Inclusive Innovation: Reframing STEM Research in COVID-19

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Tamara N. Hamilton is the Co-Principal Investigator and Project Director for the National Science Foundation Upstate Louis Stokes Alliance for Minority Participation (ULSAMP) at Syracuse University (SU). She has held this position since November 2012. ULSAMP is a collaboration between seven institutions, five private four-year research-intensive and two community colleges, in New York. At SU, Tamara is responsible for managing the day-to-day operations of the ULSAMP grant and the SU LSAMP Program, which supports students pursuing undergraduate degrees in science, technology, engineering, and mathematics (STEM). Before coming to SU, Tamara was at the University of Maryland, College Park where she was Assistant Director of the Center for Minorities in Science and Engineering. As Assistant Director of CMSE, Tamara was responsible for establishing retention programs for underrepresented minority STEM students including directing the NSF LSAMP and Bridge to the Doctorate Graduate Fellowship Programs. In 2012, Tamara and the rest of the members of CMSE were honored by the National Society of Black Engineers and ExxonMobil with the Impact Award for their successful efforts in the retention and graduation of engineering students. In 2022, Tamara received the Key Contributor Award from NSBE Region 1 for her continued efforts in supporting students in engineering.

Tamara received her bachelor's degree in Afro-American Studies and a master's degree in Education Leadership and Policy Studies with a specialization in Higher Education, both from the University of Maryland, College Park. Tamara is a doctoral candidate in Higher Education at SU where she serves as an adjunct instructor teaching classes on identity development and the intersections of race, ethnicity, gender, sexuality, disability, spirituality, and social class. Her research interests include broadening participation in STEM, identity, diversity, equity, inclusion, belonging, and access.

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Claudine has seventeen years of experience working at New York University (NYU) in a variety of roles including mentor, counselor, Interim Director of the Science and Technology Entry Program (STEP) and Building Excellence in Science and Technology Program (BEST). She also worked as an academic advisor and counselor at the College of Arts and Science (CAS) for students admitted to the University through the Arthur O. Eve Higher Education Opportunity Program (HEOP) and the Collegiate Science and Technology Entry Program (CSTEP).

Claudine served as an Administrative Representative for the Office of the Provost on the Administrative Management Council (AMC), a member of the Academic Progress Committee, a member of the CAS

Diversity, Equity and Inclusion, and International Students team, and she is a current member of the annual STEP Student Statewide Conference Planning Committee and Co-chair of the Entertainment committee. Claudine consults as an adoption social worker on private adoptions, and is an Educational Consultant with the New York City Department of Education (NYCDOE) in partnership with the Department of Labor (DOL) on the Youth CareerConnect Mentoring Initiative (YCC).

Chelsea Bouldin,

I am a Black woman PhD fellow who delights in co-creating worlds that embrace expansive processes of being. "How do us Black women, girls, and femmes know ourselves?" is my most persistent query. Flavorful food, Black sci-fi books, bound-less writing, impromptu exploration, and laughing endlessly fill my dreamiest days.

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Over the past several years, there has been a consistent increase in the number of science and engineering (S&E) degrees awarded at all levels (associate's, bachelor's, master's, and doctoral) and across many fields [1]. Bachelor's degrees account for nearly 70% of all S&E degrees awarded which rose steadily from about 400,000 in 2000 to just under 725,000 in 2019 [1]. The racial and ethnic composition of degree recipients has changed over time, reflecting population shifts and increasing rates of higher education attainment by members of underrepresented minority (UREP) groups [1]. Both the share and number of S&E degrees awarded to UREPs increased and while the gap in educational attainment has narrowed, it remains [1], [2]. Blacks, Hispanics, American Indians, and Alaska Natives remain underrepresented among S&E degree recipients in almost all fields and degree levels relative to their representation in the general population [1]. Blacks and Hispanics are underrepresented among students earning S&E degrees and among science, technology, engineering, and mathematics (STEM) workers with at least a bachelor's degree [3]. Uneven representation of demographic groups in the STEM workforce indicates that there is great opportunity to increase the number of students particularly at the bachelor's degree level or higher [3]. To increase the number of UREP students pursuing STEM degrees, institutions have established programming to provide co-curricular experiences for students to support their academic, financial, emotional, and social needs. Undergraduate research, one example of a co-curricular experience, has been found to be positively associated with obtaining a STEM baccalaureate degree, persisting in the field, and performing academically well [4]. UREP students who participate in undergraduate research experiences show increased confidence in their abilities, understanding of the nature of research, and understanding of graduate school [5].

