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Lessons Learned and Future Implications From a STEM Summer Research Experience

Gorbett, D., Shenberger-Trujillo, J., Rodriguez, S., Arciero, A., Helmut, K., & Robertson, W.
University of Texas – El Paso

Abstract

Mentorship and research experiences accelerate the integration of historically underrepresented minorities into science, technology, engineering, and mathematics (STEM) fields of study. The University of Texas System (UT System) Louis Stokes Alliance for Minority Participation (LSAMP) implemented a multifaceted undergraduate research strategy to increase students from underrepresented groups who earn undergraduate STEM degrees. This study assessed students' perceptions of mentorship and research experiences during COVID-19.

Participants were randomly selected from the Summer Research Academy (SRA) and Summer Research Academy - Abroad (SRA-A) programs to provide feedback on their experiences over the summer. The four focus groups consisted of 1 to 7 student participants, and the sessions lasted from 1 hour to 1.5 hours. All focus groups were conducted virtually using Zoom and Miro. Participants were asked about their perceptions of pre-program preparation, research experience, interactions with the program, and virtual summer activities.

Students wanted communication and clear expectations to begin between their mentors and program directors before the start of the program. Students appreciated regular check-ins and meetings with their mentors to discuss research. Students preferred in-person experiences but benefited from digital communications. Students mentioned they wanted more experiences throughout the summer where they could interact with the other students in the program formally and informally.

This study has allowed the UT System Leadership to develop a mentoring workshop for faculty participating in the SRA and SRA-A. Throughout the workshop, faculty members will learn about inclusive mentoring. In addition, UT System Leadership created various formal and informal activities throughout the summer for the upcoming students. Future research efforts will include the evaluation of the mentoring workshop and the newly created summer activities.

Literature Review

Research continues to show a disparity in degree attainment and advancement into graduate studies among underrepresented minorities and underrepresented groups (e.g., African-Americans, Hispanics, or Latinos/Latinas, American Indians/Native Americans, Alaskan Natives, Mixed-Race, women, people with disabilities, and members of the LGBTQ communities) in Science, Technology, Engineering and Mathematics (STEM) fields (National Center for Science and Engineering Statistics, 2021; Estrada et al., 2018; National Center for Education Statistics, 2021). In addition, students in STEM from underrepresented minorities and groups face various challenges. For example, teaching practices, pre-college preparation, and the culture in STEM education are documented as some of the obstacles facing underrepresented minorities and groups (Whittaker et al., 2012).

Given this trend and the obstacles underrepresented minorities and groups face, there is a need and a focus among researchers, institutions, and community partners to increase diversity in the STEM pipeline. Researchers have identified key factors such as research experience and mentorship that accelerated the socio-academic integration of underrepresented minorities and groups into STEM fields of study (Estrada et al., 2018; Whittaker & Montgomery, 2012). Overall, studies concluded that research experience had been positively related to career choice, placement, and preparation (Laursen et al., 2010). Furthermore, recent research shows programs that include research experiences are related to degree completion and academic persistence among students (Estrada et al., 2018; Hernandez et al., 2018; Schultz et al., 2011). In addition to research experience, mentorship has increased academic achievement, productivity, and persistence (Eby et al., 2007). For example, providing student's resources, opportunities to network, and encouragement have all been shown to increase academic achievement and persistence (Eby et al., 2007).

In addition to the obstacles facing underrepresented minorities and groups, students were burdened with COVID-19. As a result, students have adapted to a constantly changing learning environment. Through COVID-19, remote and online

learning have emerged and are evolving quickly. However, the literature on remote and online learning has highlighted some deficiencies. For example, some shortcomings include online infrastructure weaknesses, faculty inexperience, and the complex home environment (Ali, 2020; Murgatrotd, 2020). These deficiencies have raised equity concerns (Ali, 2020; Zhang, Wang, Yang, & Wang, 2020), and researchers have requested more evaluations on the impacts of COVID-19 on students' research experiences.

