Creating Accessible Research Opportunities: Lowering the Barrier for Undergraduates

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Abstract

Undergraduate research participation is a high impact collegiate activity, increasing successful outcomes for students in both industry and academia. While students often reporting desiring participation in these experiences, lack of direction and resources from Universities often prevent students from becoming involved. Further, lacking confidence and feelings of belonging can additionally prevent students from seeking research opportunities. In response to these barriers, we created Starting an Undergraduate Research Experience (SURE) to provide training of research skills and increasing feelings of belonging in research. Peer mentors and student leadership were heavily emphasized due to their effects on increasing student engagement and learning. Results indicated that SURE increased student confidence in approaching research related applications and feelings of belonging as engineers. Planning for future SURE workshops has already begun, and student leaders hope to continue laying the foundations of a fully comprehensive research onboarding and readiness program.

Keywords: Undergraduate research, peer mentor, belonging, barriers to entry

Introduction

Participation in undergraduate engineering research has been identified as a high impact activity that leads to improved academic and professional outcomes[1,2]. Developing as a young researcher occurs not only through gaining the hands-on experience of participating in an applied research setting, but also through receiving validation[1]. These feelings of inclusiveness are generated mainly through debunking imposter syndrome[3], the feeling that one is not smart enough or does not belong in a certain setting, and through creating environments where students are able to voice their opinions and concern. Imposter syndrome is pervasive among researchers at every level but can be especially harmful towards undergraduate newcomers who have not been validated through previous research experiences[4]. Women and underrepresented minorities are particularly unlikely to have had prior research engagements, and thus are similarly likely to lack feelings of belongingness regarding research[5,6]. A 2015 survey conducted at the University of Virginia indicated that underrepresented minority and women students had lower perceptions of belonging than other students in relation to UVA (Figure 1). This is believed to be a major factor in driving research for credit enrollment below 10% for these students.

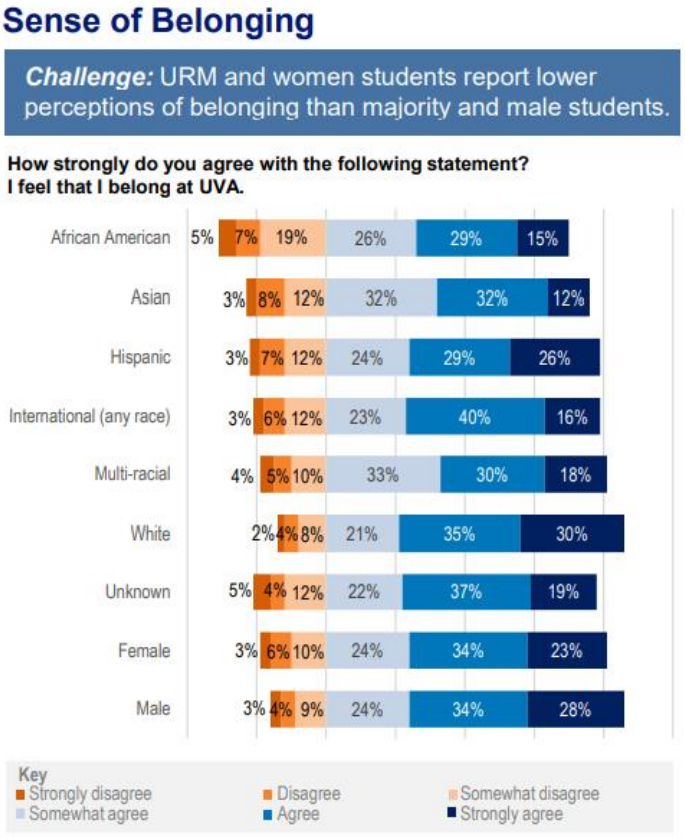

Fig. 1. Student feelings of belonging at the University of Virginia. Survey data from 2015 indicates that underrepresented minority (URM) and women students reported lower feelings of belonging. These feelings were a major motivator of SURE and became one of the main aims.