In spring 2020, in direct response to the COVID-19 pandemic, institutions were forced to make shifts in co-curricular offerings. As a result of the move to online learning, research experiences were either canceled, postponed or moved to a virtual format. COVID-19 presented a new opportunity for students to still participate in activities from remote locations. After in-person activities resumed, aspects of these virtual opportunities have continued to be embraced by programs through virtual symposiums, more intentional and in depth "checking-in" at the start of meetings, wellness focused workshops, and emphasized community building. Additionally, virtual research experiences have expanded the number of students participating in these programs. The purpose of this paper is to share lessons learned from a co-curricular program for underrepresented students that successfully made the shift from in-person research experiences to virtual and back to in-person. First, we present the literature on the experiences of UREP STEM students as a guiding framework for the development of the research initiatives. Then, we will share program activities and outcomes from the virtual research experiences and conclude with implications for practitioners and faculty as they support UREP students in STEM fields.

UREP STEM Students Participation in Research Experiences

Students who participate in undergraduate research develop concrete knowledge and research skills, which influences their belief in seeing themselves as scientists, researchers, and feeling a sense of belonging and validation [6]. If students do not acquire these beliefs, they often do not apply or seek out graduate programs or positions they are competitive for and position

them for a STEM career [6]. Paid research experiences provide underrepresented students with financial support which in turn provides personal and financial support to their families [6]. The paid component enables them to reduce some of their work responsibilities held both on campus and off [6]. The financial support to engage in research activities is essential if we hope to diversify STEM fields and future faculty [6].

Research experiences positively impact students achieving STEM degrees. UREP students stated that research opportunities increased their motivations and confidence to secure a baccalaureate degree [6]. Research experiences exposed participants to opportunities and laboratory experiences they otherwise would not have become aware of, and participants talked about future goals and career options with faculty and graduate student mentors, learned from professionals in the field through workshops and research projects, and received insight on how to manage graduate school [5]. Students attributed what they learned in their research experiences often helped them do better in their courses since they had already been introduced to many of the concepts/knowledge and knew how to apply them [6]. Mentoring by professors and other positive interactions with faculty increases the likelihood that UREP students feel a sense of belonging. Faculty play a critical role in building students' confidence and these efforts are not contained to the research experience [6]. Mentors help students set short and long-term goals, provide critical feedback, believe in their capabilities, encourage them, help them overcome obstacles, and share alternative viewpoints to assist protégés in their decision-making [8]. Students value faculty who gave them opportunities to identify research activities/ projects that had personal meaning to them, especially projects that could benefit their communities [6].

STEM Intervention Programs (SIPs) [7], like research experiences, provide students with professional opportunities that are highly valued by students and faculty supervisors (e.g., useful workshops and programs to support students' academic and professional goals such as preparing for research poster sessions or presentations, sessions about diverse careers in STEM, steps involved in applying for graduate school programs, and how to secure financing for graduate study) [6]. The program, presented in this paper, is an example of a SIP. Our research program is guided by three core tenets: STEM identity, community, and sense of belonging. These core principles work together to directly increase the number of underrepresented students persisting in STEM fields.

