduate Research Conference.

Selected Examples of Funded Projects
Mentoring
Building Confidence and Increasing Engagement through Undergraduate Research (Phase I & II), 2020 – 2022, PI: Faculty
Description: This project collaborated with the Academic Redshirt in Science and Engineering (ARISE) program which serves students from low resourced schools in the state of Illinois, who are typically from underrepresented backgrounds in engineering. The aim was to provide paid research opportunities, build STEM confidence, and serve as a launchpad for ARISE students to enter larger research groups. This project created an opportunity for ARISE students to develop research and technical skills in a broad field of study that uses fundamentals from many engineering disciplines and reduced disparities in undergraduate research experiences and graduation rates for Black, Hispanic, and Indigenous students. Following the success of the Phase I project, a Phase II was awarded, which expanded the program to offer research opportunities to members of the NSBE and SHPE student chapters.

Outcomes: Research participation for ARISE students increased from 1% to 11%, with 80% of participants reporting being "much more likely" to pursue a master's degree than prior to doing research, and 50% reporting being "much more likely" to pursue a PhD. Many of the students presented their research at professional conferences. This project also led to a National Science Foundation Emerging Frontiers in Research and Innovation (EFRI) Research Experience and Mentoring (REM) award in collaboration with Harvard University and Bunker Hill Community College to pilot a model to engage students from underrepresented backgrounds at these partner institutions in undergraduate research [13], [14], [15].

Grainger Engineering Graduate Student Diversity Ambassadors Program, 2022 – 2024, PI: Staff
Description: This project established the first cohort of the Engineering Graduate Student Diversity Ambassadors initiative, a college-wide student leadership program charged to strengthen the recruitment and retention of students from marginalized populations in graduate programs.

Outcomes: Since its launch in 2022, the program has successfully recruited and developed 40 Ambassadors. These student leaders underwent extensive training to enhance their roles as exemplary models and peer mentors. Trainings and workshops were designed to improve communication skills with prospective students, build confidence in sharing their own narratives, enhance mentoring skills, elucidate knowledge of their individual strengths, and develop empathy. Ambassadors have welcomed over 700 students at annual welcoming events,

participated in a number of institutional and national recruitment events, served as peer mentors, and organized various community-building programs. The Grainger College of Engineering has committed funds annually to sustain this program in the short term, and there are plans to seek external funding to support staff, programming, and Ambassadors for long-term sustainability.

Outreach/Access

Accessible and Inclusive Materials for High Quality Family STEM Experiences (AIM High), 2022 – present, PI: Staff

Description: This project team of faculty, staff, and students from The Grainger College of Engineering, alongside staff and parents from two local, social impact organizations (Driven to Reach Excellence and Academic Achievement for Males (DREAAM) Opportunity Center and Urbana Neighborhood Connections Center) worked together to plan and implement monthly family STEM nights. Each session included a shared meal, a design challenge or hands-on project to introduce families to a variety of engineering majors, and an activity or discussion topic to dispel myths that can result in "STEM isn't for me" perceptions that frequently cause talented middle grade students to close the door to a future in STEM early in their academic journey.

Outcomes: During the first year of implementation, despite the need to pivot to at-home project kits and online sessions during the pandemic, the participating caregivers (parents or grandparents) reported increased understanding of engineering fields and surprise at their own abilities to persist through challenging activities with their students. The students demonstrated a deeper understanding of engineering fields and their applicability to real-world issues. Four years later, this program is an ongoing initiative co-hosted by DREAAM and The Grainger College of Engineering. This partnership received supplemental GIANT funding to increase accessibility to the design projects through an online activity repository and expansion to partner with a Latin-serving community organization, *Cena y Ciencias*. More recently, this team has been awarded $124,500 in additional grant funding from the Chancellor's Call to Action to address Racial & Social Injustice. The expanded effort seeks to implement Saturday STEM classes for K-12 families and a new STEM night program for K-6 families in collaboration with The Well Experience organization, which serves local Black women and girls. In this new initiative, the organization's high school students take on facilitation and mentorship roles. Graduate and undergraduate students from the University support these teens in developing their STEM confidence and leadership skills as they prepare to facilitate the Family STEM Night sessions [16].

In League with STEM, 2023 – present, PI: Graduate Student

Description: This project partners with the Youth For Christ Midnight Basketball East Central Illinois, a local community organization, and is aimed to foster STEM interest among local Black middle and high school students through exposure to hands-on design activities and mentorship by university students and STEM professionals. The team is composed of undergraduate and graduate students and STEM professionals from local industries.

