

Coordinating Summer Undergraduate Research Programs for Expanding Diversity and Impact: Opportunities and Challenges

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Introduction

During summers 2015-2017, we operated a National Science Foundation (NSF) funded Research Experiences for Undergraduates (REU) Site, “Biomedical Engineering Community of Undergraduate Research Scholars for Cancer” (BME CUREs Cancer) at The University of Texas at Austin. The directors of the BME CUREs Cancer program have sought to multiply the impact of our Site by embedding students supported by other summer research experience grants, which we refer to here as Affiliated Scholars. In this paper, we will discuss the opportunities and challenges we encountered in coordinating these summer undergraduate research programs.

CUREs Scholars were matched with a summer project from among a rich variety of research endeavors within strategic areas identified by the National Cancer Institute of the National Institutes of Health (NIH). Each Scholar was part of a research team with both faculty and graduate student mentors, a mentoring system that is effective and widely employed. Scholars also benefited from: a research skills boot camp their first week; weekly educational seminars with fellow summer scholars led by the program directors; shared on-campus housing; and social events.

Affiliated Scholars were supported by a variety of other funding mechanisms with a variety of research areas. By grouping these scholars into the CUREs structure with a shared scientific theme of engineering approaches to cancer research, regardless of their funding source, we sought to facilitate their identification with a larger, diverse student cohort. Criteria across the programs introduced challenges to establishing a shared community, such as subsets of Affiliated Scholars entering the summer program with existing social relationships. We will discuss specific challenges and opportunities we observed and provide recommendations for blending a primary REU with Affiliated Scholars based on our experiences.

1. Challenges: Variability in Programs’ Goals and Structures

The mission of the NSF REU program is to expand undergraduate participation in research through the integration of research and education. NSF REU Site grants provide funding for a small number of undergraduate students, typically 8-10, to visit the host institution in the summer. The grant provides support for on-campus housing, stipends, research supplies, and educational activities during a 10-12 week period, a cost of approximately \$1,000 to \$1,200 per week per student. The grant provides little to no support for faculty and staff summer effort to implement these activities. Each visiting student is matched with an investigator in the field at the REU Site host institution and participates in a meaningful way in the lab’s research endeavors. [1]

The BME CUREs Cancer Site matches students with investigators who are studying cancer-related problems in biomedical engineering. This program also includes weekly educational activities led by program directors and other field experts on topics important to participants’ professional development as scientists, and specifically cancer research. Topics of these seminars include: applying to graduate school; social impacts of research; research ethics; the history and understanding of cancer; and practical skills for presenting research. BME CUREs designs these activities for rising sophomores. This rich mentorship environment provides students with an in-depth introduction to a career as a researcher and can therefore have a large impact on their identity as a scientist early in their undergraduate career, allowing them the time to adequately prepare for successful admission to and completion of a graduate degree program. [2] By blending Affiliated Scholars into the CUREs program, the directors have tried to expand access to this mentorship and research environment to more undergraduate visiting scholars.

Affiliated Scholars programs have varying goals and often focus activities on varying populations of students. For example, the NIH MARC program offers fellowships to academically strong juniors and seniors through a T34 funding mechanism through the students' home institutions. MARC aims to increase graduates from underrepresented minority groups in science, technology, engineering, and math programs. [3] An Affiliated MARC Scholar participating in the BME CUREs therefore was sent by their home institution to biomedical engineering and was willing to work on a cancer-related project through the CUREs connection. The funding structure for the MARC Scholar was such that the CUREs hosting department needed to sponsor the visiting student in order for them to stay in on-campus housing. Furthermore, scholars in MARC are upperclassmen and may have had more research experience and professional maturity. Although this difference did not necessarily create a negative experience for CUREs scholars, the program activities may not have been seen as directly useful to Affiliated MARC Scholars. The CUREs program has hosted one Affiliated MARC Scholar to date.

The NSF LSAMP program has very similar goals as the NIH MARC program: to increase graduates in minority groups from STEM disciplines. [4] The University of Texas System LSAMP grant is hosted by The University of Texas at El Paso and sends a very limited number of students to UT Austin. Furthermore, CUREs is a biomedical engineering research program, while visiting Affiliated LSAMP Scholars may come from a wide range of natural science majors, some of which may not align with biomedical research goals; therefore LSAMP scholars may or may not be able to engage in the same research goals as the primary REU. The UT LSAMP summer scholars that visit may be more aligned with CUREs scholars in professional maturity, however, as these scholars are typically sophomores or juniors. [4] The CUREs program has hosted one Affiliated LSAMP Scholar to date.

