

Materials Connection REU Site (MacREU R'Side) Evaluation, 2025*

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

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

February 28, 2026

*This REU site is funded by a grant from the National Science Foundation (award number DMR 2349087).

Abstract

This is the evaluation for the twelfth 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 relevant dimension 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 9 week REU site, held in the summer of 2025, in which 12 undergraduate students from Southern California colleges had the opportunity to conduct research in materials science and engineering labs on the UCR campus. The students largely came from demographic groups that are under-represented in STEM fields, including 33 percent Hispanic, 17 percent non-Hispanic URM students, and 58 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 12 students, 9 hailed from two year colleges and 3 came from non-research intensive four-year colleges. In particular, the students had the following home institutions: Mount San Jacinto College and Riverside City College, two local community colleges were represented at a total of 6 participants.

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 that previously was available on the “Student Assessment of Learning Goals” website <http://salgsite.org>, providing both qualitative and quantitative evaluation data. Unfortunately, the SALG website no is no longer in operation so we implemented a similar version of the survey locally in Qualtrics. In addition, we spend the last day of the program soliciting qualitative responses from the participating students in an in-person debriefing session.

Overall, the 11th cohort of the program (MacREU skipped 2020 because of the pandemic) 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 2025 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 that was previously available at the Student Assessment of Learning Goals website.¹

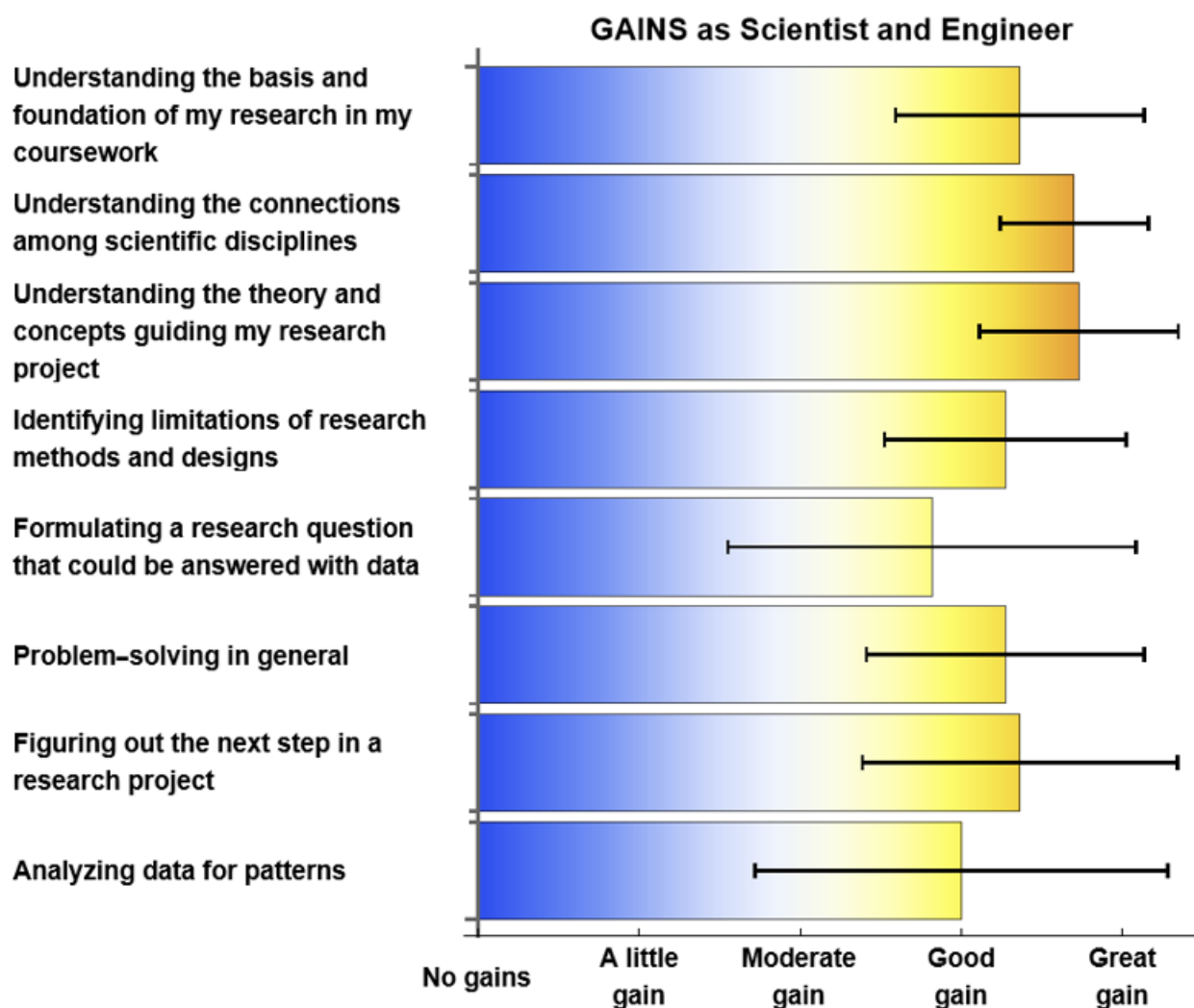


Figure 1: Gains in Thinking and Working Like a Scientist

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

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

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.