Outcomes: Throughout the school year, students participated in hands-on STEM activities. Between 140 and 210 students applied concepts from mechanical engineering, computer science, horticulture, and physics to tangible situations. They designed and built protective structures for

an egg drop challenge, programmed robots to drive in a square path, raised leafy greens from seed to harvest, and created tabletop pinball machines. Additionally, eight Black STEM role models gave presentations to these same students several times each semester, with the aim of helping students envision themselves pursuing STEM majors and careers. To promote sustainability with the community partner, the project team has partnered with The Grainger College of Engineering Office of Outreach and Public Engagement to assist with facilitating future collaboration.

Professional Development

Allies in STEM (Phase I & II)**,** 2020 – 2024, PIs: Graduate students

Description: This project was a collaboration between the Graduate Society of Women Engineers (GradSWE) and the Society for Advancement of Chicanos/Hispanics & Native Americans in Science (SACNAS) that presented opportunities for graduate students to develop skills to become lifelong allies for diverse and marginalized STEM communities, fulfilling a gap of targeted allyship programming for the STEM communities and graduate students. Graduate students from multiple STEM disciplines participated in a series of workshops such as: Everyday Actions to Be an Ally, Graduate Worker Rights, Anti-Asian Racism in Academia, Invisible Disabilities, Black Lives Matter in STEM, Cultural barriers of First-Generation College Students, and Advancement of LGBTQ Students.

Outcomes: This project evolved over four years through two phases of funding and no-cost extensions, which allowed the project to remain active following graduations and increasing academic responsibilities of project leaders. Allies in STEM offered a variety of professional development workshops. Workshops were attended by over 80 graduate students across 23 departments. Project results highlight the observed disparities between those who have and have not experienced and/or witnessed discrimination and underscore the continued importance of allyship training in the context of discrimination and overall inclusivity within STEM [17], [18].

HUG Initiative: Research Career Roadmap for Historically Marginalized or Underrepresented Genders, 2022 – 2024, PI: Graduate Student

Description: This project promotes the pursuit of research careers among undergraduate and graduate students from underrepresented genders in the Department of Electrical and Computer Engineering (ECE). The project aimed to demystify what it means to be a researcher and to provide resources on research opportunities by holding panel discussions, interactive workshops, and networking luncheons.

Outcomes: Fourteen events were hosted around three main objectives: identify roadblocks for students in ECE as they progress through their education and career paths, provide information and support for research opportunities, and foster a welcoming environment within the department. One major outcome was that many undergraduate students within the department desired to engage in undergraduate research, which this project helped to provide or facilitate [19], [20], [21], [22].

Accessibility

ASL Aspire: A Game-Based Vocabulary Platform for Deaf Students (Phase I & II), 2022 – 2024, PI: Undergraduate student

Description: This project teaches Deaf or hard of hearing (DHH) middle schoolers STEM-related American Sign Language (ASL) vocabulary and concepts through games. Students learn ASL vocabulary from modules adapted from Next Generation Science Standards (NGSS) by playing a variety of interactive and engaging mini-games. This project complements the evolution of STEM-based ASL vocabulary being developed by Deaf professionals to increase access, academic performance, and self-efficacy and belonging to DHH students.

Outcomes: With the GIANT program seed funding, ASL Aspire was able to build the website with capabilities for remote testing and launch a pilot study to gather feedback from students and teachers from across three states. ASL Aspire successfully secured additional funds to develop prototypes for the games and continue pilot study research. To date, ASL Aspire has become an incorporated company and secured patents for its innovations [23], [24].

Applying a Theoretical Understanding of Text-Based Learning Modalities to Develop New Course Modalities That Meet the Needs of Student with Disabilities (Phase I & II), 2021 – 2024, PI: Faculty
Description: This project developed digital books generated from lecture videos with transcriptions as a Universal Design for Learning approach to help students with disabilities retain content from engineering/STEM courses. Iterative implementation and improvement of the digital books through ClassTranscribe (CT) was utilized to assess the impacts on student performance and expectancy factors. The research study investigates the performance of students with disabilities and students without disabilities when using e-books generated from lecture videos.

Outcomes: Survey responses showed that students who utilized the digital tools reported positive scores regarding the course's accessibility. It was also found that digital resources increased belongingness and self-efficacy, and higher perceived learning for students with disabilities. This project won a Best DEI paper award at the 2022 American Society of Engineering Education Conference [25], [26], [27].

