2026 ASEE ANNUAL CONFERENCE June 21–24, 2026 | Charlotte Convention Center, NC
Host Sponsor UNC Charlotte
ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION
Paper ID #50150

Leveraging Automotive Culture: Lessons from an REU Site in Autonomous Vehicles

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Abstract

In 2024, Kettering University launched a Research Experiences for Undergraduates (REU) site in autonomous vehicles, with the first cohort of ten students arriving on campus in June of 2025. This site features several distinctive elements that stem from the host university's strengths and unusual academic calendar. In particular, the program is shaped by Kettering's deep automotive culture, its co-op-driven schedule, and its compressed academic terms. These characteristics strongly influence the cohort's culture, mentorship practices, and student research productivity. Beyond the local context, the site illustrates how institutions can leverage their unique strengths to broaden participation, integrate real-world industry connections, and prepare students for advanced study and professional careers. In this paper, we examine how these features shaped program design and outcomes and contributed to the overall student experience. This can be instructive to other institutions planning and/or executing an REU site, as they draw upon their own institutions' unique characteristics.

1 Introduction

Research Experiences for Undergraduates (REU) Sites have become an essential mechanism for engaging students in authentic research, broadening participation, and supporting career exploration in science and engineering. There are many REU Sites located at multiple universities, and a long history of publications on the topic. In the 2025 ASEE Annual Conference alone, there were almost 20 papers focusing on REU Sites; similar numbers of papers have been published in ASEE conferences in previous years, as well as numerous papers in other conferences and engineering education journals. This extensive body of literature clearly shows that REU Sites are both widespread and significant to institutions and students.

The past and existing REU sites focus on a wide range of different topics, and the REU Site literature is similarly wide-ranging. Some examples of REU Site focus areas are infrastructure [1], biomedical applications, [2], and automotive [3, 4, 5, 6]. Published work on REU Sites includes information on how participants select an REU Site [7], the impact of REU Sites on increasing representation in engineering [8], participants' engagement with research and identification as a researcher [9], and the impact of the REU Site on participants' educational and career goals [10]. Other papers, such as [11], review and evaluate particular sites for their effectiveness. In this paper, we discuss the unique characteristics and effectiveness of the REU

Site at Kettering University, focused on automotive engineering and in particular on autonomous vehicles. The specific features of this site can provide a guide to other universities that wish to establish REU Sites, as they consider what makes their own universities uniquely suited to organize specific types of programs.

2 Structure of REU Site

The REU Site began in June and ended in August, with a total duration of ten weeks. Participants were expected, under normal circumstances, to participate in the full ten-week program. However, in the event that an applicant was selected who was unable to do so (e.g., due to their academic calendar or personal/family issues), the situation was evaluated on a case-by-case basis. Participants were housed in shared apartments in an apartment complex adjacent to the campus. The travel arrangements and housing were coordinated by an administrative assistant, whose support of the REU Site was funded by the grant.

Ten participants were selected in the summer of 2025. Of those participants, five were men and five were women. Five of the participants were from colleges classified as Baccalaureate Colleges: Arts & Sciences Focus. Two were from community colleges, with their transfer to other universities for further study underway, and the remaining three were from a masters' granting university, a doctoral university with a high level of research (i.e., R1 status), and a doctoral university with a professional focus.

While the overall structure resembled typical summer research programs, several features of the host university's academic calendar, facilities, and mentoring environment significantly shaped the program's design and execution. This section outlines those structural components and highlights key lessons learned.

2.1 Interaction of the REU Site with the academic calendar

The university operates on a year-round academic calendar driven by its co-op program. The REU Site did not precisely align with any of the academic terms, due to the need to accommodate students from typical semester-based academic calendars. The first two weeks of the REU Site overlapped with the university's spring term, followed by three weeks in between terms, and the second half of the REU Site overlapped with the summer term. This presented both advantages and disadvantages. One of the advantages was the opportunity for the REU participants to interact with the student body, meet new people, and socialize beyond their cohort. However, the three weeks between terms were challenging, as very few people were on campus and building access was limited by default. Procedures had to be followed to ensure that the participants were able to access all necessary facilities, the logistics of arranging food for professional development activities were more difficult, and some key personnel typically take vacation during that time.