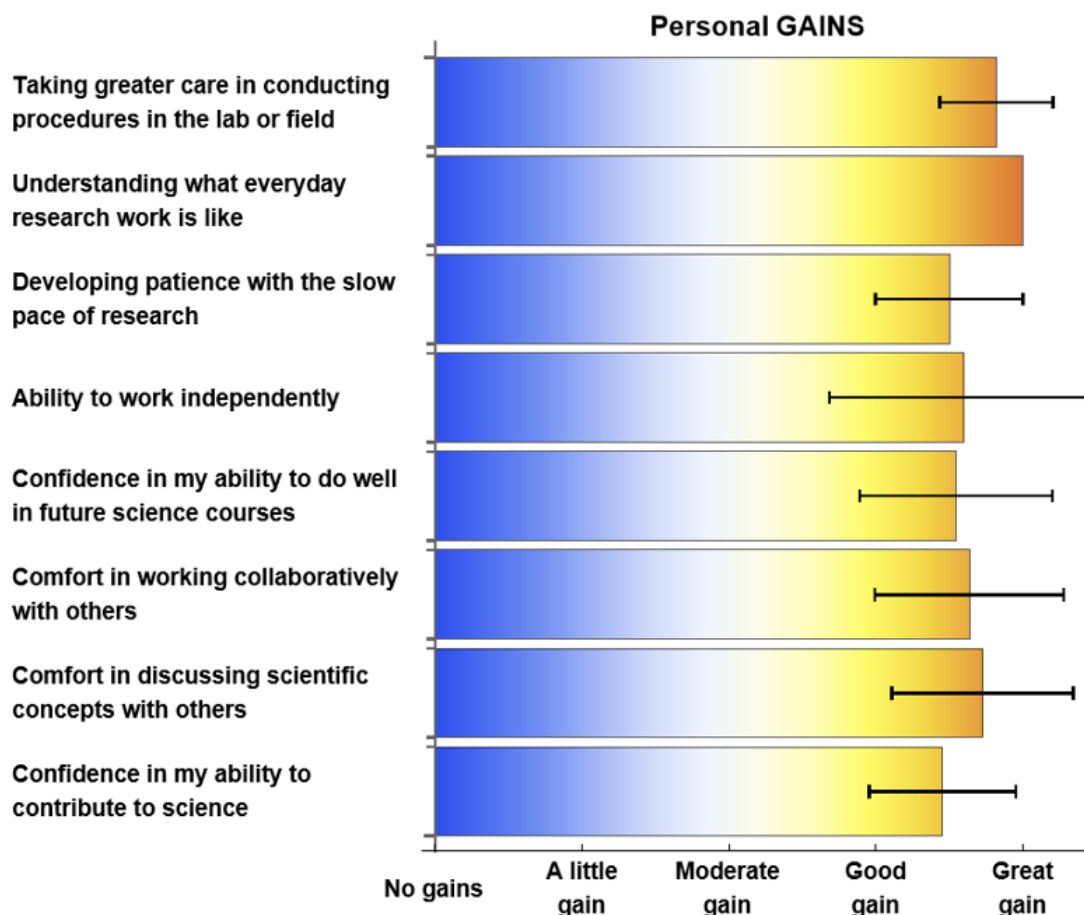


Figure 2: Personal Gains Related to Research Work

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 a wide variety of 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