Along with feelings of belonging, research education programs are often insufficient at fully indoctrinating the students to all concepts necessary to empower self-efficacy. For example, traditional direct pairing programs excel in finding students research opportunities, but often lack the training modules useful in orienting the student to a research environment. Similarly, research-based courses offer students a plethora of opportunities to hone lab-related skills in a controlled environment but forgo creating an environment of inclusivity that is integral in improving undergraduate retention[7]. COVID-19 created additional barriers to entry, both by isolating students and physically restricting undergraduate access to lab spaces. The pandemic also reduced the amount of experienced undergraduate researchers in the 2020-2021 school year, as undergraduate engineers do not usually become involved in research until their second year, leaving only a handful of third and fourth years as those who have had research experiences. As such, it was crucial to create a program that both has the environment and tools necessary to facilitate inclusivity and belongingness among aspiring undergraduate researchers and to teach them relevant research skills.

We hypothesized that creating a workshop built around marketable skills and an emphasis on belonging can contribute to students feeling as though they belong and can increase the likelihood they receive a research opportunity. In addition to increasing belongingness, we also aimed to include research readiness training to teach practical skills to encourage students to apply for research positions. We named this workshop Starting an Undergraduate Research Experience (SURE) and hosted biweekly training seminars that utilized peer mentors, small group activities, inclusivity exercises, and other teaching practices. Peer mentorship was provided by volunteering experienced undergraduate researchers and was integral in retaining student engagement and creating inclusivity within the program. In addition to the aims of research readiness and creating belongingness, it was additionally necessary to deliver the workshop virtually due to the ongoing COVID-19 pandemic. Findings of our work mostly highlight the novel methodology used in constructing the workshop series and hosting the events virtually. Results indicate that SURE caused a slight increase in both feelings of belonging and aptitude to apply to research opportunities at the collegiate level.

Methods

The novelty of the SURE program originates from its methods. Previously, few undergraduate research programs have existed at the University of Virginia or other universities. Those that do exist have very specific focuses, such as one program being a direct pairing program to find students research positions but not give much other guidance, or another being for already established undergraduate researchers to display their achievements. SURE aimed to provide a fully comprehensive onboarding into research, giving students the information necessary to acquire research positions while reassuring the students of their belonging.

Generally, SURE was conducted during both the fall and spring semester during the 2020-2021 school year. This workshop was an extracurricular activity with optional assignments, held during biweekly workshops lasting an hour long. Workshops were held at 7 pm on Wednesdays as that was the earliest time in which workshops could be held that would interfere with the least amount of undergraduate classes. During the spring semester, small group activities were held during “off weeks” of the workshops, led by peer mentors. Eight workshops were delivered, with all consisting of a brief introduction of the topic, breakout rooms of students discussing the concept with their peers and peer mentor, a large group activity led by a student leader to show examples and solidify concepts, and a short closing statement on the “so whats” of the workshop and how to prepare for coming activities. Breakout room activities were specifically designed to foster an environment of engagement and acceptance among students to invite them to ask their own research and professional development questions based on the overarching workshop topics.

Workshop topics were intentionally broad to appeal to students of all research interests. Topics began with a focus on basic research logistics and knowledge, with later workshops emphasizing specific research readiness skills and preparing students for potential experiences. Across all workshops there was emphasis on inclusivity and belongingness. Workshop topics were as follows:

- Who Does Research and Why?
- How Does One Use Research to Ask and Answer Questions?
- What Can an Undergraduate Do in Research?

- How Does an Undergraduate Get Involved in Research?
- How Do I Market Myself?
- How Do I Ace an Interview?
- How Do I Read Scientific Writing?
- What Will My Experience Look and Feel Like?

In between workshops, students were given optional assignments to expand on what they had previously learned, and to prepare them for the coming weeks workshop. For example, students were invited to complete a cover letter following the "How Do I Market Myself" workshop to expand upon the networking skills discussed in the workshop. The alternation of workshop activities with optional preparation activities for the fall semester can be seen in Figure 2.

The major hallmark of the SURE methodology was the near complete use of student leaders. Peer mentors have been shown to assist in increasing feelings of belonging and increased competency in taught skills in both classroom settings and in research readiness programs[7–10]. As such, peer mentors were recruited for both the leadership team and the mentorship team via selecting experienced engineering undergraduate researchers to act as leaders. These engineers were invited to apply for the positions based on their previous research experiences and were composed of third- and fourth-year students. Pairing student participants with mentors occurred with all identifying information blinded, with matches made based entirely on research interests or previous research experiences. For example, in the fall semester, there was a peer group comprised of BME students with interest in computational research being led by an experienced undergraduate computational BME peer mentor. Pairing in this style aimed to increase cohesion within groups by focusing students on common research interests and experiences. Peer mentors were encouraged throughout the semester to connect with their students outside of SURE activities to help in finding research opportunities or to advise students on other academic matters.

