

Minority-serving Institution Partnerships Strengthen Underrepresented Minority Recruitment for a Research Experience for Undergraduates Program (Experience)

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Introduction

The underrepresentation of females, African Americans, Hispanics, and Native Americans in Science, Technology, Engineering and Math (STEM) careers is a widely acknowledged and long-standing problem in the United States [1]. Diversifying STEM fields is essential to matching US job growth demands to maintain global competitiveness [2], [3]. Several efforts seek to increase the number of diverse undergraduates entering the STEM pipeline; however, there is still a long way to go at the graduate school level [4]. To address this need, many Predominantly White Institutions (PWI) have created pipeline programs to encourage undergraduate STEM majors to pursue graduate studies at their institution. One strong strategy is for PWIs to partner with Minority Serving Institutions (MSI) to create opportunities for underrepresented students to be exposed to STEM fields [5]. There are several well established partnerships, such as ones that create pipeline programming to graduate studies [6], [7]. Research Experiences for Undergraduates (REU) is another type of pipeline program that requires less resources and are more common within academia. Several best practices for establishing MSI partnerships with REU programs have previously been discussed [8]. This includes targeting a specific MSI [9] and establishing a personal contact with faculty within the REU's relevant research field. Here, we build on that literature and provide several examples of how one REU program was able to establish mutually beneficial institutional relationships. We also provide examples of how partnerships can withstand personnel and/or funding changes.

Context

The Power Optimization of Electro-Thermal Systems (POETS) REU Site focuses on multi-disciplinary engineering research in the area of electrified mobility. REU projects are crafted around ongoing research from the Engineering Research Center POETS [10], a National Science Foundation (NSF) sponsored center consisting of University of Illinois at Urbana-Champaign (lead), University of Arkansas, Stanford University, and Howard University. The POETS REU Site's goal is to build, strengthen, and support students' foundational and high-order knowledge in engineering disciplines while broadening their professional skill set and experiences to prepare them for PhD STEM careers. In essence, the goal is to build T-shaped REU students [11].

From 2018-2020, the POETS REU program recruited 35 highly diverse undergraduate students, 100% of whom were from underrepresented groups (Figure 1A & Figure 1B), to engage

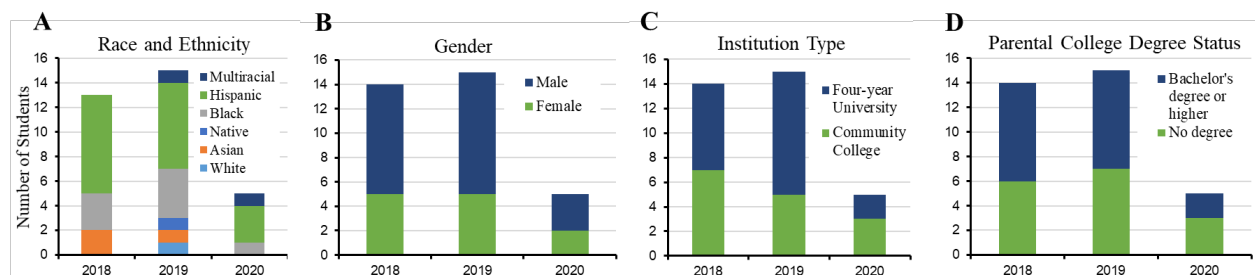


Figure 1. Demographics of POETS REU students from 2018-2020. Note: 2020 REU Site occurred remotely thus cohort was smaller than previous years. A) Race and Ethnicity. White: Non-Hispanic White. Native: American Indian and Native American. Hispanic: White Hispanic. Multiracial: One or more races or ethnicities B) Gender demographics of REU participants. C) Institution type of REU participants' home university at the time of applying to the RE program. D) Participants' parental college degree status.

in a 10-week summer program. Of this cohort, 44% were community college students (Figure 1C), and 47% had parents who had not received a college degree (Figure 1D). An external evaluation team found that over the course of the summer, the REU students strengthened their engineering skillset, increased their confidence to pursue a career in STEM, and engaged in a very positive summer experience. Of the REU alumni who have graduated (approximately 50% of prior enrollees), over 95% have pursued STEM careers, with ~50% in STEM-relevant industry positions and ~45% in graduate school pursuing PhD and MS degrees in STEM.