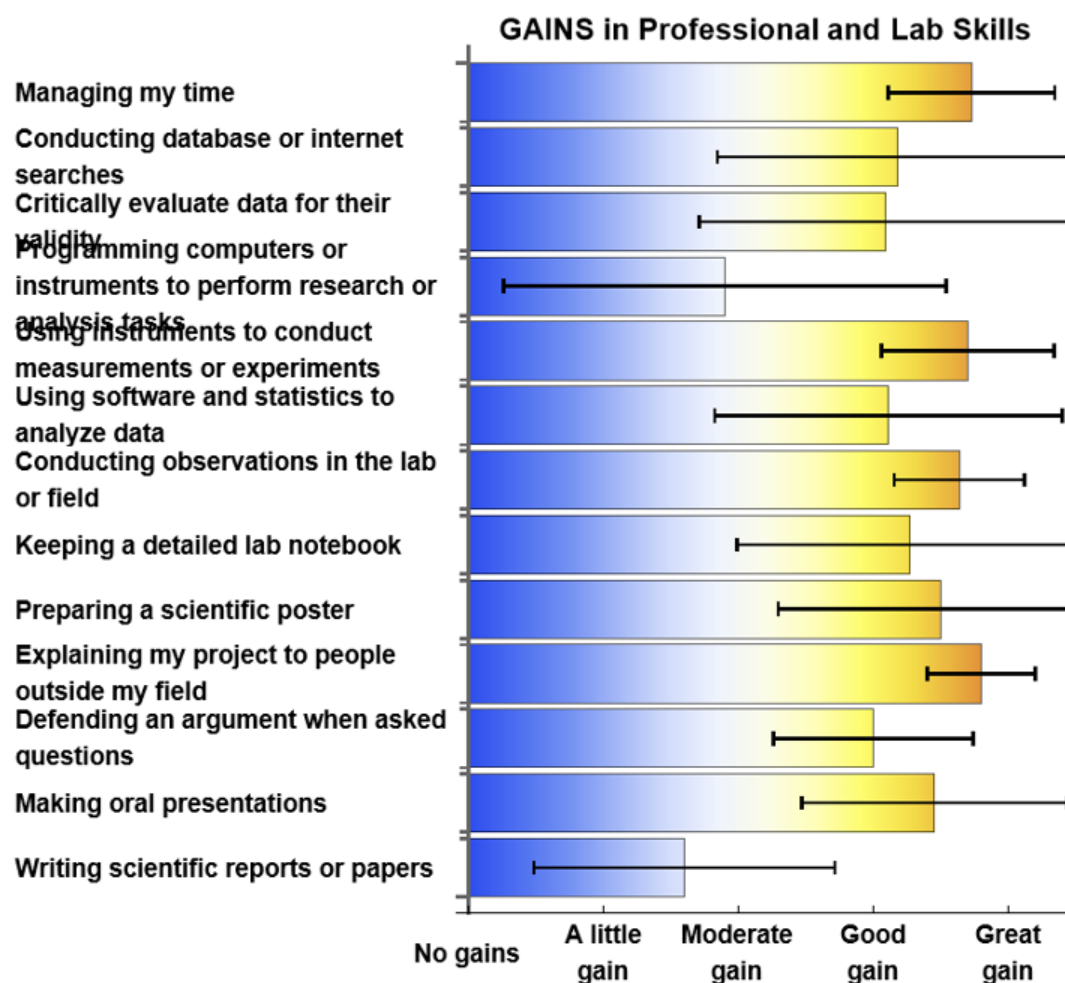


Figure 3: Gains in Academic Skills

skills across the board. That said, students report only making modest gains for some of the research skills, such as programming computers and writing scientific papers, which might reflect that working in labs over the summer does not impart the same amount of writing or programming skills that one would get in coursework.