Student outcome data was assessed via surveys at the beginning and end of each semester. Surveys included questions polling students on their sense of belonging as an engineer at UVA, whether they had previous research experiences or gained any since joining SURE, and what factors they believed kept them from becoming involved in research. Students were additionally asked to provide feedback on suggestions for improvements, which have gone into designing future workshops.

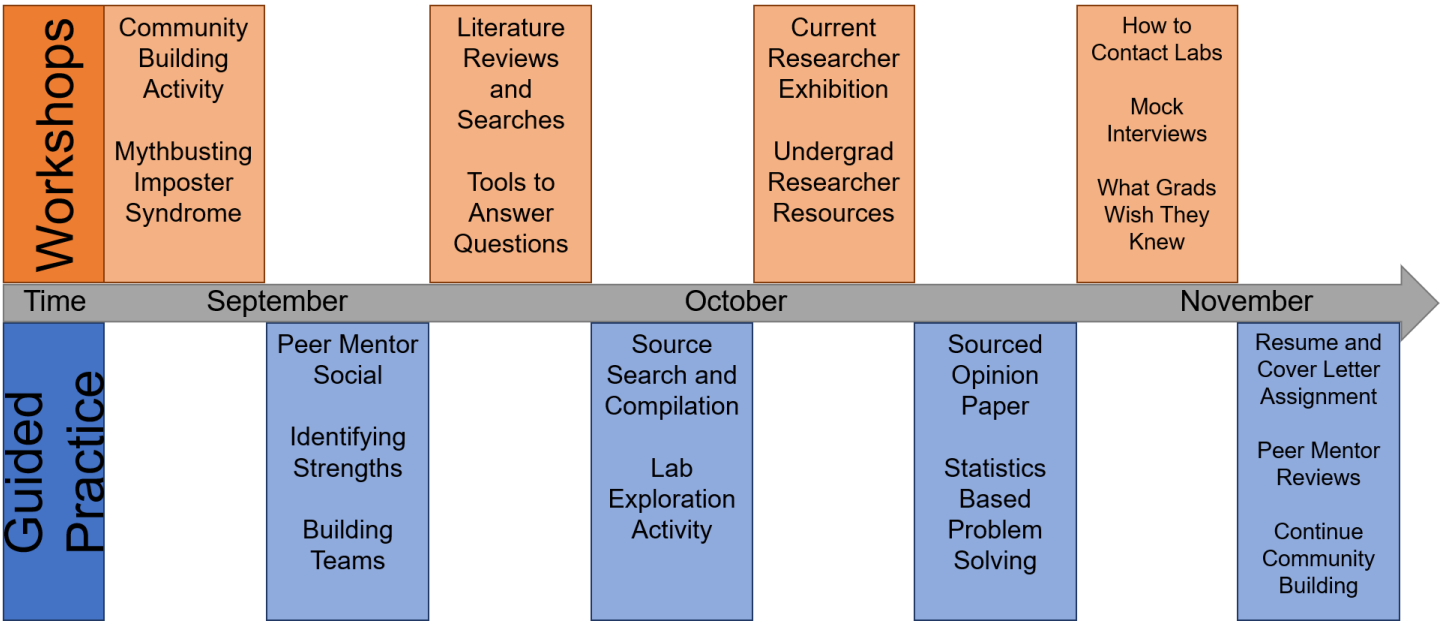

Fig. 2. Castletop diagram of the SURE workshop structure. Students were invited to discuss workshop topics during the main workshops, delivered by student leaders. Additionally, workshops featured a small group breakout that discussed individual feelings regarding the lesson. In between workshops, students were prompted to complete activities that either solidified lessons from previous workshops or introduced topics for future workshops.

