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Mentoring Practices Lessons Learned: A Seven-Year Case Study of the NHERI Research Experiences for Undergraduate Program

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Abstract

The U.S. National Science Foundation (NSF) Natural Hazards Engineering Research Infrastructure (NHERI) hosts approximately thirty (30) students every summer at eleven (11) distributed sites across the country for a unique Research Experiences for Undergraduates (REU) Program. These sites, located at universities, focus interdisciplinary research on experimentation, computation and simulation, reconnaissance, and social science aimed at mitigating the effects of natural hazards. The NSF NHERI REU summer program aims to broaden participation of underrepresented groups including women and racially minoritized students. Faculty mentoring is a key component in the structure of the NHERI REU program that aims to increase interest and preparation in engineering research and graduate studies. Experienced faculty working on research projects at the NHERI sites are assigned to students as mentors at each site. A network of mentors, at each site and across the sites, including faculty mentors, graduate student mentors, peer mentors, and staff mentors make up the support structure for the NHERI REU researchers.

Over the course of seven years, the NHERI REU program underwent formative changes, including modifications to the mentor training. A comprehensive analysis of qualitative and quantitative data reveals valuable lessons learned about mentoring best practices across interdisciplinary fields and various modalities, including remote, hybrid, and in person research settings. Through a case study analysis, data from REU students' pre- and post-assessments demonstrate the program's effectiveness in broadening their interactions with knowledgeable faculty mentors, significantly enhancing students' overall research experiences. Additionally, through qualitative survey responses, students articulated their conceptions of quality and exemplary faculty mentorship. Their feedback highlighted how mentors can create advantageous and detrimental situations, particularly significant for impacting the future interest of those engaging in research for the first time. The case study presents data spanning seven years, illustrating how the program has influenced students' perceptions of engineering research and graduate school through their research assignments and challenges. Results showcase how mentors can work together to provide the necessary support for the students' success in research and to increase their interest in the field, graduate school, and research.

This case study offers a comprehensive view of the students' experiences with NHERI REU mentors, emphasizing the critical role of effective and inclusive mentorship in shaping students' growth in engineering.

Introduction

Faculty mentors are key to encouraging participation in engineering and supporting students from diverse backgrounds. A problem in mentor programs is that little is known about the nuances of supporting first-time, undergraduate researchers from diverse and underrepresented backgrounds. The NSF NHERI REU summer program includes a mentoring program that has

evolved over seven years, informed by mentor and mentee formative evaluations. This paper shares the lessons learned from a seven-year case study that includes qualitative and quantitative data, and was informed by educational experts' experience, and through formative evaluation of the mentoring program.

Methods

This case study (Yin, 2013) was bound by time; students participate in the NHERI REU summer program for ten (10) weeks during the summer months of May, June, July, and August. All students attended research meetings, career development workshops, and the REU research symposium at the end of the year where they presented their research through public presentations and poster sessions. The students also participated in the formal mentoring program with an experienced researcher as their faculty mentor and a network of mentors across the NHERI sites.

Qualitative and quantitative data were collected from NSF NHERI REU student participants through pre-program and post-program assessments. These assessments were developed from the goals of the NHERI REU program which include to (1) provide meaningful research experiences to undergraduate students, (2) provide mentorship from an experienced faculty researcher, and (3) foster a community of researchers in natural hazards engineering research. This paper delves deeply into the mentoring experiences of students, highlighting the structure of the mentoring program and the outcomes from the students' perspectives.

NHERI REU Network

The structure of the NHERI network and the REU program are critical to understanding how multifaceted mentoring occurs. The NHERI network is a distributed network of institutions and facilities that conduct natural hazards engineering research across many hazards and disciplines including earthquake, wind, storm surge, social science, data management, and cyberinfrastructure. Research includes physical, simulation, and hybrid testing, surveys, field interviews, and reconnaissance.

The main governance of the NHERI network is the Network Coordination Office (NCO) which includes the Education and Community Outreach (ECO) division. The ECO's principal investigator (PI), co-PI, and education specialist oversee the NHERI REU Summer Program across all eleven (11) facilities through the Education and Community Outreach (ECO) Committee. The education specialist chairs this unique committee comprised of representatives from each of the NHERI facilities. The ECO Committee, which meets monthly, organizes and ensures program continuity across the network, reviews program data, and provides strategic planning for subsequent programs. This same committee is responsible for the in person and virtual mentoring that occurs during the ten-week REU summer program.