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

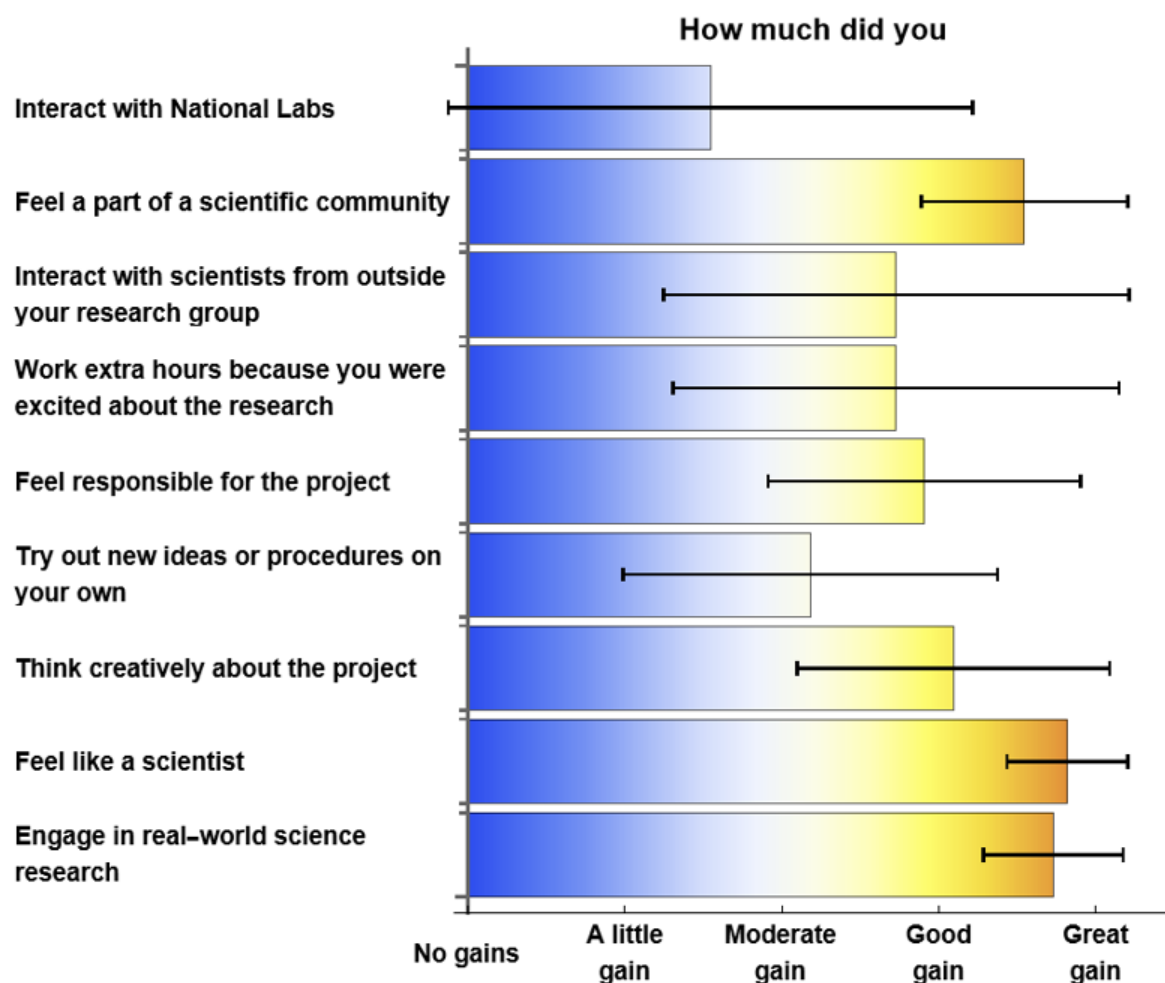


Figure 4: Attitude and Behavioral Changes

interacting only a little with national labs.

Overall, figure 5 shows that students rated the quality of their research experience as good if not 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 very positive comments about their experiences in the lab. One student however wished to have the opportunity to have more independent work in their lab.