Key Lesson: One of the lessons taken from this experience that can be used both in the future of this site as well as other universities is the need to identify all relevant functions in the university and ensure that communication is maintained, to ensure that participants have the access they need to key facilities and that appropriate arrangements are made for basic needs when the

university is almost completely closed down. Especially, institutions operating on nontraditional academic calendars must plan early for cross-unit coordination.

2.2 Use of unique university facilities

In addition to standard academic software (e.g., MATLAB/Simulink, FEA/CFD packages, CAD tools) and laboratory equipment typical of engineering programs, the university's distinctive facilities played a major role in shaping the REU experience. As part of the REU Site, participants were also able to use unique university facilities, which enhanced their experiences. One such facility was the university's test track, the Mobility Research Center (MRC), shown in Figure 1.

Participants on several projects also were able to use a 3D Scanning Laser Vibrometer, which the university had acquired under an NSF Major Research Instrumentation (MRI) award. This state of the art equipment was used to study tire vibration. Yet another participant was able to use another piece of equipment acquired under an NSF MRI award, the Environmental Scanning Electron Microscope (ESEM), used for characterization and atomic composition of a nanosensor for one project. The use of these unique university facilities was a key to the quality of the experience, and will be continued in future years of the REU Site.

Figure 1: Kettering University Mobility Research Center (MRC)

Key Lesson: In developing proposals and plans for REU Sites, REU organizers should deliberately highlight and integrate unique institutional resources, whether physical, cultural, or industry-connected, as they can meaningfully enhance research experiences and differentiate the program..

2.3 Mentoring structure

Mentors were recruited from across the university's engineering and science departments, including mechanical engineering, electrical engineering, computer engineering, computer science, and physics. This interdisciplinary team provided a broad range of technical expertise and diverse academic perspectives. All mentors were chosen for their commitment to education and guidance of students, as well as their research expertise.

The original plan called for a one-to-one match of mentors to students; however, it became evident early on that some projects required multiple areas of expertise. In practice, some mentors had more than one student, and some projects with a single student had more than one mentor. This required clear communication between mentors and students, to ensure that there were no misunderstandings or conflicts. This also aligns with standard industry practice, where people typically work on teams. In particular, as automobiles become ever more complex systems that include not only mechanical components but electrical systems and vast amounts of computer code, interdisciplinary teams are a necessity.

An additional advantage of the structure was the ability to cover for each other. Many of the mentors had periods of time, ranging from a day or two to a week, when they had to be out of town for personal or professional reasons, and a team-based mentoring approach ensured that students were not left without guidance for extended periods of time. As the second year is planned, this approach will be retained.

Key Lesson: Flexible, team-based mentoring structures can better support interdisciplinary projects and provide stronger continuity for students, especially during a summer program where faculty availability may fluctuate.

2.4 Professional development activities

As a part of the REU Site, professional development activities were provided for the students. The topics are given in Table 1. The speakers for weeks 1 - 4, 6, and 9 were university faculty members; the panel in week 6 specifically featured faculty who had industry experience, who were able to share their perspectives on both industry and academia. Weeks 5, 7, and 8 featured external speakers, with the week 7 program open to university faculty and the student entrepreneurship club, as well as the REU Site participants. The tenth and final week featured poster presentations by the REU Site participants.

Table 1: Weekly Professional Development Topics

WEEK	TOPIC
1	Institutional Review Board (IRB)
2	Graduate School
3	Research Study Design
4	Ethics & Autonomous Vehicles
5	Speaker from National Lab
6	Faculty Panel
7	NSF I-Corps and Entrepreneurial Ecosystem
8	Industry Interviewing
9	Professional Engineering (PE) Licensure
10	Participant Poster Presentations

One of the strengths of the site was the ability both to call on outstanding external speakers as well as to take advantage of internal resources, and this will also be carried forward in future years. An advantage of reflecting on the internal resources and building a list of possible internal speakers is the ability to quickly pivot if an external speaker needs to cancel or reschedule in order to provide a high quality alternative topic and speaker. It is further noted that, since classes were in session for the majority of the REU Site, students also had the option to attend any campus speakers that were hosted during that time frame.