Results

One metric of program success was student enrollment and engagement. Student enrollment was 121 in the fall and 63 in the spring. Students were enrolled from every engineering major and primarily consisted of first and second years. While BME and CS were overrepresented in enrollment, these majors have historically been the ones with the most accessible research opportunities. Student engagement was less reliable, with the fall and spring semester final workshops ending with only 43% and 31% of participants, respectively (Figure 3). Student engagement decreased throughout the semester, increasing for the final workshop likely due to increased marketing and seeking final remarks.

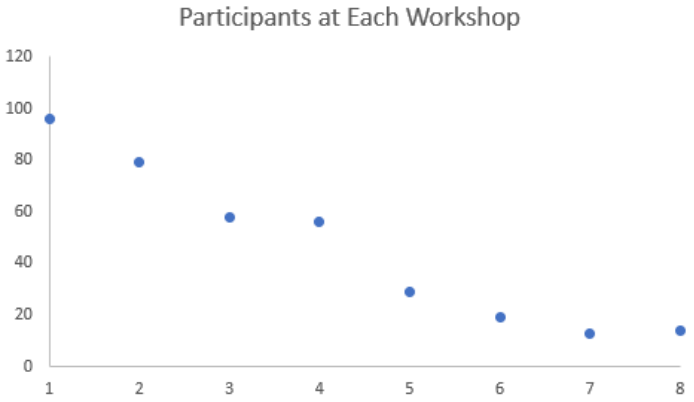

Fig. 3. Participation at each SURE Workshop. Retention rates were low across both semesters.

Workshop survey results are the other major metric used to evaluate the SURE program. Regarding the aim of increasing feelings of belonging, students were evaluated on a seven point scale regarding whether they disagreed or agreed with the statements of “I feel like I belong in SEAS” and “I feel like an engineer”. For both these statements, students agreed more with them following completion of the workshop in comparison to the pre-workshop surveys (Figure 4A-B). Regarding the aim of research readiness, students were additionally asked what most prevented them from doing research, with the main options including being “unsure where to begin”, “I don’t feel qualified”, and “research sounds too difficult”. Among nearly all these responses, students reported less perceived barriers to entry in comparison to the beginning of the workshop, indicating a higher degree of research readiness (Figure 4C). Additionally, at least three students found research opportunities following their involvement in SURE, with all three reporting that SURE was a major factor

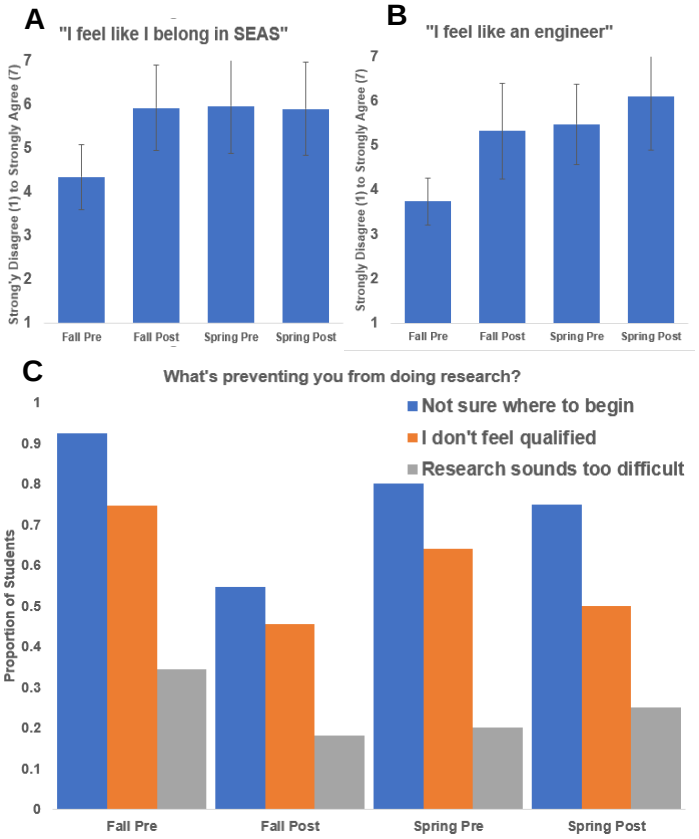

Fig. 4. Pre and Post Survey results from the fall and spring semesters. Students were asked questions to assess their feelings of belonging (4A-B) and levels of research readiness (4C).

in encouraging them to apply for research positions at UVA.