STEM Identity

Developing a strong sense of identity promotes persistence in STEM disciplines. Research experiences help UREP students see themselves as scholars and as scientists [6]. STEM identity is defined as the "expressed association between oneself and STEM that is contingent upon the individual's belief in their capabilities within and their conceptual and practical knowledge of their particular STEM discipline" [9]. Stereotype management [10], a coping strategy used by UREP STEM students, is the academic resilience and high achievement of students despite negative intellectual and societal based stereotypes and other forms of bias [10]. UREP students feel that they need to change their demeanor to make other students feel comfortable working with them [11]. They choose to conform or combat negative stereotypes to create a "safer" classroom environment such as avoiding wearing certain clothes, smiling often, excessive nodding in class, avoiding questions about their personal life, and carrying a textbook in their hand instead of in a backpack [10]. Institutions are responsible for helping its members

combat these stereotypes which influences their STEM identity. Practitioners and administrators should create a shift in the chilly institutional and STEM departmental climate for UREP students and develop programs and services to encourage underrepresented students to persist despite obstacles [12], [13], [14].

Community

Academic departments, and the classes within it, can be chilly environments for UREP STEM students. SIPs serve as a source of motivation, pride, encouragement, and accountability for UREP students [15]. These programs provide students with supportive environments where they can engage in research and where students can see themselves as successful in their field of study [7]. UREP students see Program Directors, coordinators, and counselors as members of their extended family and these individuals provide them with academic, socio-emotional, and professional support [15]. SIPs are considered, "home", a safe space for UREP students to gather or seek advice and support on predominantly White campuses [6]. Staff understand the challenges UREP students face dealing with microaggressions, financial stresses, family concerns (including family's lack of understanding about their academic/research demands on their time) and managing work and academic demands [6]. Program staff play a critical role in connecting students with research faculty and coaching students on how to approach faculty to explore, pursue, and secure these experiences [6].

Peer networks provide UREP STEM students with the social capital to succeed. Students utilize each other as a social network to build supportive relationships inside and outside classes [15]. Peer support is critical in providing space for participants to study with others who share similar interests and goals [15]. To counteract the effects of the immense stress from the interpersonal microaggressions, racial jokes, and institutional climate, UREP students create counterspaces through community building that represents the cultural wealth of their home communities. These counterspaces helped students foster the skills needed to successfully navigate between the multiple worlds of home and school [16].

Sense of Belonging

A sense of belonging is the "feeling of relatedness or connection to others and a sense of being accepted, valued, included, and encouraged by others in the academic classroom setting" [17]. Co-curricular programs and campus engagement positively relates to belongingness [18]. Through workshops and other activities, students are validated, and overcome fear and lack of confidence to experience themselves as legitimate members of the community [19], [20]. They are able to safely share personal passions and ideas and more comfortably navigate academic spaces [19]. Through a strong sense of belonging, students see themselves as resources, helping others, and making an impact on the community [19]. The well-being of the community takes precedence over individual goals, which reduces isolation and alienation and gives UREP students a greater awareness of purpose and sense of belonging in STEM [15].

Without a strong STEM identity and community, coupled with the research experiences with faculty and the work of program directors in SIPs, the sense of belonging of UREP students will decrease. The COVID-19 pandemic decreased many opportunities for community building which is linked to students' sense of belonging. The pandemic also caused students to change

educational plans and either leave college completely or not attend at all [21]. For example, by October 2020, during the height of the COVID-19 pandemic, more than 40% of households reported that a community college student was canceling their plans to attend and another 15% were taking fewer courses or switching programs [21]. Community college students are usually older, first-generation, parents that may be working at home and caring for children or elderly parents and working in industries that have been affected negatively by the pandemic [21]. Virtual research allows UREP STEM students to continue to participate in a paid experience that positively influences their interactions with faculty and peers, and promotes STEM identity, community, and sense of belonging, while juggling many responsibilities outside of school.

Virtual Research Experiences and Outcomes

Institutional Context

The site for this program is a predominately White private research-intensive university located in the Northeast of the United States. Infused with a strong entrepreneurial culture, the University is home to over 40 research centers and institutes spanning disciplines from performance, design, fine arts and humanities to information, health, social sciences and STEM. The university's total enrollment for fall 2021 was 21,772, including both full- and part-time students in undergraduate, graduate and law programs. The student population represents all 50 U.S. states and 126 countries. More than 83% of students receive aid with assistance from institutional, federal, state, and private sources.

