

**REU Site: Undergraduate Research in Smart Environments: Year 5 Evaluation Report**  
**Washington State University, Voiland College of Engineering and Architecture**  
**Prepared by Dr. Ashley Ater Kranov, External Evaluator**  
**October 23, 2019**

Since the outset of the program, we have used pre and post program surveys to assess the impact the program has had on students’ (1) research skills and (2) attitude toward graduate school. The survey was also used to assess students’ (3) satisfaction with their mentoring experience and (4) overall satisfaction with the REU experience. From 2016-2017 the UNCC CISE REU a la Carte was used; however, because the CISE REU survey was extremely long and included many questions not aligned with our goals, we cut the number of questions in 2018. In 2019, we designed our own survey to ensure full student participation and collection of the data most useful to the WSU REU program. We administered our own pre and post program mentoring survey which measures our mentors’ ability to (5) provide an authentic research experience to the students, (6) improve students’ research skills, and (7) advise undergraduate students. Finally, using follow-up communications with the REU students and faculty mentors, we will assess the students’ eventual (8) publication of research, and (9) enrollment in graduate school.

In 2019, 10 students participated in the WSU REU program. Ten students completed the pre-REU survey and 8 took the post- REU survey, and not all responded to each question. The project team intends to follow up with students in 2020 to see if the 2019 cohort: (a) finished their BS degrees, (b) had any publications/ presentations related to their REU experiences, and (c) pursued graduate degrees.

**SUMMARY OF STUDENT RESULTS 2015-2019**

TABLE 1. Summary of student results 2015-2019.

<b>Indicator</b>		<b>Results 2015-2019</b>
1.	Retention in undergraduate science & engineering programs	<ul style="list-style-type: none"> <li>• 2019: Data will be collected in 2020</li> <li>• 2018: (N=7 respondents out of 10): by 2019, 3 completed their BS programs; 4 still in their BS programs. 2017: (N=6 respondents out of 10): by 2018, 5 were still in their BS programs.</li> <li>• 2016: (N = 10 respondents out of 11): by 2017, 9 completed their BS degrees; 1 participated in student mentoring.</li> <li>• 2015 (N= 6 respondents out of 10): by 2016, 5 completed their BS degrees, with 1 ongoing.</li> </ul>
2.	Publications and presentations involving REU participants	<ul style="list-style-type: none"> <li>• 2019: no papers during the REU; follow up will take place in 2020</li> <li>• 2018: 1 journal paper published over the 2018-2019 academic year.</li> </ul>

		<ul style="list-style-type: none"> <li>• 2017: 1 conference proceedings paper during the REU. 4 conference papers were published over the 2017-2018 academic year.</li> <li>• 2016: (N = 10 respondents out of 11): by 2017, 3 conference proceedings papers, 1 poster, and 1 senior design project</li> <li>• 2015 (N= 6 respondents out of 10): by 2016, 1 conference proceedings paper</li> </ul>
3.	Percentage of students that go on to graduate school	<ul style="list-style-type: none"> <li>• 2019 This data will be collected in 2020.</li> <li>• 2018 (Pre-REU: N = 9; Post-REU: N=3): <u>Pre-REU</u>: 1 student indicated Strongly Agree; 3 Somewhat Agree; 4 Neutral; 1 Somewhat Disagree; <u>Post-REU</u>: 1 student indicated Strongly Agree; 2 Strongly Disagree 1 Disagree. Post –REU: 1 Somewhat Agree; 2 Strongly Disagree.</li> <li>• 2017 (N= 6 out of 10 respondents): one student entered graduate school fall 2018; all other respondents intended to pursue a graduate degree. (Pre-REU: N= 9; Post-REU=7): Pre-REU: 4 Strongly Agree they plan to go to graduate school; 3 Somewhat Agree; 2 Neutral. Post-REU: 4 students indicated Strongly Agree they plan to apply to graduate school; 1 Somewhat Agree; 1 Neutral; 1 Somewhat Disagree.</li> <li>• 2016 (N= 9 respondents out of 11): 5 students entered graduate school; 2 plan to enter graduate school; 2 took jobs in industry.</li> <li>• 2015 (N= 6 respondents out of 10): 3 entered graduate school, 2 planned to enter graduate school; 1 didn't plan to go to graduate school.</li> </ul>
4.	Contentment of students	<ul style="list-style-type: none"> <li>• 2019: (N=8): the 2019 cohort was the most content/most satisfied with the experience, what they learned, and their mentors of all cohorts since 2015.</li> <li>• 2018: (N = 3 respondents out of 11) Of the three respondents, 1 was highly content/satisfied, 1 satisfied and 1 highly dissatisfied.</li> <li>• 2017: The 2017 cohort was much less content/less satisfied with the mentor-mentee relationship and the overall research experience than previous cohorts.</li> <li>• 2015 &amp; 2016: The majority of 2015 &amp; 2016 students were generally content/satisfied with all aspects of the REU program.</li> </ul>
5.	Percentage of REU participants from under-represented groups	<ul style="list-style-type: none"> <li>• 2019 cohort included: 20% (N=2) women and 80% (N=8) men; 7 Caucasian, 2 Asian, 1 African American.</li> <li>• 2018 cohort included: 44% (N=4) women and 56% (N=7) men; 7 Caucasian, 4 Asian.</li> <li>• 2017 cohort included: 40% (N=4) women and 60% (N=6) men; 1 Hispanic/Latino, 2 Other, 2 Asian, 5 Caucasian.</li> </ul>