The current study assesses students' perceptions of participating in the Louis Stokes Alliance for Minority Participation's (LSAMP) summer research programs during COVID-19. These programs focus on increasing associate and bachelor's degree attainment and advancing into graduate studies in STEM fields among underrepresented minorities and groups. Based on research, the University of Texas System (UT System) LSAMP implemented a multi-prong strategy that offers students up to two summers of undergraduate research experiences. Students participated in an eight-week research project approved by UT LSAMP leadership under the supervision of university or community college faculty members. Depending on the institution of origin, previous research experience, and academic standing, students are usually recruited to participate in one of five summer research tracks (e.g., Summer Research Academy (SRA) or the Student Cohort for Undergraduate Research in Marine Biosciences Abroad (SCUBA) Summer Research Academy-Abroad (SRA-A), Knowledge and Independence through Externships (KItE), and Department of Energy (DoE) Faculty and Student Team (FaST) programs). During the COVID-19 pandemic, the UT System Leadership attempted to continue to provide summer research support during the Summer of 2021 but were only able to offer SRA and SRA-A.

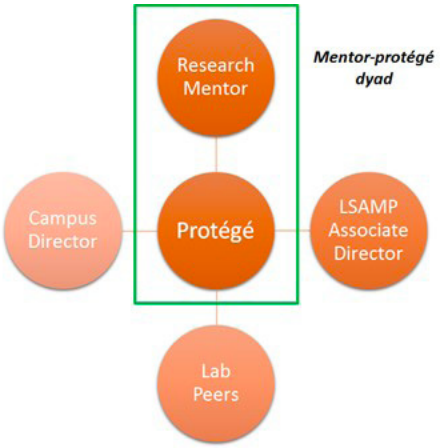
Students without a prior record of participation in LSAMP activities were recruited for the Summer Research Academy (SRA). Students with at least one previous research experience were recruited for the Summer Research Academy-Abroad (SRA-A). Below are brief descriptions of each of the programs.

As part of the SRA, students (who receive a stipend to support their participation) spend the summer working 30 hours per week on research projects at various UT Systems LSAMP partnering institutions. LSAMP leadership encourages students to participate in the SRA at a partnering institution and not at the institution where they are currently enrolled. Students selected for the SRA-A complete a summer project at a research institution abroad. Some SRA students and all SRA-A students did their research experience virtually due to COVID-19 restrictions.

In most instances, the preferred mentoring model among LSAMP summer research programs is the traditional mentor-protégé dyad (National Academies Report, 2019). In this case, the student (or protégé) was assigned to a faculty mentor or doctoral student who supervised the student's work and provided guidance, training, and encouragement. The protégé met weekly with the mentor to report on progress and receive additional instructions. The second most used model was the small cohort mentoring model, in which one or two professors met with a group of proteges working on related projects (National Academies Report, 2019). The team would meet regularly, sometimes daily, to discuss progress and plan future activities. Mentors were selected based on their research expertise, mentoring experience, and willingness to participate in the program. The protégé received additional support from the campus director hosting the student and was responsible for the student's professional development. The associate program director regularly communicated with the student, campus director, and peers who worked alongside the protégé. Figure 1 summarizes the support centered on the protégé.

Figure 1

Programmatic Support for the Mentor-Protégé Dyad



Methods

In 2021, 38 undergraduate students were selected to participate in summer research experiences. Students participated in research activities for eight weeks, mentored by a university faculty member for a minimum of 30 hours per week. These experiences varied from in-person or online. In addition, students were required to create and present a poster on their project at the virtual UT System LSAMP Conference through Whova. Whova is an online event management system that allows collaboration and engagement throughout the conference. At the end of their summer research experience, students were asked to participate in an online survey and focus groups to assess their perceptions of the research experience and mentorship. The evaluation team created the survey, and the focus group questions. Before data collection, researchers obtained permission from the Institutional Review Board at the University of Texas at El Paso (UTEP).