Academic Year Program - Spring 2020

During the 2019-2020 academic year, 11 UREP students were engaged in paid in-person research with STEM faculty. Students worked approximately 10 hours a week and professional development workshops were held bi-weekly on topics such as graduate school opportunities, career planning, and the various STEM disciplines. Students were required to have one-on-one meetings with advisors and progress reports were submitted at the beginning of each workshop to provide updates on the research with staff. In March 2020, the program shifted to virtual with the closure of the university, and the staff created a plan to continue to pay research scholars for the remainder of the semester. Students were paid for attending weekly virtual workshops, meeting one-on-one with coordinators, continuing virtual research with faculty, and participating in the virtual research symposium. The team met with students via Zoom to follow-up on transition to online learning, internship/graduate school applications, and other concerns. In the end, 7 of the 11 students participated in the virtual workshops. 3 other students followed up with staff individually. To reduce the pressure of students managing online learning and the COVID-19 effects, students who chose to stop out for the remainder of the spring semester were not penalized and were invited to continue in the following fall semester.

During the virtual research meetings, staff provided a safe and open space for students to share concerns with summer internships being canceled or continuing during the unknowns of the pandemic, family members being sick, and the overwhelming feelings of isolation as the campus moved to online learning. At the first virtual meeting, staff discussed time management and self-care with participants. Some students met individually with staff to discuss deeper concerns. Of the 7 participants who chose to continue their research, 5 students presented their

work at the virtual symposium. The students stated that they were very grateful for the opportunity for the continuation of pay during the virtual end of the semester. Due to in-person summer programs and internships being canceled, the program extended an offer to the academic year students to participate in the virtual summer experience. 4 students took advantage of this offer and continued their research in the summer. Other students referred their peers to participate in the summer program. In the end, staff were able to still connect, personally and financially, with the students during COVID-19 which assisted the staff with making recommendations for how to connect with the students virtually during the summer.

Summer Research Experience for Undergraduates (REU) Program

Virtual Experience - Summer 2020

In spring of 2020, the institution like most others around the country decided to immediately pivot to a fully remote academic program. Summer 2020 became uncertain. By mid-spring, students had already been selected for the summer program and with so many activities being canceled, the program decided to move forward with its plans. The program was shortened from 10 weeks to 8 to allow staff additional planning time for the new virtual research experience. Students still wanted to conduct research and the faculty members were eager to provide rich research experiences despite being virtual. Fortunately, the Summer REU Program was still able to provide stipends to those participating and since the institution's library had extended its remote access, students could take advantage of library resources as well.

In anticipation of needed adjustments due to this virtual format, the Summer REU Program decided to extend acceptance to 19 currently enrolled university students. Students from other institutions were initially accepted to the program, however with the lack of campus housing for the summer, those acceptances were rescinded. This option made it easier to identify available institutional faculty mentors and make the student faculty connections expeditiously. Although all students were STEM majors, they boasted a diverse array of program concentrations like engineering, computer science, neuroscience, nutrition, and other science fields. The research component was outlined and driven by a learning contract agreed upon and signed by the student research scholar and the faculty mentor. It was used as a guide that helped all parties remain informed of the research direction and expectations, although remote.

The 19 students attended a virtual welcome orientation on the first day of the program which included introductions and entailed next steps. It also allowed the students an opportunity to build community virtually and recognize that they were in the company of many fellow peers who similarly chose to conduct research despite the pandemic. On the following day, the Summer REU program facilitated an orientation meeting with the faculty mentors to foster community among the research faculty and to introduce the Summer REU staff as a point of contact. This session also entertained faculty questions and established some protocols for any student or faculty concerns should they arise during the program.

During the week, students worked remotely with the faculty and their lab staff and students held themselves accountable to keep track of their research hours which consisted of conducting research, reading articles and reports, participating in professional development activities, giving presentations of their work, and attending meetings with their research team

and faculty mentor. Faculty mentors signed off on progress reports submitted by students documenting their research hours and reflections on their progress which were then submitted to the program coordinator. This allowed students to not only manage their time but also have an opportunity to contemplate their experiences. Students also provided qualitative feedback after every session which the program used to make adjustments and shape the program to be more student centered. Faculty mentors provided introductory information to acclimate students to the virtual lab environment and research team which helped to foster a sense of community among all research scholars. Faculty mentors were expected to meet regularly with their research mentees to be kept abreast of the student progress and also provide an avenue to exchange ideas, ask questions and address any concerns. Faculty mentors and their key lab staff served as the point of contact for the students.