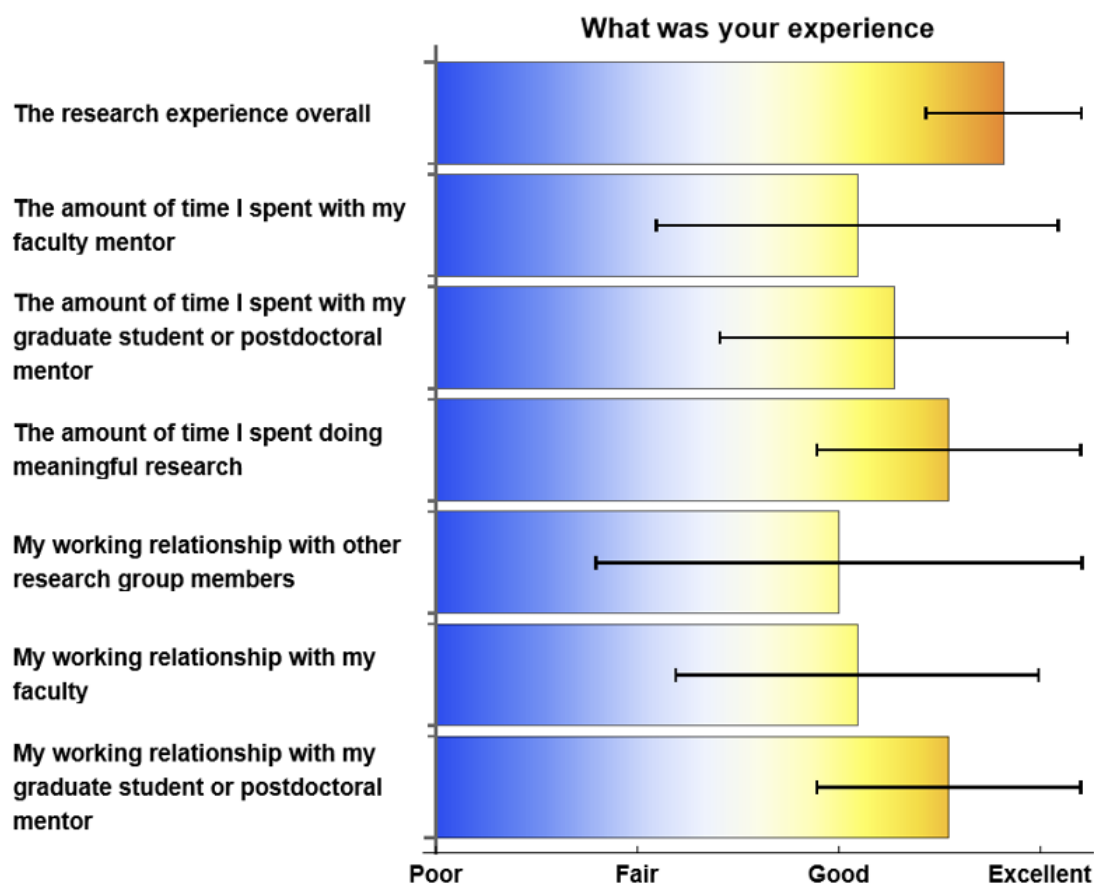


Figure 5: Quality of Research Experience

- This has been my first experience in professional research which has allowed me to confirm that this is the path I wish to follow.
- I enjoyed being immersed in the science world over the summer.
- I spent a meaningful amount of time with my postdoc mentor. I appreciate the research that I have done over these past couple of months and love the real-world application that I was able to take part of.
- My post doc mentor was a very nice person. She was able to constantly guide me and help teach me the fundamental concepts of our research we conducted over the 9 weeks. I did not talk to most of the other research members regularly but I did talk quite often to two of the 10 lab members.
- My Relationship with my graduate student mentor was phenomenal on a academic professional level on even on a personal level.

- I was able to learn so much from my graduate student mentor and P.I. They were so welcoming to their lab and even took me out to lunch just to bond with them. After training me on what to do in their specific lab, they trusted me to complete my work on my own without their help which I do not believe to be common. Even when I worked on my own, I was still able to ask questions for clarification and they would never shut them down. My mentor also told me about how the chemistry works in depth so I'd be able to better understand it – that definitely takes time and patience.
- Truly enjoyed working in Dr. Chengs lab everyone was so great and welcoming. As well making it easy to get a good picture of what grad student life from preparing for qual's to weekly meetings, as well as in general managing your own project and others. Would love to work for this lab in the future as it was so amazing.
- My mentors and PI were very supportive throughout the whole program. They were always open to helping me and never made me feel like a burden or feel bad for asking questions.
- I was with my graduate student mentor (Allison Sander) at all times as she guided me through each aspect of the research and project. I worked very closely with her and we had a great working relationship as she was very encouraging, was happy when I asked questions, and never showed judgment with any questions. I might've liked to have a little more independent research experience and think more independently about the research I was doing, because at times I felt like I was just told what my project would be and what questions to have. I only ever saw my PI at lab meetings, however, that time was mainly for graduate students to interact with her, so we did not talk. Instead she communicated about my project through Allison as Allison ran everything by her. I did not get the opportunity to work with or shadow any other research group members. I had never had a research experience before so there is nothing I can compare this experience to, but I thought the program and experience was excellent.

Figure 6 continues to lend support to the proposition that the program enhanced students' interest in science and engineering as a career, as students typically indicated 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. To some extent 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 STEM PhD or masters' program and working in a science lab or national lab. The students expressed less interest in pursuing a career in industry. This figure overall indicates both the effectiveness of the program in enhancing students' interest in academic science and also that the program did not typically select students already on the science track, since