These positive outcomes from the REU program can largely be attributed to the capacity of the MSIs to provide a highly diverse and well-prepared recruitment pool. Here we will outline strategies for selecting, establishing, and expanding such partnerships for effective REU program development. We will also discuss how these partnerships can be expanded by reporting several examples in relation to this REU program.

Selecting a Recruitment Partner

There are several best practices in recruiting diverse talent into a REU program that have previously been published [12]–[14]. This includes recruiting at minority-serving professional society meetings such as National Society of Black Engineers (NSBE), Society of Women Engineers (SWE), Society of Hispanic Professional Engineers (SHPE), and Society for the Advancement of Chicanos and Native Americans in Science (SACNAS). Some programs primarily rely on mailing lists, which include faculty connections and/or university career office coordinators, for REU advertisement distribution. Social media and internship clearing houses in more recent years have been utilized for advertisement as well. The POETS REU program found that establishing partnerships with a select few MSIs was the most effective strategy for finding students within our target audience, with MSI student application rates growing from 2% (2017) to 15% (2018-2020). There were several factors the POETS REU considered when choosing recruitment partners:

1. **Demographics.** A list of postsecondary institutions enrolling populations with significant percentages of undergraduate minority students can be found on the US Department of Education’s website [15]. The website provides lists for various institutions, such as Hispanic-Serving Institutions (HSIs), Tribal Colleges, and Historically Black Colleges and Universities (HBCUs). The target populations to be served by the REU provides a natural mechanism for selecting potential partner institutions.
2. **Type.** The type of institution is also an important consideration: trade school, community college, private, or public. The level of research opportunities for undergraduates is also an important consideration when selecting a recruitment partner.
3. **Location of the institution.** Selecting an institution near the PWI has many benefits, including the low cost of travel for in person interactions and recruitment events. Additionally, if a REU program seeks to recruit students into their institution’s graduate programs, having a regionally close recruitment partner is an advantage, as some students prefer to stay closer to home for their graduate studies. If a program is interested in students transferring to their PWI, it may also be important to consider schools who waive out-of-state tuition: either for people who live in bordering states or based on the merit of candidates.
4. **Staff support.** An active career counseling staff or program coordinator is an invaluable resource when looking to develop relationships with a MSI. These personnel are ideally in

direct contact with students daily through their management of extracurricular activities involving registered student organization (RSOs), engineering clubs, and student support services. This contact can be leveraged to help identify students, especially nontraditional students, who may be a good fit for the program. They can also help distribute information or coordinate information sessions. Student support services staff may also play a role in tracking students' application development and providing feedback.

5. **Faculty support.** Faculty members are also great advocates for REU programs. Involved faculty can identify high potential students to apply to the REU. These relationships can be fostered from personal contacts or found by reviewing the MSI website to locate highly active faculty (RSO sponsors), or faculty with similar research interests.
6. **Experimental Learning Opportunities.** Many REU programs seek to recruit students who have less access to research opportunities at their university (i.e., R2 and lower), as they are the students who can most benefit from a REU experience. However, one factor that may be overlooked is consideration of an institution's project-based learning activities within the coursework or extracurricular activities. In many cases, students just need to be told that these activities can give them a leg up in their application. Additionally, the recruitment of students with existing baseline research skills could accelerate their success within the REU programming [16]. Well organized RSOs are also a great pool to pull from when recruiting REU students.

In the POETS REU's case, the program's first cohort began in the summer of 2018 with an influx of REU Site funding. Given the rapid growth required at program startup, program coordinators needed to modify any previously used recruitment strategy to ensure a large pool of qualified, diverse candidates. In the two years prior, the POETS REU program had focused on emailing department heads at top 20 engineering universities to disseminate POETS REU recruitment information, as well as having representation at SACNAS and SHPE national conferences. In 2017, less than 5% of applicants noted they learned about our programs via a national conference. In the fall of 2017, we continued these efforts in addition to advertising at specific MSIs, Historically Black Colleges and Universities (HBCUs), and HSIs. Our point of entry to these schools was a faculty member and/or the university's career center coordinator. When available, faculty that performed research in a similar research space as the POETS Center [10] were contacted and asked to forward POETS REU information to highly qualified students in their classes or lab.