The NIH Building Infrastructure Leading to Diversity: Southwest Consortium of Health-Oriented Education Leaders and Research Scholars (BUILDing SCHOLARS, or BUILD) is a multi-institution consortium in Texas, New Mexico, Arizona and other regions with a goal to provide programs and activities that will train the next generation of biomedical researchers from the southwest United States. [5] UT El Paso is the lead institution in this BUILD consortium. The UT Austin Department of Biomedical Engineering is a research partner participating in the BUILD program, and as such has agreed to host 3-8 BUILD participants each summer as a part of the BME CUREs Cancer REU program. The BUILD goal of developing biomedical researchers more closely aligns with

CUREs, and the specific disease-centered focus on cancer aligns with Affiliated BUILD Scholars' interests. Many of the students in the BUILD program that participate in summer research with our Site are more advanced in their undergraduate degree, often at the junior and senior level. This difference in maturity and experience poses a much larger challenge for the Affiliated BUILD Scholars because they come in a larger group of 6 to 8 each summer, whereas other Affiliated Scholars are often the only visiting scholar in their program. The NSF REU Site for CUREs Cancer specifically recruits 8 rising sophomores who have finished their first year in college from a variety of backgrounds, but all of them are early in their undergraduate career. The program directors observed that a larger group of 6 BUILD scholars which are more mature and know each other can often overpower discussion in educational and social activities. We also observed that in social events, the two scholar groups did not entirely mix and often kept to their own group. This was not the case with other Affiliated Scholars who were completely integrated into the CUREs Cancer scholars group.

2. Opportunities: Professional and Social Development

Despite some of the challenges presented related to matching of research interests and social and professional maturity among the CUREs and Affiliated Scholars, the program directors have noted some important opportunities to expand access to a rich research mentorship environment without incurring significant cost.

Earning an NSF REU Site award is a competitive and challenging process. These grants provide just enough funding to support the 8-10 student participants, and little to no funding for administrative and faculty time in developing and implementing the enriching and important educational activities over 10 weeks. These include the weekly seminars with scholars as well as formal Entering Mentoring training for graduate student mentors working with each visiting scholar. [6] The host institution's department shares the cost of these programs through faculty and staff time, which is significant for 8 students. Adding another 7-9 Affiliated Scholars to the existing educational activities does not increase this cost but doubles the impact in terms of access to this instruction. Where only 8 CUREs Cancer Scholars would have been able to participate in these seminars, with the expansion of Affiliated Scholars now 15 to 17 scholars have the potential to develop a strong identity as a scientist. [2] This is a synergistic partnership that greatly multiplies the goals of the affiliated programs in increasing access to careers in STEM to diverse groups of students.

Furthermore, including these visiting scholars with the existing group supports their social development over the summer. Affiliated Scholars visiting the UT Austin campus in the summer alone can potentially feel quite isolated. Being a part of group discussions about research, graduate school, and other important topics related to pursuing a career in STEM can again help them feel a part of a group of future scientists and encourage them to continue in their path. We have observed many scholars have reunited in later summers, developing long-lasting friendships and professional connections in the field.

3. Suggestions for Future Implementations

The opportunities to benefit a larger number of scholars through integration of Affiliated Scholars with an existing NSF REU Site outweigh the current challenges. The program directors intend to continue this practice and based on our experience we offer suggestions for practical consideration for future implementations of this practice.

The first is to consider the number of students in the host REU Site and the number of students from the Affiliated Scholars programs. Outnumbering the REU group with scholars from other institutions may significantly change the dynamics of the group and inhibit social cohesiveness if the Affiliated Scholars know each other or their interests and maturity are significantly mismatched with the REU Site. If a program wishes to incorporate a larger group, such as the BUILDing SCHOLARS example provided in this paper, working with the directors of the other program to coordinate selection of visiting students to align with REU goals is crucial.

The second is to reach out to faculty hosting Affiliated Scholars about the opportunity for their visiting undergraduate researcher(s) to participate in the REU activities. Many times, these scholars are the only student sent to host university from their home institution through a fellowship, such as the MARC and LSAMP programs, and they may not know about REU program and other summer scholar groups in which they may be eligible to participate. Alerting faculty and program coordinators to these opportunities can help identify Affiliated Scholars who would be a good match to join an REU Site. The program directors suggest specifically including activity requirements related to participation, such graduate student mentor training or research presentations. This can reduce surprises and allow investigators to know what to expect when asking their visiting scholar to join the REU group.

A third suggestion is to seek out Affiliated Scholar programs that do align with research goals, in our case cancer research. Although disease-specific research programs in STEM may be few, cancer is a topic of great

importance to funding agencies such as the NSF and NIH, which also have a large mission to increase access to scientific careers through educational activities. Reaching out to specific faculty whose research overlaps with the REU mission may help align the research goals of Affiliated Scholars with the host REU Site's goals.

Lastly, if the host institution has centralized activities for summer scholars—such as UT Austin's Office of Undergraduate Research Summer Research Scholars Programs—REU scholars may make friends with Affiliated Scholars already on campus and organically invite them to participate in REU activities. The CUREs program has benefited from these connections among the students to incorporate Affiliated Scholars based on their sincere interests the REU Site activities. The program directors suggest being open to allowing these organic connections to lead to inclusions of Affiliated Scholars into an REU Site, which further encourages the social and professional connections being made among the scholars.

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