NHERI REU Mentoring Program

NHERI REU includes a mentoring program designed by engineering education specialists that has evolved to support faculty mentors with differing backgrounds and experiences in several ways. The goal of the mentoring program is to prepare and support engineering faculty to provide effective and meaningful mentorship to NHERI REU undergraduate researchers, who many times are first-time researchers.

As a hybrid program, the NHERI REU includes an in-person faculty research mentor, often an ECO Committee member, and a virtual mentor, the ECO Education Specialist. While research is conducted at one of eleven (11) NHERI experimental or research facilities, all REU students meet each week for virtual research meetings to prepare a research poster, presentation, and peer-reviewed paper on the research they conducted. Students also meet at least once a week for an individual check-in meeting with the Education Specialist to ensure understanding, receive feedback on writing assignments, ask questions, and strategize solutions to any challenges they may be facing. Finally, career development workshops are held twice a month and serve as a supplement to the mentoring activities. These workshops focus on applying to graduate school (i.e., application process, resume, curriculum vitae, and personal statement creation), professional networking, diversity, equity, and inclusion, and exploration of various career pathways through a panel of natural hazards experts in academia and industry.

Each year, the NHERI NCO ECO provided virtual training to faculty, postdocs, and graduate students who supported undergraduate researchers. The training included best practices in effective communication, goal setting, setting clear expectations, adaptation of projects for individual students, fostering independence, and scaffolding new learning. The training was developed and adapted using materials from CIMER, the Center for the Improvement of Mentored Experience in Research [2]. Mentor training occurred during monthly ECO Committee Meetings and before the launch of the NHERI REU Summer Program.

The ECO Committee representatives worked closely with the REU participants during their summer research projects. In the few cases where the REU students were mentored by another faculty, graduate student mentor, and/or postdoctoral mentor, the ECO Committee Member supported both the REU student and supplemental mentor throughout the summer to ensure program continuity and best mentoring practices were achieved. If situations arose (i.e., students were unhappy with their research assignment or were finding it difficult to connect with their research team), the facility ECO Committee member along with the Education Specialist worked to support the student and help address the challenges. Challenges in research assignments or within the research groups were communicated across the network of mentors, which helped find solutions early in the students' summer journey.

Results

Table 1 shows the NHERI REU mentees' self-identified demographics (i.e., race, gender, first generation status, and the Carnegie Classification of the institution the mentee attended) and includes all students who participated in the program for the past seven years.

Table 1. NSF NHERI REU demographic breakdown [1]2017-2023

Cohorts		2017 (n=17)	2018 (n=29)	2019 (n=31)	2021 (n=28)	2022 (n=31)	2023 (n=29)	2024 (n=30)	Total ([2]*N*=195)
Race	American Indian/ Alaskan Native	-	3%	-	-	-	-	-	%
	Asian	29%	10%	13%	7%	-	27%	19%	%
	Black	18%	13%	7%	11%	18%	14%	6%	%
	Hispanic	12%	3%	29%	29%	18%	24%	26%	%
	Multiracial (at least one URG)	6%	16%	6%	21%	16%	14%	16%	%
	Native Hawaiian or Pacific Islander	-	3%	-	-	-	-	3%	%
	White	24%	52%	45%	32%	47%	21%	26%	%
	Not reported	11%	-	-	-	-	-	6%	%
Gender	Female	47%	52%	39%	50%	59%	69%	61%	%
	Male	53%	48%	61%	50%	41%	28%	39%	%
	Transgender non-conforming	-	-	-	-	-	3%	-	%
First-Generation Status	First-Generation	41%	19%	19%	29%	19%	39%	35%	%
	Not First-Generation	47%	81%	78%	71%	81%	61%	65%	%
	Not reported	12%	-	3%	-	-	-	-	%
Carnegie Classification	R1 University	65%	57%	71%	57%	65%	48%	52%	%
	Non-R1 Universities	35%	43%	29%	43%	35%	52%	48%	%

[1] NHERI did not host an REU program in 2020 due to the COVID-19 pandemic.

[2] Reflects one student who participated twice and one student who left the program without completing it.