In addition to conducting research during the work week, the Summer REU scholars participated in weekly Friday workshops hosted by the program coordinator but were also attended by the program director and administrative staff. The primary goal of these sessions has traditionally been to provide the students personal and professional development. However, in addition to this important feature, this space also served as an opportunity for both students and staff to check in with a particular focus on mental health and overall wellbeing, in light of the current circumstances. Everyone present at the workshop was requested to consider their week and to name a highlight, a low point and a growth that they could identify and share with the group. This facilitated an atmosphere of transparency and openness about the research experience specifically within the context of a global pandemic and its impact on everyone's lives. The program used this activity as a tool to check the temperature of each student and staff and follow up with individuals as was necessary. Over the span of the summer, each week concentrated on a distinct topic: wellness, time management, national research laboratories, alumni and faculty panels, STEM identity, mock presentations, and the final Virtual Research Symposium. The workshops were facilitated by staff, campus partners, alumni and colleagues, all who made themselves available to share wisdom and resources with the students virtually from their various locations. These Friday gatherings were instrumental in promoting stability and program norms in spite of the surrounding uncertainty.

At the conclusion of the Summer REU program, students' work culminated in a PowerPoint research presentation that took place at an online research symposium attended by all Summer REU students, staff, faculty and invited guests across the campus. Students prepared for this event by practicing and providing a mock presentation in the presence of their peers where they received feedback and support. Students finalized their projects in collaboration with their faculty mentors based on meeting the goals of their proposed projects at the start of the summer. Notably, one student was feeling unwell as we approached the symposium and in anticipation of his absence, recorded his presentation in advance. This recorded PowerPoint was played as part of the symposium so that this student's work could be included, something that would have been more difficult prior to the pandemic. Each student was allotted 15 minutes to share their research along with 5 minutes devoted to audience questions or comments. Having 19 students present in one day was a bit challenging, but allowed all that were present to recognize the excellent research that took place in spite of the environmental restraints. The summer culminated with a celebratory closing event led by the students that incorporated the distribution of certificates of conclusion and some fun online group games.

The summer of 2020 required more frequent follow up and check in with students that resulted in frequent zoom meetings in order to provide as many opportunities as possible for students to talk and process their feelings and struggles. Students seemed to enjoy sharing and focusing much of their discussion on the future, particularly in regard to their college graduation and desire to attend graduate school or enter the workforce. These conversations sustained an element of hope. The Summer REU was impacted by students or family members falling ill at different times throughout the summer as well as other familial issues that students were forced to contend with while simultaneously forging ahead in their research.

Hybrid Experience - 2021

In the spring of 2021 as the institution at large continued with COVID-19 health protocols, it was again decided that the Summer REU Program would be virtual. Similar to the summer of 2020, most facets of the program were conducted remotely, however the program resumed its 10-week structure. 18 Summer REU Program scholars participated, this time with varying degrees of in-person participation. As a Program that is a member of a larger collegiate alliance, the Summer REU Program extended an invitation to 1 student who participated from another state and 3 local community college students who resided in close proximity to the institution. A number of faculty mentors had returned to their labs during the 2020 - 2021 academic year and were positioned to host Summer REU students in-person. Therefore, currently enrolled undergraduate students, now with a more senior status and those who resided in off-campus apartments wanted to take advantage of an in-person research experience, working in the lab. Other students engaged virtually from their homes for the duration of the program. The Summer REU Program continued to host the weekly Friday workshops using the virtual platform so that all enrolled students could take full advantage of this resource and community promoting environment. The weekly sessions continued to cultivate an atmosphere where both students and staff shared their current status of well-being. What was discovered a few weeks into the program was that those students able to work in the lab were quite eager to meet in-person. In an effort to resume the community feel of the program, the Summer REU Program organized a number of in-person lunches where students were encouraged to get together and engage with their research peers and the Summer REU staff. In adherence with the COVID-19 guidelines and health protocols, all were required to wear face coverings and keep the established social distance when not actively eating. The Summer REU concluding research symposium was again held remotely, however, it was spread over 2 days to allow for more space between presentations. The students also spearheaded a closing event to celebrate all of their summer accomplishments. Each student received a certificate to delineate their full participation and completion of all program requirements.

