

Materials Connection REU Site (MacREU R'Side) Evaluation, 2024*

Kevin M. Esterling
UC – Riverside
kevin.esterling@ucr.edu

Ludwig Bartels
UC – Riverside
ludwig.bartels@ucr.edu

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Abstract

This is the evaluation for the eleventh year of the MacREU-UCR REU site. As it has in each of the past years, the program performed very well in exposing students to science and engineering, building their scientific skills, and encouraging them to pursue a Ph.D. The evaluation of the program showed that the students gained considerable research skills and professional development over the summer in every respect we measured. This evaluation shows that the 2024 program equaled the already very strong results of the previous years. In particular, the program maintained high levels of exposure to research and mentoring, which translated into the acquisition of research skills, professional development, and aspirations of a career in science and engineering on the side of the participants.

1 Introduction

“Materials Connection REU” (MacREU R’Side) was a 10 week REU site, held in the summer of 2024, in which XX undergraduate students, mostly from Southern California colleges, had the opportunity to conduct research in science and engineering labs on the UCR campus. The students largely came from demographic groups that are under-represented in STEM fields, including XX percent Hispanic, XX percent non-Hispanic URM students, and XX percent female or not gender identified.

The PI carefully screened students with ZOOM interviews and selected among applicants those who showed promise in science but were at risk of not pursuing a career in science. Among the XX students, XX hailed from two year colleges, XX came from non-research intensive four-year colleges and the remaining from research-intensive universities. In particular, besides UC Riverside, the students had the following home institutions: XX. XX out of the XX participants originated from institutions without significant research infrastructure, XX of them from a community college.

All of the students’ research projects were related to the growth, characterization, simulation and application of thin films or monolayer materials. Students were placed in a variety of labs within the Materials Science and Engineering program. Participants are exposed to a wide area of fields from catalytic chemistry to semiconductor processing and from solar cell manufacture to the improvement of medical devices. To learn more about the MacREU site at UCR, visit <http://macreu.ucr.edu/>. At this site, one can view short video presentations from program alumni that describes their research and experience in the program.

This evaluation draws on a survey of participating students based on the REU survey template available on the “Student Assessment of Learning Goals” website <http://salgsite.org>, providing both qualitative and quantitative evaluation data. Unfortunately, the SALG website has crashed so we implemented a similar version of the survey locally in Qualtrics.

Overall, the 10th cohort of the program (MacREU skipped 2020) well met its academic goals and broader impacts of exposing these students to research, building their academic research skills, and gaining their interest in pursuing science and engineering as a career at the Ph.D. level. In every measure in this evaluation, the 2024 program equaled the extremely strong results we observed from the previous years of the program. In sum, the program was a strong success and met its goals of instilling an interest in science and engineering among students from under-represented backgrounds. In particular, the program maintained high levels of exposure to research and mentoring, and also showed significant improvements in the program’s on-campus administration and students’ experience.

2 Student Assessment of Learning Goals Survey Results

In this section, we present the results of a survey we administered to the XX NSF-funded students; each of these students filled out a survey. The survey comes from a template

for REU evaluations available at the Student Assessment of Learning Goals website.¹ We used this website to administer the survey and to generate the figures showing results.