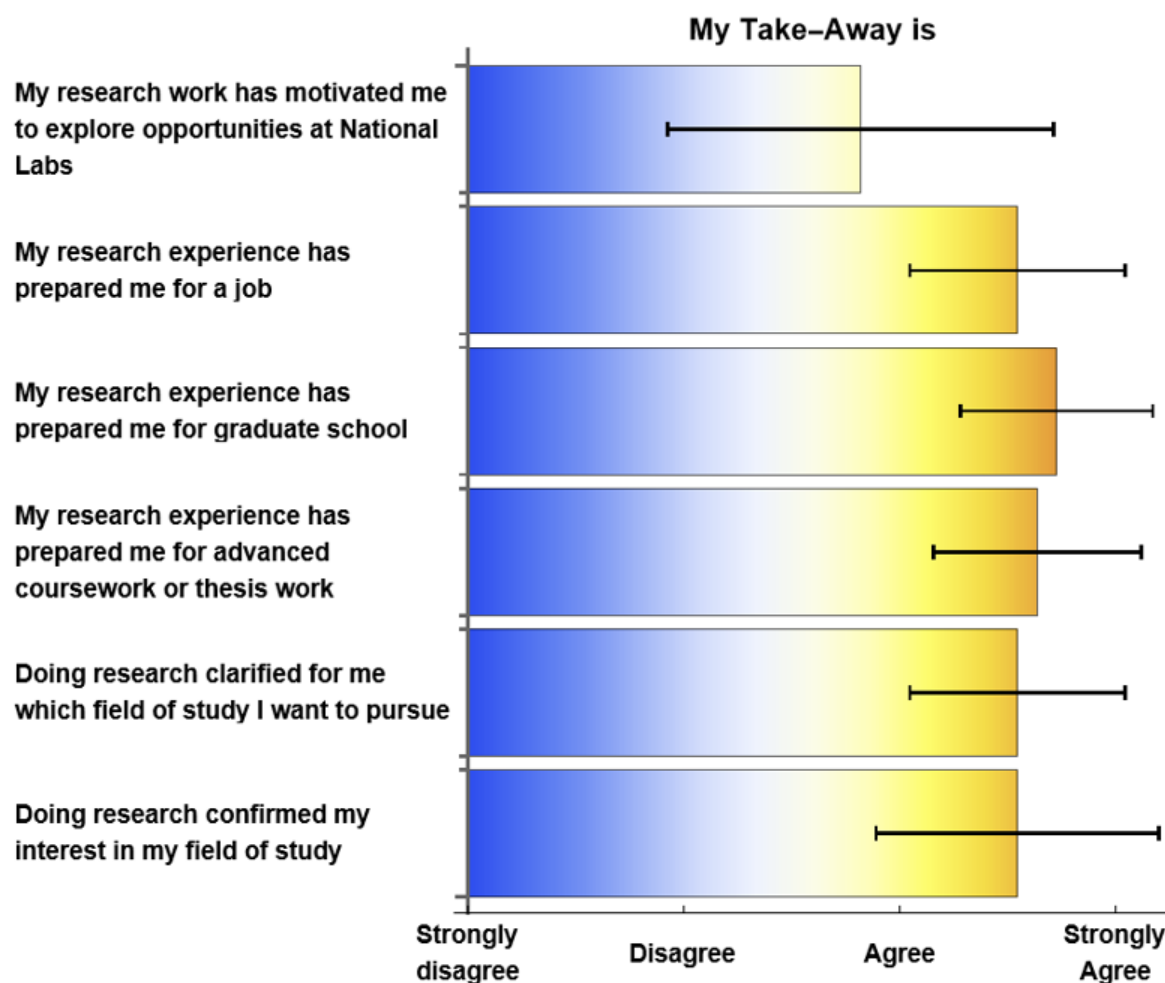


Figure 6: Effects of Research Experience on Personal Advancement

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,

- Bachelors degree, very likely to pursue PhD program before, extremely likely after.
- I intend to pursue a Chemistry/Material Science degree. I already intended to pursue a Ph.D before this program.
- My degree is chemical engineering and I probably will not pursue an advanced degree, which is not the programs fault.