Discussion

On the surface, the collected survey data seems to verify that SURE participants feel increased levels of belongingness in both SEAS and as an engineer at the end of the workshops. However, it is questionable whether this change was due to SURE or due to other factors. As the majority of participants were first years, it is likely that this change could have also been due to the normal changes students go through as they begin their college experiences. While SURE survey data was more positive than the previous survey of belonging at UVA, it is still difficult to determine to what extent SURE increased belonging in SEAS or as an engineer without a control survey, that unfortunately could not have been administered due to COVID.

However, students were also asked questions specifically regarding barriers to entry in research spaces. Students reported an increase in competency regarding where to begin the lab application process

and heightened feelings of qualification. As these questions were research specific and most first years do not participant in other research readiness programs, it is likely that these feelings were caused due to participation in SURE. This result is further justified by several reports of SURE participants citing SURE as a primary reason why they felt confident in applying to, and ultimately receiving, laboratory positions. For this reason, we believe that we have successfully accomplished both the aim of increasing feelings of belonging and providing research readiness training to lower barriers to entry in research.

We believe that student peer leaders were the main reason for this boost in confidence and success. Peer mentors reported repeatedly having conversations regarding their own application experiences, rejections, and feelings, providing the students with advice on how to proceed with their own involvements. Similarly, participants were frequently invited to share their own feelings and ask questions, normalizing and validating the experiences of the participants. Without these small group environments, it is unlikely that the workshops would have fostered the same environment of acceptance and closeness that the small groups were able to achieve, thus leading to the successes SURE experienced this year.

While we are proud of the accomplishments of SURE and SURE participants, there are improvements that can be made for future years. The largest improvement to be made is the attrition rate experienced in both the fall and spring semester. Attrition was high, with both semesters concluding with less than half of the original participants. External factors, such as students realizing they are uninterested in research or that young students have overextended on their time commitments, certainly caused this decrease. However, we also believe that miscommunications from SURE also caused this declining retention; participants were expected to remember workshop dates on their own and little communication was distributed regarding the direction of the semester or the cohesion between semesters. Improving official communications from SURE will likely increase retention and ensure that students are given the best chance possible to become involved in research.

Further, the likely end of the COVID-19 pandemic will necessitate transitioning the workshop to in person operations. While in person lab training modules were an original deliverable goal of SURE, it will likely be difficult to transition some of the previous content to an in person setting. For example, how will future instructors deliver the same small group-based workshops in an environment where everyone is together in person? If training lab skills, how will students be given lessons that are useful to them without making them so broad that they are not applicable to anyone? These questions will be important to answer over the summer as the University releases guidance on the format and restrictions of the fall semester.

The future of SURE is largely secured, an exciting prospect for a new program. Many of the students on the leadership team are returning next year and the program is retaining the same faculty leader. Leaders will meet over the summer of 2021 to discuss plans as the University releases them, and the student taught class, ENGR 1501, has been accepted for another semester in the Fall of 2021. Short term goals include the transition to in person, both in managing the anticipated chaos and in adding the lab training modules and increasing retention of the program. Student leaders will also work towards solidifying partnerships between previous collaborations we have had, such as with the instructors of ENGR 1624, the career center, and the Center for Diversity in Engineering.

Long term, SURE will aim to become a comprehensive program that will introduce students to the research basics, coach them through basic research skills, assist in finding research positions with interested faculty, and assist in further professional development once involved as a research. We seek to emulate programs at other Universities, such as Duke and UT Austin[11,12], whom already have similar programs to these. However, SURE will continue to emphasize peer mentorship and the broader undergraduate research community in an effort to solidify feelings of belonging and continue to keep barriers to entry as low as possible. It is potentially possible for SURE to become the foundation for an undergraduate research major, a useful tool in demonstrating to other universities, potential students and faculty, and funding sources the University's commitment to providing research opportunities and training for undergraduate students.

In conclusion, we have created a research readiness program with an emphasis on belonging. Peer mentors were a crucial part of delivering the program and will continue to have importance in executing SURE's goals. While student retention was

lower than expected, SURE workshops succeeded in increasing feelings of belonging and research confidence. Future leadership has already been selected and will continue to deliver workshops in the years to come.

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