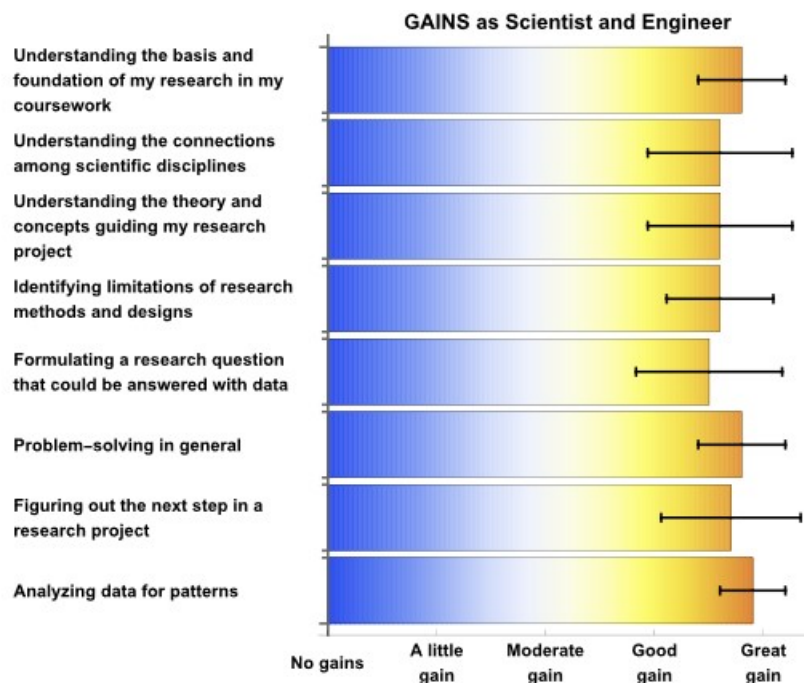


Figure 1: Gains in Thinking and Working Like a Scientist

Overall, the program well met its goals of introducing students to scientific research as a career and helping them to build capacity for conducting scientific research. This can be seen for example in Figure 1. In this section of the survey, students were asked to rate their own gains from the program in learning how to think scientifically and work like a scientist, and to apply scientific knowledge to research. Overall, students report good to great gains in skills such as analyzing data for patterns, formulating a research question and understanding theory and concepts. While there is a little variability in responses, virtually all students report good or great gains in developing this capacity.

Likewise, in figure 2 students reported considerable personal gains in their own capacity to do research, in areas such as their own ability to contribute to science, their confidence to do well in future science courses, and understanding what everyday research is like. Each confidence interval essentially exceeds a good level of gain response.

Figure 3 also presents firm evidence that students improved their professional skills such as how to prepare a scientific poster, communicating their research orally to others, critically evaluating data for validity, and using instruments to conduct measurements or experiments. Students tend to report moderate to great gains in these skills across the board. That said, students report only making modest gains for some of the research

¹See <https://salgsite.net/>, accessed February 8, 2023.

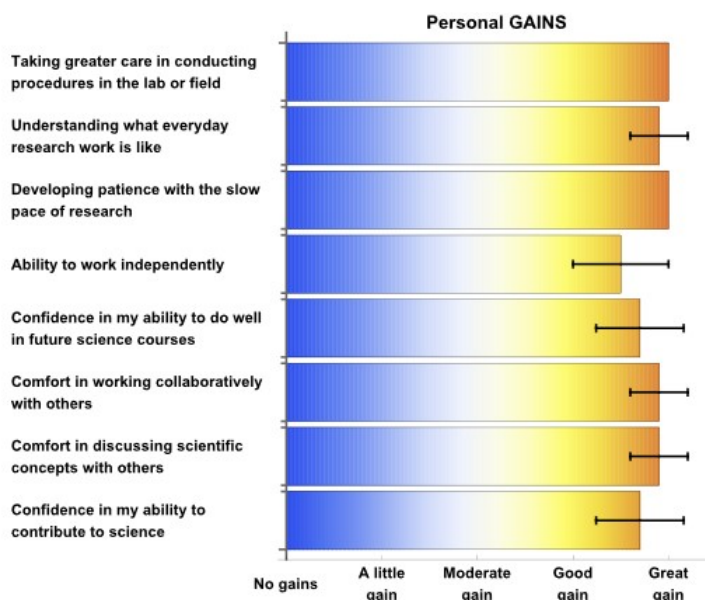


Figure 2: Personal Gains Related to Research Work

skills, such as programming computers, using software to analyze data, writing scientific papers, or keeping a detailed lab notebook, which might reflect that working in labs over the summer does not impart the same amount of writing or analysis skills that one would get in coursework. It is possible too that some of the labs use some system other than notebooks to record procedures and outcomes.