Mentors

Faculty mentors were selected every year by each site and were dependent on the projects assigned to NHERI REU students. Faculty mentors' mentoring experiences ranged from unexperienced to highly experienced mentors. Faculty mentors were early career faculty, pre-tenured faculty, associate professors, full professors, research scientists, or seasoned researchers. Many of the ECO Committee members also served as faculty mentors and helped inform the mentoring best practices for the NHERI REU summer program.

One ECO Committee member who was consistently rated as an effective mentor by his REU students shared how he helped students foster community among the students. He assigned smaller weekly projects that they could do together to build their technical skills. His students commented that their mentor was always available to help them, was transparent about his career experiences, and portrayed his role as a faculty member in a realistic and balanced way, presenting the challenges and the benefits and opportunities of working in academia. Students shared that they felt accomplished when they overcame obstacles in their research work, and this was often supported by their research mentor. This helped the REU students have a healthy view of the work involved in engineering research and at the NHERI facility.

NHERI REU Students' Experiences with Faculty Mentors

Quantitative data. Three quantitative five point Likert scale questions (i.e., 0 - "None at all" to 4 - "A great deal") were asked in the pre- and post-assessment required for all NHERI REU students to complete, which aimed to gauge the difference in mentoring experience before and after participating in the ten-week summer program (See Table 2):

1) Q20 - How much experience do you have collaborating on a research project with an experienced faculty mentor?;

2) Q21 - How much experience do you have working through challenging situations with a faculty mentor?; and

3) Q22 - How much experience do you have engaging in quality mentorship?

The post-assessment also contained three additional five-point and one three-point Likert scale quantitative questions meant to further uncover participant's mentoring experience during the program (See Table 3):

1) Q26 - As a result of your participation in the NHERI REU Summer Program, how much more experience do you have working with an experienced mentor to conduct research?;

2) Q41 - My mentor supported my successful completion of all deliverables throughout the ten-week NHERI REU Program;

3) Q48 - How much time did you engage with your faculty mentor?; and

4) Q49 - What was the quality of your faculty mentor meetings?

A paired samples *t*-test was run to determine whether a statistically significant difference existed between participants' mentoring experience before and after the NHERI REU program (i.e., Q20, Q21, and Q23). While Q20 had two outliers that were more than 1.5 box-lengths from the edge of the box in a boxplot, Q21 and Q22 did not have any outliers. The authors choose to retain all responses, and no adjustments were made since the presented results were more conservative than removing the two outliers as explained below. Based on a visual inspection of the Normal Q-Q Plots of Q20, Q21, and Q22, the data are approximately normally distributed.

Participants' responses showed that they gained a statistically significant amount of experience (Q20) collaborating on a research project with a faculty mentor by completing the ten-week NHERI REU, 1.54, 95% CI [1.336, 1.743].$t(188) = 14.909$, $p > 0.05$ with a large effect size d=1.08. Compared to when removing the two outliers, 1.567, 95% CI [1.367, 1.767], $t(186) = 15.446$, $p < 0.0001$, $d = 1.129$. To put this in perspective, Cohen's d includes small (0.2), medium (0.5), and large (0.8) effect size ranges (Cohen, 1998). Further, participant responses showed that they gained a statistically significant amount of experience (Q21) working through challenging situations with a faculty mentor, 1.33, 95% CI [1.139, 1.528], $t(188) = 13.512$, $p < 0.0001$, $d = 0.98$. Finally, participants indicated that they gained a statistically significant amount of engagement in quality mentorship, 1.048, 95% CI [0.828, 1.267], $t(188) = 9.430$, $p < 0.0001$, $d = 0.68$.