		<ul style="list-style-type: none"> <li>• 2016 cohort included: 44% (N=4) women and 56% (N=7) men; 1 Hispanic/Latino, 1 African American, 2 Other, 7 Caucasian.</li> <li>• 2015 cohort included: 40% (N=4) women and 60% (N=6) men; 2 Hispanic/Latino, 2 African American, 1 Other, 5 Caucasian.</li> </ul>
6.	Improved student understanding of the research process	<ul style="list-style-type: none"> <li>• From 2015-2019, the majority of students indicated that after completion of the REU program, they had a better understanding of the research process and its application.</li> </ul>

## 2019 DETAILED STUDENT RESPONSES

Student perception of attending graduate school.

TABLE 2. 2018 participants (Pre-REU: N=10; Post-REU: N=8). *Please rate your level of agreement to the following statements, where 5 is Strongly Agree and 1 is Strongly Disagree.*

1.	I plan to apply to graduate school.	<u>Pre-REU:</u> 5 Strongly Agree; 3 Somewhat Agree; 2 Neutral <u>Post-REU:</u> 5 Strongly Agree; 1 Somewhat Agree; 1 Neutral; 1 Somewhat Disagree
2.	Which discipline do you plan to pursue?	<u>Pre-REU:</u> 2 Science; 2 Engineering; 6 Computing <u>Post-REU:</u> 1 Engineering; 7 Computing

Improved Understanding of the Research Process

TABLE 3. 2019 participants (Pre-REU: N=10; Post-REU: N=8) *Please rate your degree of confidence with the following statements, where 5 is Very Confident and 1 is Very Unconfident.*

		<b>I can:</b>
1.	Locate primary research literature	<u>Pre-REU:</u> 4 students indicated Very Confident; 4 Somewhat Confident; 1 Somewhat Unconfident <u>Post-REU:</u> 7 students indicated Very Confident; 1 Neutral
3.	Formulate a research hypothesis	<u>Pre-REU:</u> 2 students indicated Very Confident; 4 Somewhat Confident; 3 Neutral; 1 Somewhat Unconfident <u>Post-REU:</u> 5 students indicated Very Confident; 2 Somewhat Confident; 1 Neutral

4.	Design an experimental test of a solution to a problem	<p><u>Pre-REU</u>: 1 student indicated Very Confident; 5 Somewhat Confident; 1 Neutral; 3 Somewhat Unconfident</p> <p><u>Post-REU</u>: 5 students indicated Very Confident; 3 Somewhat Confident</p>
5.	Collect data	<p><u>Pre-REU</u>: 1 student indicated Very Confident; 5 Somewhat Confident; 1 Neutral; 3 Somewhat Unconfident</p> <p><u>Post-REU</u>: 5 students indicated Very Confident; 3 Somewhat Confident</p>
6.	Statistically analyze data	<p><u>Pre-REU</u>: 7 students indicated Somewhat Confident; 1 Somewhat Unconfident; 1 Very Unconfident</p> <p><u>Post-REU</u>: 7 students indicated Somewhat Confident; 1 Somewhat Unconfident</p>
7.	Interpret data analyses	<p><u>Pre-REU</u>: 2 students indicated Very Confident; 6 Somewhat Confident; 1 Neutral; 1 Very Unconfident</p> <p><u>Post-REU</u>: 7 students indicated Somewhat Confident; 1 Somewhat Unconfident</p>
9.	Orally communicate the results of research projects	<p><u>Pre-REU</u>: 4 students indicated Very Confident; 4 Somewhat Confident; 1 Somewhat Confident; 1 Very Unconfident</p> <p><u>Post-REU</u>: 7 students indicated Somewhat Confident; 1 Somewhat Unconfident</p>
10.	Write a research paper for publication	<p><u>Pre-REU</u>: 2 students indicated Very Confident; 6 Neutral; 2 Very Unconfident</p> <p><u>Post-REU</u>: 1 student indicated Very Confident; 6 Somewhat Confident; 1 Somewhat Unconfident</p>
11.	Work with others to investigate a research problem	<p><u>Pre-REU</u>: 5 students indicated Very Confident; 4 Somewhat Confident; 1 Very Unconfident</p> <p><u>Post-REU</u>: 3 students indicated Strongly Agree; 2 Somewhat Agree; 1 Somewhat Disagree</p>
12.	Discuss research with graduate students	<p><u>Pre-REU</u>: 3 students indicated Very Confident; 3 Somewhat Confident; 3 Neutral; 1 Somewhat Unconfident</p> <p><u>Post-REU</u>: 7 students indicated Somewhat Confident; 1 Somewhat Unconfident</p>
13.	Discuss research with professors	<p><u>Pre-REU</u>: 3 students indicated Very Confident; 4 Somewhat Confident; 3 Neutral; 1 Somewhat Unconfident</p> <p><u>Post-REU</u>: 6 students indicated Somewhat Confident; 2 Somewhat Unconfident</p>