The surveys were administered electronically via Survey Monkey during the final two weeks of the SRA and before the annual conference. The students were notified and given several reminders to complete the survey. The participants were asked to provide basic demographic information (e.g., gender and ethnicity). Additional identifying demographics included student classification (e.g., freshman, sophomore, junior, or senior), expected graduation year, academic major, and field of research. The next section of survey items included students' level of satisfaction with the summer research experiences, their mentor, their research project, and the instruction and preparation they received before attending. In addition, the participants were asked to report their perceptions of the summer research experience's impact on their research, academic, and professional skills. Each item was assessed using Likert-type scale items (1 = strongly disagree to 5 = strongly agree or 1 = not satisfied to 5 = very satisfied). A "not to answer" and a "prefer not to answer" choice was available for every Likert-type question. Finally, open-ended questions were included to assess the students' motivation to apply and their suggestions and ideas for improving the UT LSAMP summer research experiences.

Focus groups were conducted with several participants from the SRA and all the students that attended the SRA-A. The sessions were conducted on Zoom and Miro virtually. Miro is a virtual and interactive whiteboard that enables the visual collaboration of the focus groups. Participants were asked about their perceptions of pre-program preparation, research experience, interactions with the program, and virtual summer activities.

Results

Descriptive characteristics were collected from the students. Table 1 includes the summary of the descriptive statistics. Of the total sample from the survey, 71% reported being female (n = 28). Participants reported their ethnicity/race as the following: 50% Hispanic/Latinx, 51% White Non-Hispanic, 18% Asian, 10% African American or Black, and 5% multiracial. Participants came from universities and community colleges throughout Texas and selected a variety of majors/concentrations.

Table 1

Descriptive Characteristics

	n	%
Gender		
Female	28	71.79
Male	9	23.08
Prefer not to answer	2	5.13
Ethnicity		
Hispanic	19	48.72
Race		
White Non-Hispanic	18	46.15
Asian	7	17.95
African American or Black	4	10.26
Multiracial	2	5.13
Other	4	10.26
Prefer not to answer	4	10.26
Home institution		
UT El Paso	9	23.08
Tarrant County Community College	6	15.38
UT Tyler	4	10.26
UT Permian Basin	4	10.26
UT Arlington	4	10.26
UT Rio Grande Valley	3	7.69
UT Austin	3	7.69
Odessa College	2	5.13
Tyler Junior College	2	5.13
UT Dallas	2	5.13
Major/Concentration		
Life/Biological/Agricultural Sciences	12	30.77
Engineering	9	23.08
Chemistry/Biochemistry	7	17.95
Mathematics/Statistics/Actuarial Sciences	2	5.13
Environmental Science/Atmospheric Science/Ocean Sciences/Ecology	2	5.13
Social and Behavioral Sciences	1	2.56
Other	6	15.38

Most projects were limited to eight weeks. Across both summer research experiences, 60% of students reported being able to complete their research projects. Overall, 28% of the students reported they would be continuing to work on the summer project during the school year. Most students (90%) reported being satisfied with the SRA and SRA-A experience.

Among the participants, 79% were happy with their research project. In addition, 89% of participants agreed the instructions and guidance they received before going into their summer research experience were helpful. Most participants reported their faculty mentor provided excellent guidance and direction (92%). In addition, participants reported being satisfied with their mentor (95%). All participants reported they would recommend this experience to other students.

In the focus groups, participants were asked about their perceptions of pre-program preparation. Participants reported they would like interactions with their mentors before the summer experience, and a need for a layout or schedule of the summer activities before they started would help them understand the program requirements and obligations. In addition, participants reported wanting scheduled and frequent meetings with their mentors throughout their summer research experience.