Return to in-person - 2022

In the summer of 2022, 14 students returned to a fully in-person program with the exception of 1 scholar who participated remotely. This was due to their faculty member not residing in the local area over the summer. Students reported the weekend prior to the start of the program and were assigned to a specific on campus residential hall close to the labs they worked in. The program coordinator was responsible for ensuring that students arrived on time and had

access to the building as well as room keys and dining cards. The Summer REU Program financed the cost of student housing, 3 meals a day at the dining hall, access to the university library and printing resources, parking passes and access to the university recreational facilities. The Summer REU Program staff collaborated with faculty mentors to facilitate students' entrance to university labs as some students in the cohort were visiting students from other academic institutions in other states. These students were guests and needed to be fully integrated into the campus community.

The 1 remote scholar met with the program coordinator and the summer intern weekly and also participated in the Friday workshop sessions. Although a fully in-person program, a number of the Friday workshops were still held in a virtual platform in an effort to accommodate guest speakers such as alumni and representatives from national research laboratories. The virtual workshops also allowed the 1 remote scholar an opportunity to interact with their peers as well. Since time management, wellness and STEM identity tend to emerge as important concepts in the summer, it was decided that those topics would take priority and be offered to the students early in the program. Students received individual attention and check-ins that now took place in person, but the program coordinator also met with students virtually when necessary and convenient. Although meals were offered through the residence hall, the Summer REU Program provided lunch every Friday prior to the meetings to build community each week. In person meetings facilitated organic and impromptu conversations unrelated to research and allowed for participants, both students and staff, to learn more about each other. Community continued to be fostered through additional activities like game night and a painting event. Outside of the program activities, the students planned additional trips, especially the students who were not local students. These were student-led excursions that demonstrated the establishment of relationships outside of the structured research environment.

After hosting a research symposium just for program participants for the last two years, the Summer REU program collaborated with offices across campus to participate in the campus-wide research symposium. Summer REU students presented their research through poster presentations. The Summer REU students learned the tools necessary to create a poster and the importance of including critical information particularly that of funding agencies. Each student participated in a mock presentation with peers and received constructive feedback. Some students presented with a partner so they learned the additional art of co-presentation and partnership. At the campus-wide symposium, participants were able to bond with other summer scholars outside of their program and feel a sense of belonging to the wider research community.

Reflection from Program Staff

"Similar to everyone else, the summer of 2020 was a very scary time and being tasked with coordinating the Summer REU Program at this critical time was initially daunting. However, understanding the essential nature of this program and the importance of providing some structure helped to address anxiety and center on the students' needs. I understood that it was my responsibility in conjunction with the program leadership to establish support as we buttressed the students through the most challenging summer. It was the assurance that the program was moving forward and that students would still be receiving their stipends that aided in opening the door for fruitful research experiences. Faculty mentors demonstrated their

determination to come alongside students who were brand new to research and introduce them and guide them through. Collaborating with the faculty mentors in sustaining a stable environment proved to lead to outstanding research scholars as was exemplified by excellent PowerPoint and poster presentations at each of the symposiums".

<div align="right">Summer Program Coordinator</div>

Academic Year Research Program

2020-2021 Academic Year

The fall 2020-spring 2021 academic year marked a unique shift in the research program. Like all of higher education, the program was required to commence a new academic year under the context of COVID-19 and subsequent considerations. In fall 2020, the research program which historically was an in-person experience continued to be held virtually. The complexity and meaning of this shift was layered by the participating students' varied levels of previous familiarity and involvement with the larger research program pre-pandemic. The program has traditionally admitted both new and returning students, and this year was no different. However, the ways in which the context of the pandemic created a foreignness to all involved in the program, whether new or returning, fostered a particular type of situated community unique to this moment that was new to all.