Table 2. Quantitative Paired Sample *t*-Test NSF NHERI REU Mentor Questions 2017-2024

Collected	Question	Mean	SD	*t*	*df*	Sig.	Cohen's *d*
PRE & POST	Q20 - How much experience do you have collaborating on a research project with an experienced faculty mentor?	1.54	1.42	14.91	188	0.000	1.08
PRE & POST	Q21 - How much experience do you have working through challenging situations	1.33	1.36	13.51	188	0.000	0.98

	with a faculty mentor?						
PRE & POST	Q22 - How much experience do you have engaging in quality mentorship?	1.05	1.53	9.43	188	0.000	0.68

The remaining questions (See Table 3) were analyzed using descriptive statistics. Of 189 responses to Q26, 49% indicated they had much more experience working with an experienced faculty mentor to conduct research after participating in the NSF NHERI REU Summer Program; the remaining participants responded with the following, 32% “A lot,” 10% “A moderate amount,” 5% “A little,” and 1% “None at all”. Of the 189 respondents to Q41, 51% “Strongly agree[d]” their faculty mentor supported their successful completion of all program deliverables; 27% “Agree[d],” 12% “Somewhat agree[d],” 3% “Neither agree[d] nor disagree[d],” and 4% “Somewhat disagree[d].” In response to Q48, which was first surveyed beginning in 2018, 58% reported meeting with their faculty mentor “At least once a week”; 16% “At least once every couple of weeks,” 7% “Periodically but not often,” 5% “Less than once a month,” and 2% “I did not interact with my assigned faculty mentor.” Also introduced in 2018, 67% of participants reported in Q49 that they engaged in “high-quality interaction” with their faculty mentor which was defined as receiving guidance and support for their project content and direction during mostly one-on-one or in-person meetings. Of participants, 17% indicated they had “average interaction” with their faculty mentor, which was defines as their mentor signed papers, approved schedule, and didn't provide much guidance and direction for their project content and communicated mostly through email with few live meetings. The remaining respondents reported 3% “not applicable” or that they did not meet with their faculty mentor online or in-person.

Table 3. Quantitative Frequency NSF NHERI REU Mentor Questions 2017-2024

Collected	Question	*N*	Years surveyed	Mean	SD
POST	Q26 - As a result of your participation in the NHERI REU Summer Program, how much more experience do you have working with an experienced mentor to conduct research?	189	2017-2024	3.28	0.91

POST	Q41 - My mentor supported my successful completion of all deliverables throughout the ten-week NHERI REU Program.	189	2017-2024	3.21	1.056
POST	Q48 - How much time did you engage with your faculty mentor?	173	2018-2024	3.39	1.015
POST	Q49 - What was the quality of your faculty mentor meetings?	172	2018-2024	1.73	0.517

Qualitative data. Each REU participant also responded to one qualitative question in the post-assessment that specifically aimed to elaborate on the details of their NHERI REU mentor experience and two questions that provided students the opportunity to expound on their overall experience. These two questions often included references to their mentor experience:

1) Q50 - Describe how your mentor interactions could have been improved, if at all;

2) Q31 - How did your participation in the NHERI REU Summer Program influence, impact, or affect your future career plans?; and

3) Q46 - Please provide any other comments, suggestions, and/or feedback in the space below. We appreciate your details, and we will use these to improve the NHERI REU Experience.

Table 3 summarizes the themes found in the qualitative responses. Detailed responses can be found after this summarizing table.

Table 3. Qualitative NSF NHERI REU Mentor Questions 2017-2024

Collected	Questions	*N*	Themes (See Results section below for more details)
POST	Q50 - Describe how your mentor interactions could have been improved, if at all.	174	Improvements to mentor communication, organization, consideration, guidance, support, interaction, and interest were recommended.
POST	Q31 - How did your participation in the NHERI REU Summer Program influence, impact, or affect your future career plans?	179	

POST	Q46 - Please provide any other comments, suggestions, and/or feedback in the space below. We appreciate your details, and we will use these to improve the NHERI REU Experience.	142	

Positive Mentoring Experiences

Faculty mentors supported their REU mentee in several positive ways. The following reflect the themes highlighted by students in their post-assessment responses at the end of the Summer Program. Students reflected on the positive experiences provided through their mentors' support in the following thematic, qualitative responses.

"Effective communication". One salient theme that highly impacted REU students' experiences was communication. When done well, communication played a positive role in students' mentoring experiences. One student responded by saying that "Effective communication is key" for their positive mentoring experience. To give more details on what effective communication entails, another REU participant said that their faculty mentor "Listened, gave feedback, all the important aspects of being a mentor," while another said, "my mentor provided a lot of information to me and my peers." These elements of effective communication were important to the REU researchers.