Figure 4 continues to support the view that students gained in their self-efficacy for conducting research, where students typically indicated they gained a fair amount or a great deal in their own feelings of efficacy in engaging in real-world science research, feelings of responsibility for their research project, feeling part of the scientific community, and interacting with scientists from outside of the school. Many also felt confidence in their own ability to try out new ideas or procedures on their own, although at a lower rate than the other attitudes reported which might reflect that undergraduate students' experience is more about mentorship than research production. Most students report interacting only a little with national labs.

Overall, figure 5 shows that students rated the quality of their research experience as excellent, including their working relationships with their research mentor, the amount of time doing meaningful research and the overall experience, and the amount of time spent with their graduate student mentors, interactions with their peers, and getting advice from their mentors about graduate schools. Students report having good access to their faculty mentor, but the lower rate of access to the faculty mentor compared to the graduate student mentors is by design of the program and so not unexpected..

The questionnaire also give students an opportunity to add more thoughts on the quality of their research experience and they wrote as follows. The students overall write

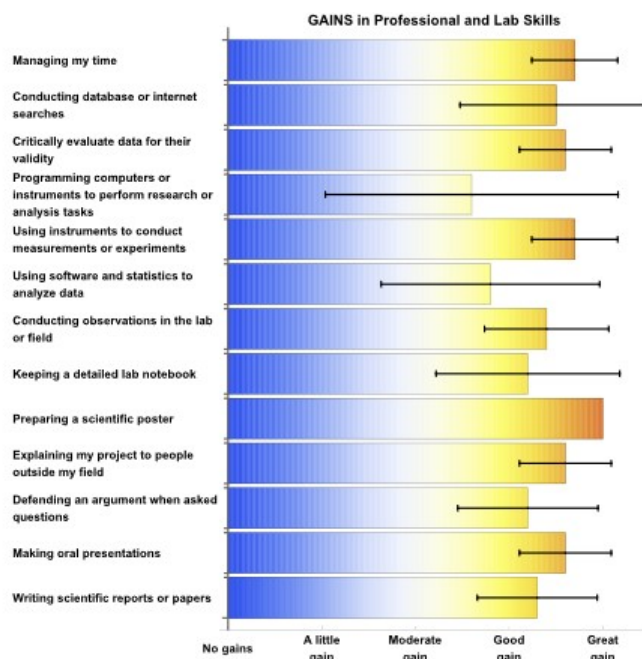


Figure 3: Gains in Academic Skills

very positive comments about their experiences in the lab.

- This opportunity gave me the chance to perform real, relevant biochemical research, which was great for learning techniques and gaining experience I will need in grad school. It also gave me an idea of what life as a grad student looks like, and I was able to collaborate with other phenomenal scientists, gaining great guidance and mentorship.
- My research experience was very excellent. I learned a lot about myself as a scientist and I proved to myself how capable I am of being a good scientist
- Had a great experience with my graduate student and my Pi.
- My graduate student and faculty mentor made this an extremely memorable experience.

Figure 6 continues to lend support to our belief that the program enhanced students' interest in science and engineering as a career, typically indicating that the program confirmed and clarified their scientific career interests. Across all of the measures, students report agreeing that participating in the program enhanced their preparation for a career in science, especially in confirming their interest in their field of study and the field they wish to pursue, preparing them for advanced coursework and graduate school. They also feel the experience prepared them for a job and exploring opportunities at national labs.