The program consciously considered the lessons learned over the course of months of trial-and-error, and ultimately demanded a sort of critical reflection that has proven to be significant in the program's goals of holistic success of students. Ultimately, not only was the format of the program tailored to respond to the threats of COVID-19, but the ways staff consulted the program materially/curricularly were also influenced. The workshops that are a key element of the program began to consider and center wellness more readily than previous years had. Program staff recognized that in addition to the experience with research itself, that the students were also yearning community where their needs as entire students and people could be expressed, something that staff also personally desired. This is most recognized in the extensive space created at the beginning of meetings to "check-in" with one another. Although this addition to "normal" operations may seem minor, in effect, this check in time became a sacred part of setting the tone of hearing one another and being supportive in multiple avenues. These check-ins are one example of a "pandemic inspired" practice that has continued even as a sense of normalcy is being regained and in person activity has commenced.

2021-2022 Academic Year

The fall 2021- spring 2022 academic year program marked a return to an in-person research experience. This reiterated sense of newness was shared by students in the program who were also returners but had not partaken in the in-person program. Once again, there was a need to reorient to an ever-changing pandemic context. This precarity demanded a vulnerability of both staff and students to have transparent conversations about how they were feeling and what they needed. Continuing from last year, the extensive space held for "check-ins" at the start of activities, now in person, continued. This portion of the meetings continued to be a site of address and redress. The continued reflection allowed staff structure and content for research

meetings in a way that acknowledged and reflected what each person shared at the start of a given workshop. Ultimately, the shared and reported concerns and thoughts inspired more wellness and holistic based content that could then be applied to the students' specific research agendas.

Reflection from Program Staff

"In fall 2020, this dynamic of communal bonding predicated on online learning was further emphasized during the academic year by the fact that I, as the graduate student coordinator for the program, was also just beginning this role. There is a beautiful way in which the pandemic encouraged a breaking down of traditional power/experiential based hierarchy, and what was a newness for us all, demanded consultation. The fall 2021- spring 2022 academic year program marked a return to an in-person research experience. As the program coordinator, this marked my second year with the program, but in many ways it felt like a first. Once again, there was a need to reorient to an ever-changing pandemic context– clearly, the pandemic was not "over" yet, things were shifting in a direction of less perceived precarity".

Graduate Student Coordinator

Smaller scale/Short-term Virtual Research Experiences

An opportunity that was born in the midst of the pandemic was the smaller-scale or short-term virtual research experiences. The program imagined a week-long research experience geared particularly toward first-year students or students who had not had previous lab experience. Because the program had successfully implemented virtual academic year long and summer research experiences, the program was able to factor in various elements of what had been learned and the first execution of this project was successfully held in the summer of 2021. This program consisted of underrepresented undergraduate students from various institutions and was led by 2 faculty members who also had limited experience leading a research project virtually. Once again, from inception and conceptualization to execution and explanation, this shift in how to do and teach research virtually, demanded imaginative creativity, collaboration, vulnerability, and flexibility. This included thinking of a way to get students in various locales the materials needed for said project. Staff ordered materials requested by the faculty leading the project, packed and mailed research kits for each of the participating students who were then guided in the execution of their projects during the week-long program.

Much like the year prior, the 2022 week-long virtual research program was also an ultimate success that required brainstorming and resilience to organize. Although things had largely resumed to in-person learning at this point, the program recognized that a short-term virtual experience allowed to have a breadth of participating students that an in-person experience would not accommodate in the same ways. Another session of this short-term virtual experience with many of the same elements of the first iteration of the program was held, however, this time, the program was led by a different, sole faculty member from a different STEM background than the previous faculty pair. The value of various entry points to a virtual research experience was evident, as during both of these unique experiences, there was much offered by each faculty member/pair based on their various backgrounds of expertise. The ways in which each faculty approached "creative" research was constructively, but not surprisingly,

apparent in their approach to creative lab-based research. The continued success of this evolving program is one the program plans to continue in various ways, including by working with faculty that are of various STEM research backgrounds. This program works to spark the research interest of students, early in their college careers, to increase their STEM identity, sense of belonging, and create a community of UREP STEM scholars.