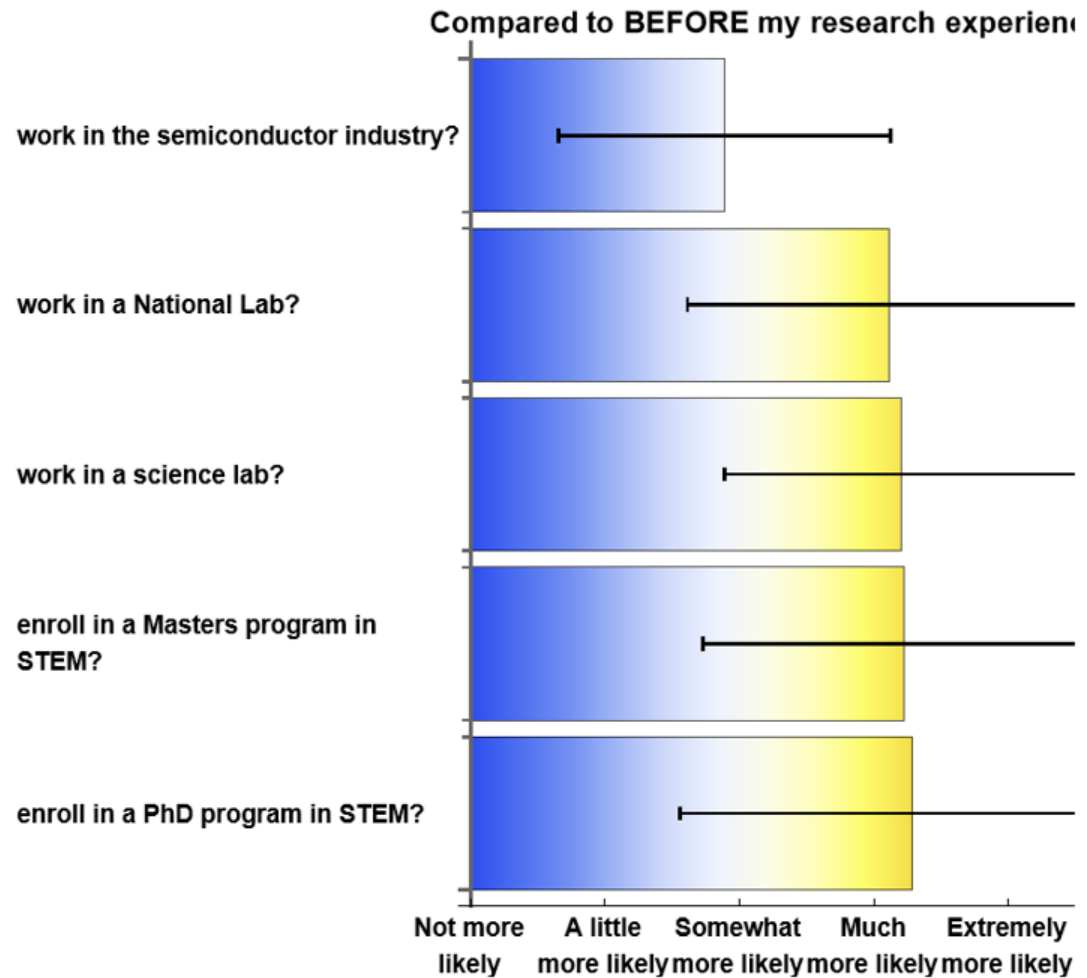


Figure 7: Effect of Experience on Entering the Pipeline

- I intend to get a B.S. in Biology with an emphasis in Medical Technology and a minor in Chemistry. I knew that I wanted to move forward into graduate school to get a doctorate in Biomedical Engineering, but I wasn't too sure about how it would be like as I had no experience in engineering. Throughout the summer, I was working in an Environmental Engineering lab that worked on water treatment. It was different from what I have ever experienced in a research lab. After being in this lab, it is extremely likely that I want to go into an engineering-based field in a graduate program.
- My major is chemical engineering, and I am excited for graduate school to hopefully obtain a masters degree in Materials Science. Before doing this research opportunity, I knew that my bachelors would not be enough to land a career due to the current job market. I wanted to get my masters before this program and after completion

of this research, I know for certain that I will be aiming to obtaining my masters degree.

- My intended degree before was only my undergraduate degree in mechanical engineering only. However, after this internship I have become extremely motivated at pursuing graduate school and working on a longer research-based project.
- I am majoring in chemical engineering. Before this program, I was not planning on going into graduate school because I thought of it as a waste of time since it takes up most of your 20's. However, after this program I definitely do plan on attending graduate school. I admire how much discipline and passion it takes to be a graduate student and I want to be that person.
- My intended degree before was to go into a pharmD program, compared to now I am more likely to enroll in a dual degree program with a PhD or solely a chemistry PhD
- I am a Chemical Engineering major and before this program I had no idea what grad school was like. However, I always enjoyed the idea of having an advanced degree despite not knowing what that actually entailed and what it took to get there. Now, after this program I am sure that I want to pursue a Masters degree after my Bachelor's. I was able to learn what it takes and what day-to-day life and responsibilities were like. This helped me have a better understanding and make an informed decision about my future.
- I am starting at UCSD in the fall as a transfer student under Bioengineering: Biotechnology. I have had the intentions to go to graduate school after my undergraduate program is completed, and this program gave me the chance to see what that would be like. I feel like this program did not change my perspective from before, as I still want to get my PhD now that I have completed the program.
- Degree: Chemical Biology, before this program I was in between pursuing higher academia or a career in medicine. I had previous research experience which I enjoyed, but was unsure if I could pursue it further (at a graduate level.) This program was very different from my last research program. I do see myself possibly enrolling in a graduate program.

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,

- It made me more confident that I can apply to grad school!
- This internship has made me more likely to pursue academia over private labwork.
- It made me realize that I do not want to work in a lab full time or get my PhD.