However, some students did not meet frequently with their mentors and still felt valued by the communications provided by their faculty mentor. Another student said, "My faculty mentor and I did not meet very many times, but I did not feel ignored at all. Any emails I sent him were answered quickly and answered everything I had questions about." These are effective ways to communicate with REU students when, as a faculty mentor, you may not be available to meet in person with students. Being responsive and answering all questions from students is key to providing a positive experience for REU students.

Effective communication was also important when students had multiple mentors. The structure of the NHERI REU Program contains a network of mentors. A student can have anywhere from two (2) to four (4) mentors supporting their summer research goals. Sharing information to support students across this mentor network is also important. As another REU student highlighted, "My mentors were very good at communicating. I think it was vital for me to have both a faculty mentor and graduate mentor because they understood each other, and helped explain everything to me as well."

Demonstrated authentic care. Nel Noddings (YEAR) presents how the ethic of care is actionable. Faculty mentors displayed this care in many ways. Included are some of the ways as expressed by the NHERI REU students.

> "My mentor ... provided a lot of guidance and one-on-one support when we needed it."
>
> "He showed he truly cared about my learning experience and was patient with me when I needed time to digest new concepts and information."
>
> "But my mentor was a very considerate and attentive mentor who actually cared about my progress and supported me as best he could. He left a great chunk up to me, but he taught me to take initiative and control of my project."

Were available. Faculty mentors were also seen as effective mentors when they were available to help in many ways.

> "I had amazing mentors that were there for me anytime I needed help, whether it was in person, over zoom, or through email."
>
> "She was upfront about her availability and always willing to help me."
>
> "I had a good experience with my mentors, though they were busy, they made time for when I had questions and were very kind and personable."
>
> "My mentors were always available when I needed them! Working in the same building really helped."
>
> "He was very helpful and always available to answer questions."
>
> "I am grateful for the interactions that I had with my mentor because he was busy and he still made time for us."
>
> "My faculty mentor did her best to make sure she was there whenever i needed her. She was the best!"
>
> "My faculty mentor was always available and always answered my questions very quickly."
>
> "My mentor and interactions with him have been fantastic and he was available to meet and answer questions almost every day."
>
> "My mentor was always available and supportive of the research progress, which was something positive."

Provided balanced guidance. Faculty mentors also had a tough job of having high expectations, supporting the students, and providing constructive and encouraging feedback.

“My mentor had a balance of setting high and realistic goals throughout the short period of time - providing a push during major deadlines.”

“She was very supportive of our research and activities. She helped us guide throughout the paper writing and presentation preparations and gave us confidence in what we were doing.”

“He was very informative and always wanted to make sure I was interested in my work.”

“My mentor's guidance throughout this experience proved invaluable to the success of my project. The way he explained concepts and led us to our own conclusions was something I really appreciated.”

Fostered a sense of belonging. Being introduced to the natural hazards engineering research community was also an important objective of the summer program. Faculty mentors helped to create an environment of inclusivity at their sites.

“I thought my mentor did a wonderful job of making me feel included and important.”

“For me, mentoring was perfect. I had opportunities to interact within the facility and outside of the facility. There was more there than just being a mentee.”

Gave feedback for research products. Faculty mentors were also seen favorably for their support completing the research deliverables, providing edits to papers, and additional information.

“My mentors actually gave me readings about the project and timelines before I arrived at the site and were very approachable.”

“I think my faculty mentor did a wonderful job helping me with my paper and the layout of my presentation.”

Motivated and encouraged. Faculty mentors also were important in motivating and encouraging REU students throughout the summer program, at different points, including obstacles.

“My mentorship was exceptional. Mine was critical to my development and confidence and I imagine it could have done the reverse if applied badly.”

“She was a fantastic mentor who was motivating and positive throughout the whole experience.”

“I absolutely adored my mentor. He is a fantastic teacher and was kind and patient throughout the whole research process. Whenever I was able to sit down with him, he made the research process so much more enjoyable and manageable.”

“I had a great mentor. He was really engaged with us and made sure we understood everything.”

Mentoring Challenges

Students also gave honest assessments of their mentoring experiences that were most challenging. The following themes were included as areas for improvement for the mentoring program and were included in mentor training sessions.

Unfulfilled expectations. Students had expectations for faculty mentors for meetings and for reviewing their research deliverables. When these expectations were not met, students had a negative experience.

“We discussed having weekly meetings to go over project progress, but these meetings never happened.”