Evaluation
The GIANT program has achieved many successes through the collective and individual efforts of all of those who have been involved in the program including principal investigators, team members, and mentors. The program strives for continuous improvement to maintain its value and maximize its impacts. An Institutional Review Board approved survey (IRB #241843) was developed and administered to current and past participants in the GIANT program as part of the Institute's 5-year review. Questions related to the program and the number of respondents (N) include:

Q1 (N=13): How has involvement in the GIANT program impacted your educational and professional experience?
Q2 (N=11): Please comment on the strengths of the GIANT program.
Q3 (N=6): Provide suggestions for how the Institute can improve the GIANT program.

De Identification and Open Coding

All survey responses were de-identified prior to analysis to preserve confidentiality of responses. Any information that could potentially identify individual respondents or their teams were removed. Survey responses were first analyzed using a manual open-coding process, where each response was reviewed to identify keywords and phrases that captured the essence of participant feedback. After the open codes were established, responses were reviewed to identify broader themes within each question. This stage involved analyzing the open codes to group similar ideas and construct comprehensive themes.

AI Generated Codes Using Microsoft CoPilot with Data Protection
Our university recently announced the availability of Microsoft Copilot with Data Protection service, a new service endorsed by the campus. Copilot was used to summarize themes of the responses for each question (Q1, Q2, and Q3) and was efficient in summarizing broad themes. While Copilot does not capture the nuances in the open coding process, the output overlaps with the broad themes identified in the manual coding process.

Integrating Manual and Software-Generated Themes
In the final stage, themes derived from the manual coding and Co-Pilot were systematically compared and consolidated manually. Top themes emerged for each of the three questions.

Top Themes in Responses to Q1: Impact on Educational and Professional Experiences

- Research opportunities and support: The program expanded research possibilities and provided opportunities to conduct research in new areas outside of their primary fields.
- Networking and increased collaboration: Participants built connections, shared experiences, and collaborated with peers and professionals with shared goals of fostering DEI.
- Expansion and enrichment of educational experience: Participants enriched their educational journey by increasing awareness of DEI issues and by learning how to propose and conduct a grant funded project.

Participants value the opportunity to conduct research in new areas outside of their primary fields. Conducting research and gaining a deep understanding in IDEA along with having freedom to address issues of one's interest and access to resources to explore solutions complements the educational experience. Engagement in the GIANT program has expanded and enriched the educational and professional journey of survey respondents by fostering a community of diversity advocates. This community has increased a sense of belonging among individuals within a larger network within the college, institution, and beyond.

Top Themes in Responses to Q2: Strengths

- Network building and engagement: The program supports network building and provides engagement opportunities for novice researchers.
- Funding: The program offers significant financial support, allowing participants to pursue diverse and ambitious research projects.
- Community and Campus Engagement: The program enables engagement with the campus and local communities, benefiting both and contributing to broader research insights.

- Inclusive and Collaborative Participation: The program encourages involvement across different university members, fostering collaboration among students, staff, and faculty.

Respondents identified network building and collaborative opportunities, particularly for novice researchers, as strengths of the program. Team members have opportunities for expanding their professional networks and engagement with others via Institute monthly meetings where projects provide brief updates, the Institute's annual conference wherein active teams participate in a poster session, and external engineering education conferences.

Diversity initiatives are often unfunded or underfunded, making it challenging or impossible to achieve well-informed outcomes. The access to significant financial support to implement proposed activities is highly valued. Project funds may be utilized to purchase materials and supplies, support travel expenses for attendance and participation at engineering education conferences, or compensate guest speakers or facilitators for their contributions. Project funds may also be used to compensate graduate assistants, undergraduate students (hourly pay), and postdocs who contribute to the implementation, data analysis, or evaluation of the project.

Community, collaboration, and campus engagement are highlighted as benefits to the program. Participants are encouraged to engage with the campus and local communities and collaborate with various university members. Additionally, the mentored support that is provided throughout the life cycle of the project from the proposal development phase to conclusion of the project is also appreciated by team members. Participation in larger engineering education conferences such as ASEE or CoNECD affords members the ability to learn about broader initiatives within engineering, thus increasing knowledge of problems and innovative solutions.

Top Themes in Responses to Q3: Areas for Improvement

- Enhanced collaboration: Facilitated connections between similar programs and creating more resources or an online forum for researcher outreach and collaboration.
- Increased support and guidance: More active involvement of PIs, easier access to funds, regular monthly check-ins, and better guidance around program delivery expectations.