Next, participants were asked about their research experience. Participants reported some topics (e.g., programming) were more amenable to transition to an online/virtual environment than other topics that required lab access. Participants found plenty of online resources to help conduct their research, such as Google, videos, research papers, and online course materials and tutorials. Like previous research findings, participants reported challenges working from home, technology, and resources to complete their project. They expressed that creating a structured plan for the week helped keep them focused and motivated while working from home. Finally, participants reported that using masks and safety protocol helped make them feel safe during their summer research experience. Unfortunately, the researchers did not collect information on the number of students who completed their summer research experience virtually or in-person.

In terms of the program, participants reported the program directors were very supportive and understanding. Participants mentioned that, for the most part, there was clear and helpful program coordination. Participants enjoyed the variety of program activities. For example, they enjoyed social interactions with other participants of other summer research programs (e.g., McNair Scholars) and professional and social activities (e.g., painting, reading club, etc.). Participants reported they experienced and enjoyed various types of mentorships outside their faculty mentor (e.g., Ph.D. students and peers). Participants mentioned feeling comfortable approaching Ph.D. students and peers with their concerns and questions throughout their summer research experience. Finally, participants said they appreciated in-person meetings versus virtual meetings and looked forward to returning to "normal."

Finally, researchers asked participants about participants' perceptions of the various virtual activities throughout their summer research experience. Participants reported formal workshops and sessions (e.g., poster development, etiquette) was helpful, but participants mentioned wanting more sessions on poster formatting and how to record their poster presentations. Although, participants also said enjoying informal sessions with the other participants or participants at the summer research institution. Participants recommended having monthly virtual crafts, games, or movie watch parties as some informal activities. In addition, participants recommended the use of a student-led communication platform (e.g., Discord) to connect with other students in the program. Participants mentioned these activities could have been used to communicate with students, ask questions on program logistics, network, and socialize.

Conclusion

Underrepresented minorities and groups in STEM fields continue to show a disparity in degree attainment and advancement into graduate studies (Estrada et al., 2018; National Center for Education Statistics, 2021; National Center for Science and Engineering Statistics, 2021). Thus, researchers have identified vital program components related to the success of STEM students from underrepresented minorities and groups. However, due to COVID-19, many participants did not have a traditional summer research experience. Researchers have highlighted the deficiencies of remote learning and have raised equity concerns (Ali, 2020; Murgatrotd, 2020; Zhang et al., 2020). The current study evaluated undergraduate student perceptions of mentorship and research experiences from the UT LSAMP program during COVID-19.

Overall, participants reported satisfaction with the research experiences and mentor guidance and direction. Although, the halo effect may be present, but unfortunately the researchers did not account for it. Participants said the program directors were supportive and understanding. Participants mentioned their strategies when dealing with the constantly changing learning environments. Alternatively, participants provided suggestions to improve the research experiences, such as: providing a schedule and structure of their summer research activities before starting the program, frequent and constant meetings with mentors, and increased formal and informal activities.

The UT System LSAMP leadership will use the results of this study to enhance communication, organization, and structure between program leadership, mentors, and their students to further strengthen mentor-protégé relationship development. As previously mentioned, literature found mentorship has increased academic achievement, productivity, and persistence in students in STEM (Eby et al., 2007). Additionally, participants wanted more formal and informal activities to connect with other students, ask questions on program logistics, network, and socialize. Previously, studies have shown that peer

mentorship (professionally and non-professionally) leads to understanding, integrating, and navigating academic environments (Whittaker & Montgomery, 2012).

The study incorporated research experience and mentorship, key components to increase the integration of minorities and minority groups into STEM fields and graduate programs, into a summer research experience. In addition, this study found summer research experiences should have clear goals and expectations for the students before the start of the program. Summer research programs should provide the infrastructure for students to communicate, network, and socialize throughout their program. Moreover, COVID-19 has presented undue challenges to students, faculty, and research programs. In the constantly changing learning environment, these lessons can be used for students in future summer research programs.

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