“I had biweekly meetings planned, but they rarely actually happened; my paper wasn't even looked at by my mentor until a few days prior to the symposium.”

“Maybe if my mentor had made meetings with me to teach me different things on wind engineering, I would have had a better mentoring experience.”

Unavailable in-person. By far, the largest impact on negative mentoring experiences was mentors’ availability. As can be seen through the quotes, when faculty mentors were not available, students felt like they were not a priority or like their work was not important.

“I tried several times to make in-person meetings with my mentor, and he would always have other plans.

“My interactions with my mentor could have been improved if there had been more in-person communication instead of relying on everything through Slack or email. Whenever we meet in-person, we are very productive, and the mentorship was high quality.”

“The only problem was that I felt like he didn't have enough time for me. I think 3 REU students was too many for my particular site and my mentor was so busy with all his other obligations and planned trips away from our facility that I wasn't able to meet with him as much as I would have liked.”

“I kept sending my paper to him, but he was so busy that examining my writing was not a priority. Now it is the end of the program, and I don't think he has even read my entire paper, which has been a setback.”

“I think we should have had one meeting a week that was just devoted to the direction of our project (i.e. future steps, different quantitative methods we could use to interrogate our models, etc.). We had a lot of small meetings, which were helpful; however, I feel like the end goal was lost sight of in the middle of the summer.

“Because they were traveling a fair amount it was a little harder to get in contact with them very often.”

“I think it would be cool if the mentors were more interested in our success.“

“Communications were strained, like pulling teeth, and I felt dismissed when asking for help, feedback, a new direction, or a proofread.”

“Specifically, we met only twice throughout the entirety of the summer, and she did not have the capacity to oversee or provide feedback in any way for my final research project submission.”

“Mentors should actively answer emails if they are not able to be on-site for the duration of the program.”

“He made it evident he was too busy to be concerned with us.”

“My mentor could have been involved more and asked me questions and gave me guidance without me having to always seek him out and ask.”

“I think the mentor experience could have been improved if the mentor had invested more time into his mentoring duties.”

“We could have more meetings discussing how much I progressed in my project and explaining the current level or status in the project and what tool should I focus on in each level.”

“He occasionally asked me about the progress of my paper, but unless I initiate the conversation, he is usually not very involved.”

Assumptions about previous knowledge. Students often felt that their research projects were challenging because of the content knowledge required to complete the study successfully and independently. When faculty made assumptions about the student's previous knowledge, students found it challenging to interact with their faculty mentors.

“Sometimes, my mentor would assume I knew the topics, which would make our interactions difficult to some extent.”

Non-constructive feedback. Students also noticed when faculty were demeaning or discouraging. They sought constructive and encouraging feedback through their interactions with the faculty mentor.

“The mentor could have been more constructive and encouraging with their feedback.”

Lack of inclusivity. Being included was a big positive for those who were welcomed into their NHERI sites. However, for students who were not, they felt the impact and sought to correct it for other students.

“Ensuring all REU sites are inclusive of the type of students and their backgrounds visiting their sites.”

Suggestions for Improving the Faculty Mentoring Experience

Students were asked to provide suggestions to improve the faculty mentoring experience. Here are some of the suggestions they provided.

Meeting before or early in the program. One key feedback from students was the importance of meeting with their faculty mentors early in the program.

“Ideally, to meet during the first week of the program would have been best.”

“My one suggestion would be to encourage REUs and their mentors to reach out to each other before the program begins.”

“Weekly guidance from mentors from the first week.”

Have consistent meetings. Students also wanted to have consistent meetings with their faculty mentors.

“We should have set a weekly schedule to meet.”

“Meeting with them every week.”

“I think that it would be good to require one meeting a week.”

“Maybe creating scheduled meetings for students and mentors.”

“Making sure mentor and mentee have regular contact to discuss project success.”

“Also having a weekly meeting about progress made would improve communication between the advisor and intern and improve the REU intern's understanding of the project.”

“More one-on-one meetings.”

“Have an orientation meeting with mentor and make sure mentor is available and approachable.”

“Have them do a structured meeting schedule.”

“More focus on weekly goals and making sure we had a direction to work each week and actually following a once-a-week meeting schedule.”