Implications for Practitioners and Moving Forward

There are many implications for practitioners as they create and implement virtual research experiences. Research provides early connections with faculty and staff at the very beginning of students' academic programs and promotes self-confidence, understanding of scientific concepts, community, and a sense of belonging [6]. Virtual research allows universities to provide short- or long-term experiences to students within and outside their institutions at a lower cost. High-cost expenses such as room and board are replaced with lesser shipping costs for materials. During the program, offering virtual research experiences was paramount in providing some normalcy and structure during unprecedented and uncertain times. It met a need as many other confirmed summer opportunities were canceled or postponed. Particularly supporting financial needs of the students was an indicator of the value of the research experience as well as an incentive for students to press forward in their work. The virtual research experience also provided some intellectual stimulation and an alternative for students to focus on other than the COVID-19 pandemic.

The faculty mentoring that is offered through research experiences stimulates goal setting and positive self-evaluation for UREP students [22]. Although virtually, faculty can continue to create safe places for the expression of ideas and perspectives, maintain a sense of positivity in their interactions, and treat students uniquely and not with a broad brush of uniformity [17]. Program staff felt a deeper appreciation for faculty mentors and their ability to provide a remote research experience that was rich and meaningful and no less valuable than an in-person version. The virtual research symposium provided an opportunity for the campus community, those across institutions, and especially, family members to attend and learn about the student's research. This is something that may not have happened with an in-person symposium. Family members were able to better understand the importance of the student's research and STEM program. Including alumni in the research program was also a valuable asset where students were able to expand their networks and learn more about graduate school and the STEM workforce.

Check-ins were intentional ways of gauging how students and staff were navigating the research program, within the context of COVID-19 and the constant change in society including the racial climate, protests, economic hardship and political chaos. Also immensely important was individual meetings with students in order for staff to understand some of the challenges while participating in the program. It helped in thinking about how to meet the students' needs and for the Program to adjust accordingly. Online platforms, like Zoom, are excellent tools to meet with students especially for quick check-ins or meetings and it allows for a face-to-face interaction different from speaking over the telephone.

Building community through virtual experiences continues to be a difficult task. In the research program, students were reluctant to engage with each other outside of the required hours. They did enjoy the community building activities that centered around food and celebrations. Included with the challenges of community building, zoom fatigue was a very real occurrence. It is crucial that programs remain flexible in the Zoom environment and considerate of varied home environments. It is necessary to be mindful of the availability of designated physical and mental space and the presence of other household members or a lack of privacy for students. Programs should be accepting of the fact that some students may need to turn their cameras off intermittently but still be fully engaged. During the virtual research program, staff found out that some students were caregivers for family members and therefore juggling multiple responsibilities while participating in the program. The ability to pivot to a virtual research experience provided an even clearer understanding that students from all backgrounds, but particularly historically underrepresented scholars, may have complex family environments so there is a need to be flexible and understanding and inclusive of all circumstances. When creating a virtual research experience, faculty and staff should be mindful of student access to efficient technology, appropriate space to conduct research, flexibility in conducting research in the household and student's balance between household duties and responsibilities. Scholars recommend that programs hold trainings for coordinators, graduate student mentors, and program assistants that focus specifically on the unique needs of students [5].

Undergraduate research is positively associated with UREP students obtaining a baccalaureate degree, persisting, and performing academically well [4]. Longevity in research further increases these outcomes [4]. The COVID pandemic caused many research programs to change its offerings for students. Moving forward, the large shift to virtual programming has highlighted many opportunities such as gender expression through the use of preferred pronouns and names during activities and shorter time for meetings to lessen distractions and accommodate varied learning approaches. As programs return to in-person experiences, virtual opportunities will continue because it allows programs to expand its reach to UREP STEM students and to assist in increasing their self-confidence, STEM identity and sense of belonging.

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