Key Lesson: Maintaining a balanced mix of internal and external speakers, and preparing a backup roster of internal presenters ensures continuity and flexibility in the professional development program. This approach allows organizers to uphold high-quality programming, while also exposing students to a wide range of perspectives across academia and industry.

3 Results

In order to assess the REU Site's effectiveness and guide future improvements, participants were asked to fill out a survey based on the Undergraduate Research Student Self-Assessment survey (URSSA) [12]. The results of this assessment indicated that participants generally were satisfied with their research experiences. Some areas of improvement identified were providing more structured social activities, as the participants primarily arranged these themselves; enhancing the connection between mentors and students; and working to ensure that students received additional support in their first weeks of the program to set them up for success. Of particular importance, participants generally felt that their research experience prepared them well for their future, as shown in Figure 2.

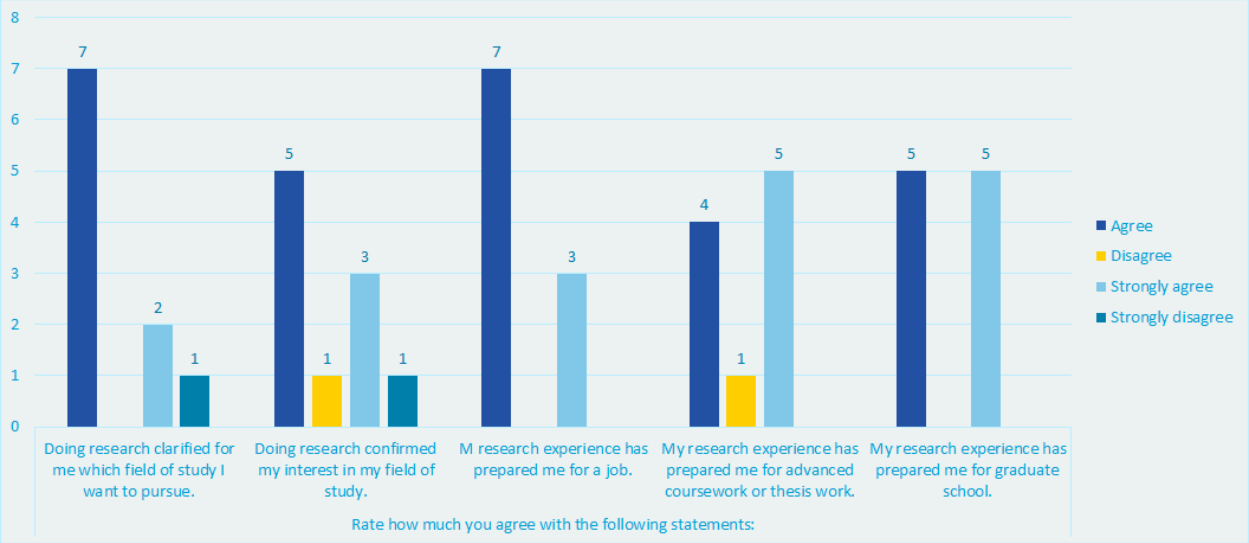

Figure 2: REU Site Preparation for Future Activities

Discussion and Conclusion

Overall, the inaugural year of the REU Site at Kettering University can be considered to be successful. Participants gained significant research experience in the field of autonomous vehicles, preparing them for future study and for their careers. The site's success was influenced by dedicated faculty mentors and the use of unique university resources. Continuous improvement is always important, and the assessment of the first year will be used to continue the successful aspects of the site while improving the overall experience. The specific lessons taken from this site can be used both at the site itself and by other universities hosting similar programs.

Acknowledgments

The authors would like to acknowledge the financial support of the National Science Foundation under Award No. 2349213. Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

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