The GIANT program has identified areas of growth as it continues to evolve. Respondents have suggested facilitated collaboration. Therefore, we are organizing communities of practice for discussions among projects with the same target populations, goals, and/or themes. These communities of practice will identify the successes, challenges, lessons learned, and questions related to the implementation of their projects individually and collectively, as well as in the field(s) of research. The long-term goal is to provide recommendations for future GIANT teams and the college on how to effectively approach research with specific DEI focuses. Communities of Practice will also present at the IDEA Conference and publish findings in engineering education journals or conference proceedings. Another suggestion provided by survey respondents was to provide clearer insights on programmatic expectations such as project deliverables and more active involvement with program leadership. We have begun to address these programmatic concerns. Previously, partly due to the pandemic, the program had flexible guidelines and deadlines for program reporting and spending of the funding. This year, we have implemented structured deadlines for the submission of final or annual reports, as well as instituted a fiscal year for which either funds are to be spent or a no cost extension may be requested. This change has created more structure for both the program administrator and the

project teams. Additionally, we have initiated conversations to form communities of practice for teams within themes to develop protocols for implementing programmatic activities including, but not limited to best practices, challenges, lessons learned, required administrative processes, success measures, collective impact, etc. These protocols will be presented at the Institute conference, archived for future projects, and disseminated in relevant journal publications.

Discussion

How does one measure the success and impact of any DEI program? One can look at the quantitative and qualitative aspects. Quantitative metrics can include the number of people benefitting from the program, the increase in participation rate of women, Black/African American, Hispanic/Latino/a/e, or Native American/Indigenous students in engineering degrees or in research, or the number of scholarly products. Some quantitative measures may not be assessed until decades later, e.g., when a 2nd grader eventually chooses to pursue a STEM major in college. Qualitative aspects can include analyses of interviews and free response survey data to ascertain improved sense of belonging, self-efficacy, or access to educational opportunities among the target population. They could also include an increased understanding of gender or race/ethnicity in STEM opportunities, skills development in becoming an equity advocate, and a deepening passion for DEI in STEM. They could also include subtle data-driven shifts in culture or practice, e.g., creating groups for class assignments where female students are not isolated, sustaining near peer-mentor networks, or sustainability and institutionalization of pilot initiatives through permanent funding and/or staffing. Using these quantitative and qualitative metrics, we assert that nearly all of the individual projects as well as the overall program have been successful and highly impactful.

Granted that the projects reported in this paper were the successful ones, we acknowledge that some projects were less successful, and a few did not get off the ground. The primary reasons for unsuccessful projects were key team members changing positions within the university after the project was funded, leaving the university by attrition or graduation, and complications due to the Covid-19 pandemic. These cases still provided valuable information on what elements are required for success, namely, a team of committed individuals who have the bandwidth and funding to work on an initiative they are passionate about, strong leadership and mentorship, a well-developed research question and plan, pre-established connections with the target population (particularly for K-12 or community-based projects), a well-articulated set goals that are achievable in one year, and the flexibility to accommodate delays via a no cost extension. While these are limited cases, funding awarded to these projects are reinvested into the program. Approximately, $82,000 has been recovered from these projects and used to fund future projects or provide support for the project teams in terms of student hourly interns who assist with data analysis.

Evidence of past commitment to and specific plans for achieving the DEI goals of a university or company can be a differentiating factor among qualified job applicants. Moreover, in recent years, there has been an increase in the number of non-tenure-track research and teaching faculty positions whose criteria for promotion often include the impact of scholarly publications and the ability to secure funding to sustain a research program (e.g., in STEM educational research for teaching faculty). The GIANT program has offered a structured on-ramp, mentorship, and opportunities to students, postdocs, staff, and research/teaching faculty to develop grant-writing

and leadership skills, create and manage projects in service of the college mission, and conduct funded research that leads to publications, all of which are vital for career advancement.

Reflecting on the Kezar framework for systemic change, the GIANT program exhibits its characteristics. *Mobilize*: individuals within The Grainger College of Engineering at all levels are empowered to propose projects to address an IDEA issue. A broad range of ideas and some suggested topics are open for submission. *Implement*: projects are provided with funding, mentoring, and a supportive community to achieve their goals and disseminate findings. *Institutionalize:* Within the GIANT program, there are examples of projects that are institutionalized. For example, the Grainger Engineering Graduate Student Diversity Ambassadors Program is now funded by the college and In League with STEM sustains its partnership with the Midnight Basketball community program through the college's Office of Outreach and Public Engagement. The Grainger College of Engineering is committed to its investment in the IDEA Institute and its GIANT program. Funding and dedicated staff, including permanent staff and student interns, are essential to the success of this program and its future growth. This infrastructure has garnered interest from other colleges and administrative offices across campus that are interested in replicating these initiatives. As the GIANT program evolves, we will explore opportunities to collaborate with other academic colleges and units as we all strive to foster an inclusive and equitable campus.

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