Figure 7 also confirms that the program enhanced students' expectations and interests in pursuing research and science as a career, indicating gains in interest in enrolling in a

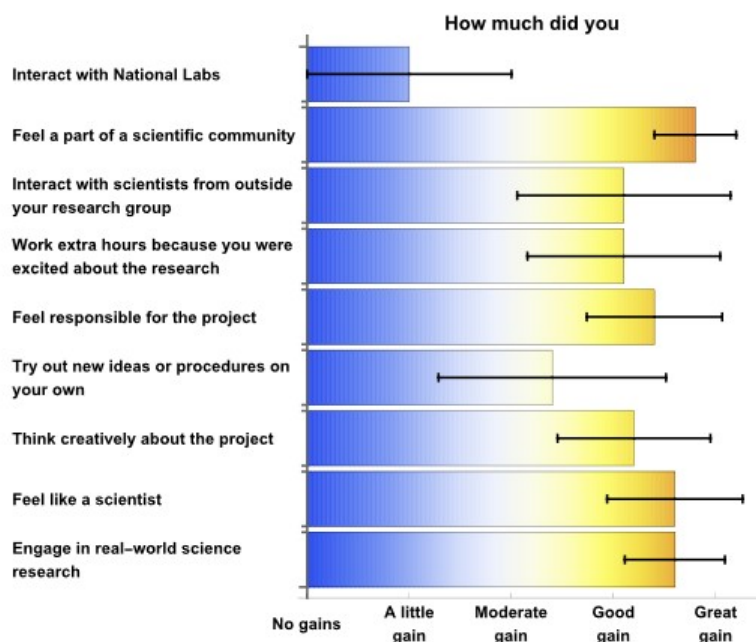


Figure 4: Attitude and Behavioral Changes

STEM PhD or masters' program and working in a science lab or national lab. This figure overall indicates both the effectiveness of the program in enhancing students' interest in science and also that the program did not typically select students already on the science track, since if students entered program on a science career track they also would have indicated no gains.

The questionnaire also asked students to type in their intended degree and, "compared to your intentions BEFORE doing research, HOW LIKELY YOU ARE NOW to enroll in a graduate program leading to an advanced degree." Students wrote,

- My intended degree was MD, now I am considering MDPHD
- Materials Science and Engineering - extremely likely
- Biochemistry & Molecular Biology; much more likely to pursue grad school
- I want to go to graduate school for Pharmacy. I always knew I wanted a PHd
- I am a hundred percent sure I am pursuing my master degree.
- I am currently aiming for an Associates in Biology, aiming for a Bachelors in Animal Biology and I am much more likely to enroll in a graduate school.
- Intended degree – Bachelor's of Science; likeliness now - significantly more likely to pursue Master's

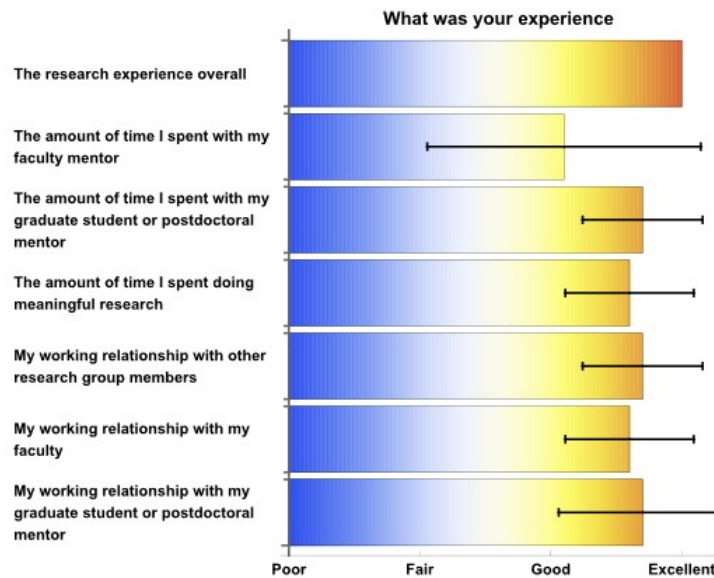


Figure 5: Quality of Research Experience

- Mechanical Engineering Major, I feel most likely to enroll in a graduate program
- Aerospace Engineering, highly likely or almost certain given my circumstance.
- I intend to pursue a bachelor's in Public Health Sciences. Before this program, I was hesitant to do any kind of research into graduate programs. Now, I know what I am looking for when it comes to a graduate program and what kinds of options there are for me. I am looking more into Environmental Health Sciences or Environmental Epidemiology programs after my time in an environmental engineering lab. I feel more confident in what I'm looking for when it comes to these programs.