**Mentor-mentee relationship**

TABLE 4. 2019 (N=8). Please indicate the extent to which you agree with each statement below about your mentor. Scale: Strongly Agree, Agree, Neutral, Somewhat Disagree, Strongly Disagree

<b>My mentor:</b>		
1.	was accessible	5 Strongly Agree; 2 Agree; 1 Neutral
2.	demonstrated professional integrity	7 Strongly Agree; 1 Agree
3.	demonstrated content expertise in my area of need	6 Strongly Agree; 2 Agree
4.	was approachable	7 Strongly Agree; 1 Agree
5.	was supportive and encouraging	7 Strongly Agree; 1 Neutral
6.	provided constructive and useful critiques of my work	5 Strongly Agree; 2 Agree; 1 Somewhat Disagree
7.	was helpful in providing direction and guidance on research project issues	4 Strongly Agree; 3 Agree; 1 Neutral
8.	answered my questions satisfactorily (e.g. timely, clear, comprehensive)	2 Strongly Agree; 1 Strongly Disagree
9.	acknowledged my contributions appropriately	6 Strongly Agree; 1 Agree; 1 Neutral
10.	suggested appropriate resources	5 Strongly Agree; 2 Agree; 1 Neutral
11.	challenged me to extend my abilities	5 Strongly Agree; 2 Agree; 1 Strongly Disagree

**Student contentment/satisfaction with the program**

TABLE 5. How satisfied were you with: Scale: Highly Satisfied, Somewhat Satisfied, Neutral, Somewhat Dissatisfied, Highly Dissatisfied. (N= 8)

1.	You faculty advisor	6 Highly Satisfied; 1 Somewhat Satisfied; 1 Somewhat Dissatisfied
2.	Your housing arrangements	7 Highly Satisfied; 1 Somewhat Satisfied
3.	The program in general	3 Highly Satisfied; 3 Somewhat Satisfied 2 Neutral

4.	Your research experience	4 Highly Satisfied; 1 Somewhat Satisfied; 2 Neutral; 1 Somewhat Dissatisfied
5.	Your interaction with project staff	4 Highly Satisfied; 3 Somewhat Satisfied; 1 Neutral
6.	Your interaction with other students	6 Highly Satisfied; 1 Somewhat Satisfied; 1 Neutral

## 2019 MENTOR RESULTS

The project's four mentor objectives are:

1. Provision of an authentic research experience to students.
2. Encouragement of students to obtain an advanced degree in engineering.
3. Development of students' applied research skills.
4. Becoming more skilled as a faculty mentor (so that students can achieve project goals).

The method chosen to measure the indicators was a brief survey focusing on mentor expectations and the extent to which they were met. All six participating mentors responded to all questions in the Pre and Post-REU surveys.

### PRE-REU SURVEY MENTOR RESULTS

The Pre-REU survey questions focused on capturing mentor motivation for participating in the program and expectations of themselves and their students.

TABLE 6. Summary of faculty mentor Pre-REU survey response results by indicator.  
*Rate the degree to which the following impacted your decision to participate in this summer's REU program. Scale: Not At All; A Little; A Fair Amount; A Lot.*

Indicator		Survey Statement and Responses 2019
1.	Provision of an authentic research experience to students.	<i>I think it's important to give undergraduate students authentic research opportunities.</i> A Fair Amount = 4; A Lot = 2
2.	Encouragement of students to obtain an advanced degree in engineering.	<i>I think the experience will encourage undergraduate students to pursue an advanced degree in engineering.</i> A Fair Amount = 1; A Lot = 5
3.	Development of students' applied research skills.	<i>I think the experience will help undergraduate students develop their applied research skills.</i> A Fair Amount = 1; A Lot = 5
4.	Becoming more skilled as a faculty mentor	<i>I would like to become more skilled at mentoring undergraduate students in the research process.</i> A Little = 1; A Fair Amount = 2; A Lot = 3