We also focused our recruitment efforts on a handful of HSIs due to the overall strategic plan of our research center. When selecting our potential collaborators, we considered several of the factors listed above. The program coordinators ultimately targeted two HSI community college schools with Mathematics, Engineering, Science Achievement (MESA) programs, and one four-year HSI college with an active engineering career services office. MESA is an academic preparation program with the goal of increasing the number of students successfully transferring to four-year colleges as STEM majors. We also targeted several engineering clubs at these schools for recruitment due to their experience in collaborative team-based projects. For example, San Antonio College (SAC) has been nationally recognized for projects involving a hydrogen fuel cell car [17], [18]. Cañada College has a semester long research shadowing program [19]. University of Texas at San Antonio has a history of students having hands-on course work and research opportunities for upperclassmen [20]. Overall, this strategy resulted in 20% of our applicants overall, and 60% of students accepted into the program, coming from a MSI.

Establishing Strong Partnerships with MSI

Once schools have been identified, the next step is to make contact and establish the partnership. At this stage, having an “in” to the organization helps via a personal contact or professional relationship. It is also possible to go in with a cold contact, but experience dictates this is not the preferred route. If a more in-depth partnership is sought than distribution of recruitment materials, then the following considerations should be made.

1. **Listen more than you speak.** At the beginning of establishing this partnership it is important hear from the faculty, staff, and/or students. Consider the following questions: Who are the students at this MSI? What are their constraints, interests, strengths, and obstacles? Obtaining answers to these questions allows program coordinators to customize their program based on their target audience.
2. **Build Trust.** Building trust among the institution students, faculty, and staff goes a long way to establish a strong partnership. Just as in personal relationships, building in opportunities to be transparent, vulnerable, and intentional are critical. Examples include discussing the faculty-student matching process, managing expectations of students being admitted, describing weaknesses of the REU, and simply putting in the time. It will pay dividends.
3. **Establish expectations clearly and early.** Be frank about what the program can provide and describe what the ideal REU applicant looks like. This requires program coordinators to reflect on what commitments they can make. Will your program overlook lower GPA or a disjointed education history? What selection criteria would help the MSI students be admitted into the program (e.g., weighing hands-on project experience equally to a formal research experience, considering non-traditional metrics such as grit, teamwork, or previous successes)? Are you willing to reserve a specific number of spots for the MSI’s students? How much time is the program willing to commit to mentor students to be successful?
4. **Offer value to the MSI.** Every interaction with students, faculty, and staff should provide value to the MSI, taking an MSI-centered mindset. Some examples include reviewing MSI students’ applications prior to their final submission, providing a seminar on how to apply to REUs broadly, holding round tables with faculty to discuss other opportunities, or sharing relevant funding solicitations to the MSI’s grant manager.
5. **Consider cultural differences.** Every MSI has a unique institutional culture, institutional subcultures, organizational structure, history, and unique characteristics of the student, faculty, staff, and administrators. Learning about these differences are paramount to the success for the partnerships and its long-term sustainability [21]. Ultimately, this understanding will help program coordinators create center programming which provides value to the target MSI partners.

For the POETS REU program, contact with the primary recruitment partners was initiated through unsolicited emails to relevant engineering faculty and/or MESA/career center staff. This initial email requested an opportunity to discuss recruitment of their students for a new REU program. In each case, in-person meetings or virtual calls were arranged with each stakeholder. This allowed the REU program coordinators to clearly state their expectations for student participation and the support they were willing to provide. For the POETS REU, participants received a \$5000 stipend along with other financial support (e.g., housing, meal plan, travel allowance, conference allowances). The MSI faculty were also able to ask questions and make suggestions for the program. In several cases faculty seemed surprised and excited for the opportunity to collaborate.

For example, the POETS REU program has been able to incorporate MSI faculty suggestions into unique program aspects as well as complementary initiatives. One programmatic example includes changes to the on-site REU recruitment information sessions. These sessions were used primarily to serve the students with a small pitch for the POETS REU program at the end. One session discussed the value of participating in a REU program, as several students were not aware of what it meant “to do research.” Another session had students walk through a Circle of Life exercise to reflect on their current skills and consider what type of extracurricular activities they needed to participate in to improve their skill set. Lastly, another session included tips and tricks for applying to top REU programs across the country. While not every session type was held every year, it helped build institutional knowledge, increase self-efficacy among applicants, and grew students’ engineering research identity over time. Additionally, this practice increased the number of applications from our MSI partners. We hypothesize that this increase was associated with enhancements in applicants’ research self-efficacy associated with fully understanding the meaning of research and relating this definition to their prior activities.