The questionnaire included an open-ended question asking students to reflect on how their research experience influenced their own thinking about future career and graduate school plans. The students wrote,

- My research experience definitely made me consider graduate school and has sparked my interest in research.
- I was uncertain what the way forward was. I was able to network and make proactive goals to prepare for grad school applications.
- I have wanted to pursue a Ph.D since my second year of college, but getting this experience showed me the life of a grad student. This made me certain that I want to enroll in graduate school.
- I know now I have options and I'm more confident in my choices

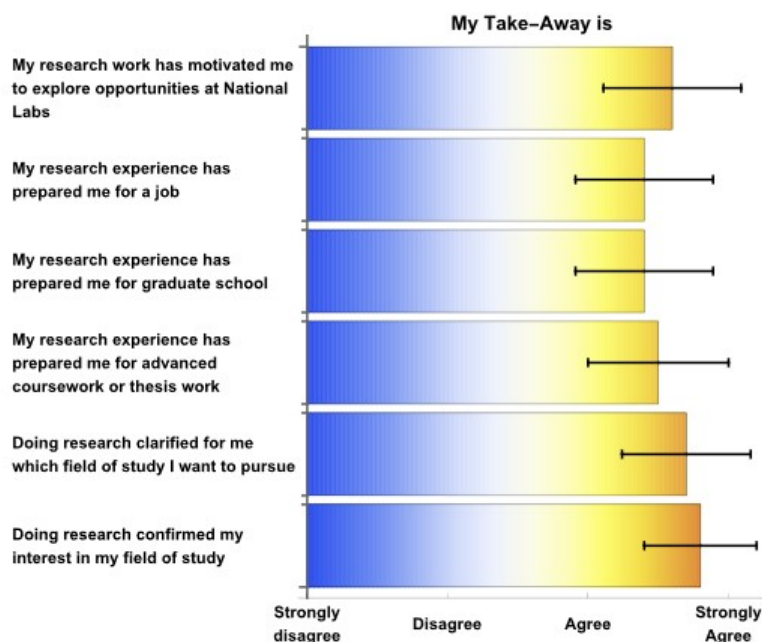


Figure 6: Effects of Research Experience on Personal Advancement

- Watching and working with graduate students in the field. Getting their perspectives on the program and reflecting on it.
- This research had me wondering if I wanted to change my major to what department I was working in (Bioengineering), and made me wonder if I would double major and pursue both paths in grad school.
- I now have a more clear idea of which specific project I would like to work on in the future
- It definitely helped me get a better understanding of what it looks like to work in a graduate program, and has sparked my interest to pursue
- Extended my aspirations in conducting research by hovering me hands of training and guidance through experiments and various aspects of the process.
- After experiencing just this sliver of research, I feel less intimidated and more curious about graduate school and the research process overall. My graduate student was open to all my questions and made graduate school look manageable and realistic, while still stressing the workload and commitment it takes to be successful. I would say it greatly pushed me towards a future career in research and graduate school.

The questionnaire also asked students to reflect on other ways the program enhanced their interest in science as a career and led to personal gains, and they wrote,

