BOARD # 242: Formative Evaluation of REU Site Hosting Community College Students and Funded by NSF REU Program

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Abstract

This Research Experiences for Undergraduates (REU) program supports active research participation by community college (CC) students with a focus on Smart Engineering, including: Artificial Intelligence/Machine Learning, Smart Health, Smart Materials, and Smart Infrastructure. The program is offered as 10-week non-residential summer research experience for local community college students. The program also features high-quality interactions of students with faculty and/or other research mentors, access to appropriate facilities and professional development opportunities, an opportunity to tap the nation's diverse student talent pool, and broaden participation in science and engineering. Th participating CC students are also introduced to and encouraged to transfer to 4-year college education to enhance their future employment and increase participation of the underreported in STEM education [1,2].

This extended abstract presents the results from a retrospective pre-post exit survey by the grant external evaluator of participants in the xxx University Pathways REU in engineering, as funded by the National Science Foundation. This project supports regional community college students at xx University for summer work in engineering research, placing the participants in research labs working on cutting edge problems in AI/machine learning, smart infrastructures, smart materials, and smart health. The students also carried out design projects using SparkFun Inventor kits and laptops that were provided to them as part of the grant stiped [3- 7]

The evaluation research questions include:

- To what extent was the project successful at engendering growth across the four target constructs?
- What aspects of the summer experience are reported as being most beneficial?
- What do participating students say about their summer experience more generally?
- How do the 2024 cohort's results compare with those of the previous two cohorts?

The key findings include:

- The REU exit pre-post surveys again showed consistently positive results across the intended outcomes with moderate to large effect sizes.
- The importance of conducting research under the guidance of a faculty mentor was viewed by the students as essential to the summer's experience.
- The 2024 REU group expressed a strong association between gains in self-confidence, understanding of engineering and a commitment to continue in engineering.
- The 2024 evaluation findings are generally consistent with those of the previous two years, with the 2024 group reporting the most positive effects of participation among the three cohorts.

Introduction

This REU site supports active research participation by community college (CC) students with a focus on Smart Engineering, including: Artificial Intelligence/Machine Learning, Smart Health, Smart, Materials, and Smart Infrastructure. The program is offered as 10-week nonresidential

summer research experience for local community college students. The program also features interactions of students with research, access to appropriate research facilities.

In the summer of 2024, Northeastern University completed the third year of the summer research experience for undergraduates (REU) program called REU-PATHWAYS for community college students to enrich their education and careers, which focused on the fields of AI/machine learning, smart infrastructures, smart materials, and smart health. Thirteen community college students completed this 10-week summer research experience with faculty affiliated with the College of Engineering, engaging in topics pertaining to smart engineering. The program focused on skill development to support long-term success of community college students, whether they join the workforce after their education or transfer to 4-year colleges to earn higher degrees. This REU site is guided by two of the grand challenges of the National Academy of Engineering: personalized learning and scientific discovery. Community college (CC) students, graduate students, and research faculty engaged in team-based research projects. The REU site grant is intended to provide a 10-week summer research experience for 10 CC students each year. REU students were paired with faculty and graduate students' teams. In addition to gaining research experience, they received training on teamwork and communication best practices through a suite of professional development opportunities. Field trips provided students first-hand exposure to the STEM workforce in action. These efforts are expected to yield two major outcomes: (1) a cohort of CC young researchers, many from underrepresented groups, who have a strong understanding of interdisciplinary team-based research, and (2) publications showcasing the work of these students to the broader research community.

Sample and Methods

The grant external evaluator performed a formative evaluation for the third year of the grant [8]. The sampling frame for the REU survey included all participants (N=10 of 13, for a response rate of 77%). The responding students came from seven Boston-area community colleges, with no further demographic data available for the current report. The assessment was devised by DSRA (the external evaluator) in consultation with project leadership and administered online just after the summer session in August 2024. The instrument used 48 items to measure the four target constructs, with these constructs being (1) an appreciation for the importance of engineering, (2) participant self-confidence in being able to engage in engineering research, (3) the perceived likelihood of participants engaging in further engineering efforts, and (4) participant understanding of various aspects of engineering. The four constructs were measured at a single time point, using a retrospective pre-test model that supported the measurement of pre-post change. Each of the four constructs used a six point, Likert-type scale running from most negative to most positive, with the number of items varying slightly by construct. Reliability analysis was measured at an excellent 0.995 (Cronbach's Alpha), with no factor analysis or other structural equation modeling conducted due to the small sample size. All data were collected on the DSRA SurveyMonkey website, downloaded and cleaned on DSRA servers, then analyzed in SPSS and R. Evaluation research questions included:

- To what extent was the project successful at engendering growth across the four target constructs?
- What aspects of the summer experience are reported as being most beneficial?
- What do participating students say about their summer experience more generally?

- How do the 2024 cohort's results compare with those of the previous two cohorts?

Results and Analysis

We analyzed the results from the pre- and post-surveys using statistical methods. Table 1 summarizes our findings by construct. All pre-post items showed statistically significant pre-post change ($p<.05$, paired samples t test), with the estimated effect sizes (in the ES column below) ranging from moderate to large in magnitude. Note that the standard deviations in the following consistently shrink at T2, indicating that even with wide variation among the students at the beginning of the summer, these differences tended to lessen by the end, indicating the effects of participation were widely shared.

Table 1 Pre-Post Change Summarized by Construct

Construct	Mean	N	SD	ES	%Gain
PRE Importance	26.30	10	5.96		
POST Importance (max=36)	32.80	10	3.16	1.74	24.71
PRE Confidence	16.50	10	6.80		
POST Confidence (max=30)	25.90	10	3.38	2.32	56.97
PRE Likelihood	18.80	10	7.89		
POST Likelihood (max=30)	24.70	10	4.30	0.66	31.38
PRE Understanding	27.00	9	10.77		
POST Understanding (max=48)	42.11	9	5.35	1.96	55.96
PRE Total	88.11	9	29.09		
POST Total (max=144)	125.67	9	13.54	2.23	42.63

We also analyzed the pre-post gains in the four categories (Importance, Confidence, Likelihood, Understanding) using ANOVA. Overall, these are very good results and supportive of the inference that the consistently effective Pathways program showed steady improvement over the period of its funding.

Reu students have included open text comments in the surveys. Here is a simple

- The biggest surprise was being inside of a computer architecture lab. I had never been inside of one before and didn't know what to expect
- being involved with lab work has given me helpful & well-rounded exposure to the realities of engineering research as a job

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