“Though this may be difficult, scheduling regular meeting times in advance for mentor and mentee interaction would be helpful.

Clearly communicate expectations. NHERI REU participants highlighted aspects of communication that were lacking. One of these included the ways in which faculty mentors communicated their expectations to students. A student responded in the post-assessment, “My mentor should have clearly communicated expectations,” while another student said, “I think making mentors give explicit expectations at the beginning of the summer.” Having clear expectations from the beginning of the research experience and continuing the considerations for these expectations are key to providing important information to students that can help guide them to understanding their role in the project.

In-person research and meetings. Students also wanted to have in-person meetings and research experiences. Especially during the COVID-19 pandemic, most of the research projects were done online. However, once the pandemic restrictions were lifted, the students wanted to have more in-person meetings rather than email or other virtual communications.

“In-person research would be an incredible experience for undergraduate students within a lab.”

“Easy face-to-face access to mentors. Communication through email is not sufficient.”

“Returning in person will make mentorship easier and more effective.”

“Return to the in-person platform and remain in communication with both mentors and students throughout the summer.”

“I would suggest making sure faculty mentors are in person not virtual.”

“More weekly meetings face to face.”

Discussion

Faculty mentors are important for the success of new student researchers in engineering and natural hazards engineering research. Mentoring activities and details that may seem insignificant to novice mentors impact students’ overall experiences and can make a difference in the way they engage and are motivated to continue their career trajectories. Good communication can make a difference in the ways students perceive their roles in the research project, their involvement with other researchers, their motivation to work toward a goal for the overall project, and their overall satisfaction with the program, which may translate to their motivation to pursuing research work in the future.

To provide some guidance for faculty mentors, students recommend that faculty or those assigning mentors assess the workload of potential faculty mentors prior to assigning mentees.

One of the consistent metainferences from the qualitative data is that students do not want to feel like their work is not valuable or that they are not important enough to receive guidance from their faculty mentors. Additionally, having a detailed research plan for student researchers to engage in prior to their involvement, including a research project, milestones, a timeline, a set of expectations, resources for support, and a meeting schedule, will help students feel supported throughout the summer program.

Faculty mentors should reflect on how they want to engage with student researchers and should be honest about their professional development needs prior to taking on a mentoring role or taking on a mentee who is a first-time researcher or underrepresented in engineering. Being unavailable, unreachable, or unresponsive can be just as damaging as being a demeaning mentor to first-time researchers. Students, although resilient, may be discouraged from continuing this work, working in the specialty area, or exit the field, depending on their experience.

“I thought that the online sessions were helpful for mentoring as well as the on-site mentorship.”

“Maybe assign a graduate student with at least a master for every student as an extra source of help when needed.”

“Been more responsive to emails, had more meetings to give direction during research project.”

“Having a mentor who is travelling or consumed by several other projects can be challenging; in this case, a helpful graduate student mentor is a good resource.”

“If there were a sort of office hour per day that we could come and simply talk about things that weren't directly related to work that would be nice.”

“Have the mentors prepare materials for the students to read beforehand/expose themselves to beforehand.”

“Have a project ready when students come in.”

“Encourage REU students to reach out and express their own needs to their mentor.”

“Maybe REU students for the next year could have a conference call for REU students from the previous year.”

“I would have liked to work more closely with my faculty mentor, where he/she teaches us certain concepts every few days. This would have allowed me to feel more engaged with my faculty mentor.”

“Mentors could have set better plans in place for when they went out of town.”

“Just make sure to show students how to advocate for themselves if they need more support from the mentors.”

“If there is anything to improve, it would have been helpful to receive knowledge checks every now and then to challenge my understanding of the topics covered during research.”

“I would have mentors create a plan for their mentees that would detail the timeline of the project for the duration of the REU. This is so that mentors can have a general idea of how they will guide their mentees through the REU experience.”

“Consider having a pre-orientation meeting at each site to set expectations and answer questions before the REU begins.”

“Ensure that mentors are willing to dedicate a considerable amount of time to helping the students.”

“Have the mentors make sure the REU students understand the background knowledge, and take the time to teach them it, as well as how to do the tasks, etc.”

“Make sure that whenever possible both graduate and faculty mentors are either based at the site or plan to be there for large parts of the summer. Although remote interaction via zoom works it is not the ideal setup.”