## **DETAILED MENTOR PRE-REU SURVEY RESPONSES**

*What do you expect from the REU student in terms of participation in your research program? (N=6)*

- Gain understanding on how to approach a research program such as MS or PhD in future. Overcome initial steps in problem solving, determination leading to a short conference paper or journal letter.
- 1) learn and 2) contribute to an activity based on their strength
- Work closely with me and graduate students to outline expected tasks and outcomes and accomplish those.
- Have a basic understanding of research pipelines and apply scientific methods to solve real-world problems.
- I hope the student will actually finish the project (or at least a substantial portion of it), which is thoughtfully discussed with the student with respect to the limited time.
- Meeting weekly with their mentor.

*What do you expect in terms of research productivity of the REU student? (N =5)*

- Conference paper / letter detailing their research over the 6-week term.
- perhaps lead to a workshop/conference publication
- To accomplish agreed deliverables with close supervision.
- well organized technical report with complete experimental analysis.
- I expect the result will be published, at least as a demo/abstract/short paper if not a full research paper.
- Weekly progress reports and a paper at the end of the program.

*How do you think you will benefit from serving as an REU mentor? (N =5)*

- 1) Grow as a mentor. 2) Learn more about the kind of training undergrads in other institutions are receiving
- Enhancing my advising skills Getting some work done in my research lab Motive researchers to pursue career in energy
- Get to understand what skills are needed from REU students and learn to work with excellent REU students.
- I will earn experience advising undergraduates.
- More research productivity. Possibly identify students to recruit.

*How do you think your REU student will benefit from your mentorship? (N =5)*

- Hopefully, they will get meaningful research experience and be exposed to interesting problems. They will also get mentorship in graduate study and industry career.
- Energy is an important field and REU may continue to contribute Learn research skills Interact with large team
- Get familiar with making use of high-value datasets and develop/apply data-driven approaches for their future career.
- they will learn the basics about CS research
- Get a taste for research. Have fun working on cool projects with their peers.

## **POST-REU SURVEY MENTOR RESULTS**

Table 7. 2019. Summary of faculty mentor Post-REU survey response results by indicator (N = 7)  
*Rate the degree to which the following describes your experience in this summer's REU program.* Scale 1: Not At All; A Little; A Fair Amount; A Lot. Scale 2: Not At All; Somewhat Well; Well; Very Well

<b>Indicator</b>		<b>Survey Statement and Responses 2019</b>
<b>1.</b>	Provision of an authentic research experience to students.	<i>I think the experience gave the undergraduate students authentic research opportunities.</i> A Fair Amount = 2; A Lot = 5
<b>2.</b>	Encouragement of students to obtain an advanced degree in engineering.	<i>I think the experience encouraged the undergraduate students to pursue an advanced degree in engineering.</i> A Fair Amount = 2; A Lot = 5
<b>3.</b>	Development of students' applied research skills.	<i>I think the experience helped the undergraduate students develop their applied research skills.</i> A Fair Amount = 1; A Lot = 6  <i>When asked: How well did the student meet your expectations in terms of participation in your research program?</i> 1 mentor indicated "Somewhat Well"; 2 "Well"; and 4 "Very Well"
<b>4.</b>	Becoming more skilled as a faculty mentor	<i>I became more skilled at mentoring undergraduate students in the research process.</i> "A Fair Amount" = 2; "A Lot" = 4  <i>When asked how much they had benefitted from the mentoring, 2 mentors indicated "A Little"; 5 "A Lot"</i>  <i>When asked: How much do you think your REU student benefitted from your mentorship? 4 mentors indicated "A Fair Amount"; 3 mentors indicated "A Lot"</i>

## **DETAILED MENTOR POST-REU RESPONSES**

*What suggestions for improvement do you have for the research team as they prepare next year's REU program?*

- I'm very happy with the support in this program. I will like this program to be continued in the coming years.
- None
- I think the team is doing an excellent job. Keep up the great work.
- Existing practice is great.



### **EVALUATOR COMMENTS**

Overall, the project leadership team has achieved its goals over the five years of this project to provide an authentic applied research experience to undergraduate students. The majority of students and faculty agree that the program provides this opportunity, as well as providing motivation for continuing education in graduate programs. Faculty overall seem to enjoy mentoring the students and think that they perform that role adequately, with some students performing above expectations.

Both students and faculty who responded to these surveys in 2019 expressed perception of greater student learning and greater satisfaction with the program overall. This uptick in satisfaction should not go unnoticed by the program lead and its team members.