

Summative Performance Evaluation of a 3-Year NSF-REU Site on Metrology & Inspection

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Overview

The purpose of this short summary is to briefly report on the summative performance evaluation of a three year National Science Foundation (NSF) Research Experiences for Undergraduates (REU) site on metrology and non-destructive inspection (NDI).

The goal of this REU site was to enhance the knowledge and skill level of a diverse cohort of undergraduates through empowering, hands-on, and interdisciplinary research experiences in metrology and NDI technologies. This NSF program had the following goals for this 3-year cycle: (1) Excite, empower, and educate 30 undergraduate participants in traditional/advanced metrology and NDI, (2) for the undergraduate participants to experience an immersive research-training through a related transformative project, (3) to mold the undergraduate participants as both independent/collaborative researchers capable of effective communication, (4) for the undergraduate participants to learn to ask the right questions, formulate plans, pragmatically interpret data, and (5) inspire and enable the undergraduate participants to pursue advanced study and related STEM careers. This site was a direct response to a recurring concern raised by industry partners and technical workforce recruiters about the lack of pragmatic metrology/NDI-related knowledge and skills in their incoming workforce. Over the past three years, a total of 30 REU students progressed through and completed the program. During each summer, the REU cohorts were immersed in hands-on research experiences comprising of a transformative research project, capsulated technical sessions and complementary lab practice, field tours, research seminars, and professional development workshops. Following the REU program, a 1-year follow-up was instituted with each individual participant for continued interaction, growth, and guidance of the students for pursuing advanced study/careers.

An external evaluator was tasked to appraise the following – did this site meet its recruitment goals (% of underrepresented participants); what gains did the program have; what are the participant perceptions of program administration, impact on their career plans, and also the changes to participant research self-efficacy. Documents for evaluation included the participant applications (the 2017 cohort applied using a university-level application, while the 2018 and 2019 cohorts applied through a common NSF-partnered common application) as well as pre-program and post-program surveys. Information of the participant progression towards graduate school after leaving the REU was tracked by the PI using both LinkedIn and email contact. Additionally, participants were probed to understand the impact of grouping REU student pairs within a larger vertically-integrated project (VIP) team framework, and to elucidate how the team makeup and dynamics contributed to the overall site objectives. The evaluator assembled and analyzed the data (responded to close-ended and open-ended items) submitted by the participants from paper copies of their applications, pre-program surveys and post-program surveys.

Altogether, the experience, outcomes, and lessons learned from this REU site operation are expected to guide the effective and efficient operation of future REU sites as well as undergraduate research projects in general.

Summary of Results

Recruitment: The application materials were used to track the self-reported demographics of the undergraduate participants to determine the number of participants who belonged to various underrepresented groups. The participants were academically talented having an average cumulative GPA of 3.57 ± 0.36 . Of the 30 participants during 2017-2019, 10 (33.3%) self-reported to be women and 20 men (66.7%). 23.3% of the participants (7) reported to be from an NSF underrepresented race/ethnicity (Hispanic/Latino, Native Hawaiian/Pacific Islander or Black/African American). The total percentage of participants who were from any underrepresented group was 50% (15 individuals). Other items tracked were the Carnegie classifications of the institutions the students were from, the state-wise distributions of applications and participants, major motivations for seeking a REU experience, etc.

Monitoring undergraduate gains from the program: In order to understand what skills students developed while participating in this REU program, a number of similar questions were asked on the pre-program and post-program surveys: ‘Prior to attending the REU, in what ways had you been exposed to the research process in your life?’, and ‘By taking part in this REU, which of the following new things have you done?’. The majority of students identified a significant number of research activities being done for the first time during the REU program.

Participant perception of program administration: Many programming types were incorporated into this REU site, including workshops on metrology and non-destructive inspection, facility tours, social activities, and aspects of the Undergraduate Summer Research Grant Program (URSG) program. Most of the REU participants wanted to have the same number (or more) of the sessions related to metrology and NDI, and wanted these to be scheduled earlier, and also to be more interactive. 60% requested additional technical seminars and also reported benefiting from the tours. In general, all students were satisfied with the programming elements.

Impact on the career plans of the participants: Of the thirty (30) students who matriculated via the REU program, ~70% graduated with their B.S. to date. Nineteen (19) of the participants (63.3%) indicated that they were interested pursuing graduate school in science, technology, engineering or mathematics at the end of the program. More importantly, the six (6) students who came into the program ‘undecided’ on their current plans after getting their bachelor’s degrees had solidified their career plans, and another eleven (11) students narrowed their options.

Changes to participant research self-efficacy: Self-efficacy refers to individuals’ beliefs that they can produce desired results, whether the desired results are imposed by themselves, or set as expectations [1]. Using a number of questions developed in [2], we asked the participants to respond using a Likert-type scale response, where “strongly disagree” = “1” and “strongly agree” = “6”. Participants responded to these at the start and end of the program. The difference in the cohorts’ self-efficacy ratings at week 1 and week 10 were statistically significant, suggesting that the REU program was able to positively influence students’ perception of mastery experience (participating in research) which in turn should lead to improvements in students’ beliefs that they can succeed in a research setting (research self-efficacy).

Altogether these results suggest that the program [3] had gains in achieving the intended site goals as well as to enhance the knowledge and skills of a diverse cohort of undergraduates.

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