- I was previously conflicted about going into engineering, but I did have an interest in biomedical engineering. During the MacREU program, I was placed into a lab that was based on environmental engineering. This lab has showed me a new way to think about engineering, and that it isn't always about mechanics or building machines; it's about being able to create a system that will be beneficial to groups of people. I am now confident that biomedical engineering is the route that I want to go to in both future career plans and graduate school plans.
- After seeing some of the graduate students in my research lab, I realized that solely doing research would not suit my career goals. I have always wanted to work in industry, but now after completing this research, I want to obtain a masters degree in a specialized field.
- My research experience definitely got me very prepared and excited for graduate school before I begin my career in industry. it should me how fulfilling academic research truly can be. This research experience has taught me a lot about my future career due to the amount of advice I was able to get about it. I realized, if i want to go farther in my future career, going to graduate school is definitely a need.
- My research experience greatly influenced my future career where I know want to focus more on the research and development aspect of pharmacy as well I am more reassured to complete a dual program or a phd program
- Doing research in my lab this summer gave me a close look at what it is like to pursue a PhD. I also learned how much passion, perseverance, and especially time goes into pursuing such a degree. My main goal since the start of my educational journey has been to contribute to innovation and do hands-on work that contributes to bettering everyday life. Because I want to work in industry, this summer I learned that pursuing only a Master's degree would best align with my career goals. This decision was most influenced after the seminar with Dmytro. I gained a lot of valuable insight from someone who worked both in industry and academia after pursuing a lengthy PhD.
- My research experience taught me how to read and find literature which encouraged me to explore different research topics outside of what my project was on. This helped me find a specific area that I was very drawn to. Because of that, I feel like this research experience gave me the chance to see the wide range of research that I could be a part of within the field of Bioengineering, which motivates me to go to graduate school and excite me when thinking I have the chance to create new knowledge in a field I am passionate about.
- Since I was essentially acting as a graduate student this summer, I got to see how pursuing that kind of education would look like.

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,

- My perceptions have opened up due to differing cultures. I count this as a heavily positive experience.
- Being able to work by myself and not always relying on someone to help right away.
- I gained the opportunity to network with great likeminded and different-minded people. My cohort, the faculty, and the campus has been wonderful to me and being able to get to know these people has been a highlight in my journey in the MacREU program.
- I gained a very strong connection to my dormmates over the last 9 weeks. Even though some days doing research were so repetitive and boring, I was happy to know that I was paired up with such great roommates.
- My gain from doing research that was not mentioned yet is the confidence and the professional development that we received outside of the lab. It taught me how to conduct myself how to manage myself in professional atmospheres and how to give myself the best chance of succeeding in the real world outside of the classroom and outside of lab.
- Everything I have gained was listed. However, I also gained such strong connections with my cohort. Everyone is so passionate and friendly- this experience wouldn't have been as amazing as it was without them.
- Other gains that were not talked about was the strong network I was able to build to build with peers who also plan to go into research but also the possibility to have a paper published as well.
- I especially gained confidence in being in a new, usually intimidating setting. Being surrounded by such intelligent people and by technology and machines I have never seen is usually very intimidating. However, this program helped me get rid of that imposter syndrome that I usually face. A lot of guest speakers, specifically Ken, shifted my mindset when it comes to being in a new place. I belong in every room I enter, and someone believed in me enough!
- Learning how to handle uncomfortable conversations and communicate properly with other scientists who each are from diverse backgrounds. I gained a sense of confidence as a scientist.

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 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.



Figure 8: Satisfaction with the Program

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

- Encourage coffee social more
- The only complaint I have is that the morning meetings are too early in the morning.
- I think that being able to get the money at a consistent rate would have made the experience better. It was hard being away from home and having to worry about paying my rent while doing research and not have the security of finances being there on time. Other than that, the research experience was really great.
- I think that I will remember this program and the people I have met in this experience for the rest of my life. I really wish we were able to have this program extend for another week, just because I finally felt comfortable with my research just to be leaving.
- What would have made my research even better is if at some point I was able to see other labs other people in my cohort were in and if they could see my lab. Not only would it have been interesting to me and my cohort however, showing around my

graduate student mentor during the poster presentation was so incredible because it allowed for a stronger collaboration between the different brilliant minds within UCR to further advance the research happening on campus. That was one thing to the benefit of research that was not explored as thoroughly but as for my undergraduate experience it was phenomenal.

- Nothing, this experience has been perfect as I was matched with a lab that perfectly aligns with my future goals. It really gave me a sneak peak on the industry I plan to work in and it couldn't be better than that.
- Nothing, it was perfect the way it was!
- Maybe having the chance to shadow other graduate students work. My graduate student mentor is getting her PhD in Material Science and Engineering, so maybe being exposed to other work of graduate students who were studying Bioengineering (my major). Having a closer connection to my PI and having the chance to talk to her more would have been nice. Having more of a chance to work independently once I felt comfortable with the work would have also been nice, or come up with my own research questions/thoughts.
- I feel that a lot of time spent in lab was not productive. My mentor would not really engage with me or let me do much, at least in the first couple weeks of the program. I believe there should be some communication between PIs and the MacREU team to maintain a conversation about the REU student and the work they are doing. I spoke to other students in the cohort who felt the same way about feeling as if they were not contributing to their labs. Also, I think having more guest speakers that are women will be encouraging,

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 2026.