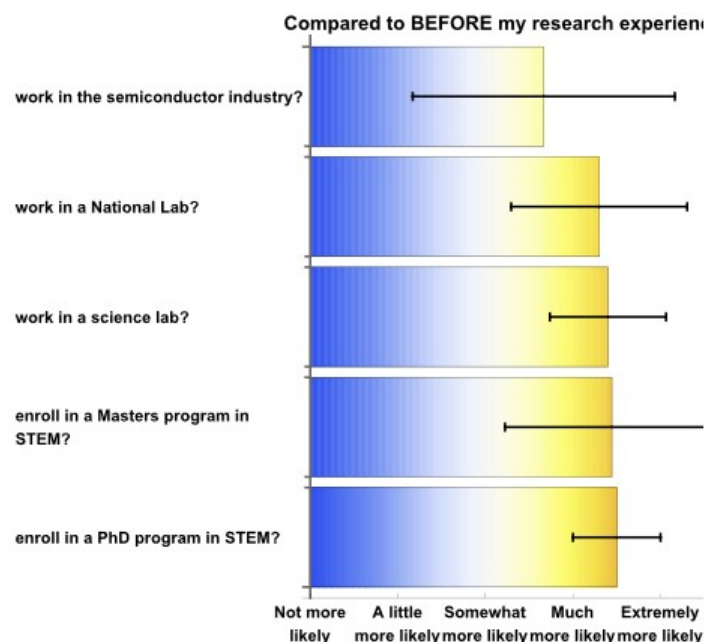


Figure 7: Effect of Experience on Entering the Pipeline

- I definitely made gains in communication and confidence in my abilities.
- I gained a better awareness of various fields of research that seem interesting.
- I gained a lot of new skills and a ability to be confident in research
- Yes, I gained from researching in my grad students work doing Hydrogels and working with some Cell Cultures
- I met incredible people and will keep in touch
- I gained more knowledge in the study of chemistry and overall different science subjects and machine learning
- Interpersonal relations and references.
- I would say that it motivated me even further to do well in my current classes. I know that these classes are the foundation for this greater future I can already see myself living.

Figure 8 indicates that students overall were satisfied with the organization and structure of the program itself. The program included training and involvement with lab personnel; we had a dedicated staff person (Rebecca Ryan) and graduate research assistant who were able to provide constant attention to the group training and activities, and more planned social activities. Overall we see high levels of satisfaction regarding the

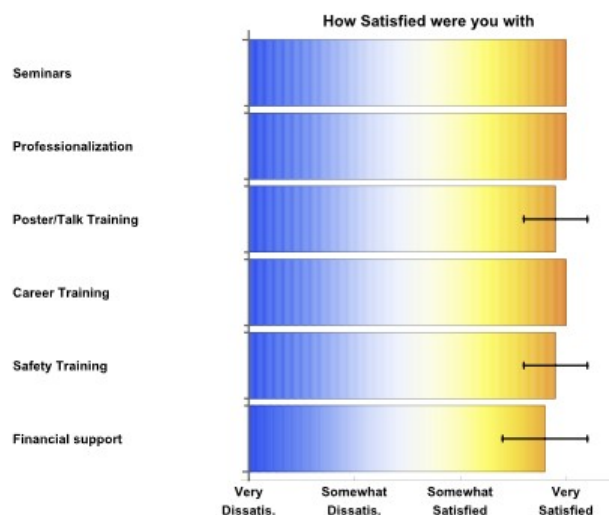


Figure 8: Satisfaction with the Program

seminars, professionalization events, poster and talk training, career training, and safety training. Students also report satisfaction with the level of financial support. Separately, the students rated the fellowship payments they receives as very to extremely important for their participation in the program.

Finally, students were given an opportunity to write suggestions on how to make the program experience better. The students wrote:

- More time
- Better advance notice of events and changes, though that was only an issue a couple of times.
- If it was longer probably since you can only do so much in a 9 week span
- If we were about to notify our PIs about our program schedule.
- I wish I had worked more hands on in the lab
- If the program received more funding to house more students on campus
- Overall I felt that the experience was great the transit to get to my lab could have been better but overall not a big deal
- Extended amount of time

3 Conclusion

Overall, the program was very successful in its goals of interesting students in a career in science and engineering, in equipping them for such a career, and providing with strong

research experience and skills. Furthermore, the evaluation scores for this year were equal to or greater across the board compared to the the baseline year of the program (2106) and equaled the high scores from the program's previous years. In addition, while the program maintained high levels of exposure to research and mentoring, it also showed significant improvements in the program's on-campus administration and students' experience.

We look forward to building on this evaluation and even improving MacREU even more in 2025.