Another example is that the POETS REU program opened the channel for MSI faculty, staff, and POETS REU alumni to identify high potential applicants and advocate on their behalf. This led the program coordinators to intentionally focus on nontraditional metrics of student admission and better understand the background of students, as their personal statements did not always fully detail their previous works. The aforementioned outcomes of the REU program indicate that this modified approach supported the recruitment of high-quality students that may have been overlooked through traditional applicant assessment techniques.

Expanding Partnership

After partnerships have been established and students are recruited, the partnership relationship may continue forward indefinitely in this manner. However, to create a partnership that has the best chance for sustainability, it is best to consider how the partnership can be institutionalized in order to withstand personnel and/or funding changes. Identifying places where the partnership can be expanded requires conversations with the MSI faculty, staff, and students. The POETS REU has been able to do such work with one MSI. These examples are described below:

Team-based REU pilot project

After meeting with MSI faculty and learning about the skills and abilities of the student population at SAC, a unique pilot project was established in 2018. SAC faculty emphasized the importance of community among their students and suggested that a team be recruited for one REU project. This would allow students to balance their skills, ensure they could work well together, and create a built-in support network. The support network was highly emphasized by the faculty and staff as being essential to their students’ success over the summer. Faculty at SAC and University of Arkansas discussed potential research projects and what pre-requisite knowledge the students needed before arriving for the internship. This helped ensure the team was successful in terms of research outcomes and student experience. This resulted in a team of three SAC students being recruited to the University of Arkansas to complete their bachelor’s degree.

The “hard working” students made an impression on the University of Arkansas engineering faculty, who successfully encouraged one of the students to transfer to the university. This unique collaboration resulted in a transfer guide for SAC students. University of Arkansas officials are working with the SAC to develop an official articulation agreement between the two institutions. Since establishing this partnership, SAC continues to have students participate in the summer research program. The pilot program capitalized on the teaching philosophy of SAC engineering faculty and the University of Arkansas’ interdisciplinary, systems-level research approach, to create student-centered programming.

Conclusion

The relationships developed through these collaborations provided broad and sustainable value to the partner MSIs. Beyond the direct impact on program participants, the relationship established invaluable collaborative infrastructure which continues to benefit all students within the STEM academic offerings of the partner institutions. The dedicated articulation agreements and workshop offerings described above are tangible examples of these outcomes. This impact was further enhanced by program participants sharing their experiences upon returning from the REU. Several representative quotes from non-author, SAC faculty shown below:

“Our partnership with POETS has had a transformative impact on our STEM programming at San Antonio College. Our students’ personal and professional growth was directly observable upon their return from the REU, and their successes have been a powerful tool for enhancing interest in research amongst our students.” - SAC Faculty 2022

“POETS faculty and program leadership did a tremendous job of engaging our personnel throughout the program design and implementation process, thereby establishing a strong sense of commitment of our personnel to the program’s success. We are grateful to POETS for their support of our students and look forward to continued successful collaborations moving forward.” - SAC Faculty 2022

Establishing these partnerships can be challenging to start as it does require a significant amount of upfront effort. However, it can ultimately lead to effective program outcomes, a sustainable recruitment partnership, and mutually beneficial institutional collaborations. Here we advocate for taking a deep and focused approach, as outlined above, as opposed to shallow and broad engagement with MSIs. Moreover this approach can help create an effective REU recruitment strategy that requires less time in the long run (as compared to attending multiple conferences for recruiting).

Continuing to keep the lines of communication open and evolving the partnership as it progresses is an important factor in any sustainable partnerships. Covid-19 has been the biggest obstacle to this work as it did impact the level of students the POETS REU program was able to recruit from the three target MSIs in 2021. We suspect this was due to the lack of in person recruitment sessions in the spring of 2021 and overall reduced community college enrollment nationwide [22]. We are hopeful that 2022 applicants from these MSIs will increase as in person recruitment was able to be resumed for the 2022 application cycle.

In conclusion, establishing a mutually beneficial relationship between PWIs and MSIs is not only a great strategy for recruiting diverse talent, but it can help create more effective programming that is targeted to a specific student demographic. Initial data indicates specific program elements (i.e., team-based projects, alumni recruitment strategies, and cohort placement), driven by MSI suggestions, helped the POETS REU students succeed within the REU program and beyond. We look forward to continuing these partnerships and seeing how our universities can continue to development synergistic initiatives.

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