NSF GEO REU Program Coordinators Show Adaptability and Resiliency During the Pandemic

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Abstract

During the COVID-19 pandemic, many undergraduate internships, including the National Science Foundation (NSF) Research Experiences for Undergraduates (REU) programs, were canceled or moved online. While several studies have examined student success during the online transition, less research has examined how REU programs changed from this experience, ongoing and novel challenges, or strategies that program coordinators employed to overcome them. To investigate this gap, REU site programs were surveyed in the NSF Geosciences (GEO) Directorate, finding many students declining participation after having been accepted into programs, difficulties accessing institutional support services, and changing student needs. Despite challenges, nearly all respondents reported program satisfaction, with several indicating the importance of GEO REU community support. Overall, REU coordinator resilience appears to be a major factor in program success.

Keywords: NSF REU; COVID-19 Pandemic; Undergraduate Internships

I. Introduction and Background

Research internships for undergraduate college students are valued by employers and graduate schools because they enhance technical and professional skills by providing "firsthand experience not offered in the classroom" (Kaplan and Skowronski, 2023). In a recent survey of 50,000 employers, researchers found that 50% of the 704 respondents prioritized work experiences in applicants over their academic record, compared to just 19% who ranked academic records as the most important (Chronicle for Higher Education, 2013). Similarly, in a survey by the National Association of Colleges and Employers of nearly 4,000 graduating seniors from 470 colleges or universities, those with paid internship experience benefited post-graduation with more job offers, shorter job searches, and higher starting salaries (Collins, 2020). Overall, research internships have been shown to effectively entrain students into STEM fields by building student science identity and skills and enhancing their social capital by enmeshing them in professional science networks (Dalbotten, Haacker-Santos, and Zurn-Birkhimer, 2014; Lopatto, 2004; Seymour et al., 2004; Wilson and LaDue, 2006).

Unfortunately, undergraduate research internships are often inaccessible. In the 2021 National Survey of College Internships, an "alarming number of non-interns (67.3% or 6,407 students) had wanted to take an internship but could not due to a variety of obstacles" (Hora et al., 2021). Students who lack resources and support, such as money and time, may not have had the opportunity to meet entry requirements, such as a high GPA. Other students are place-bound or unable to meet logistical constraints of the program due to family, work, financial, or

community responsibilities (Dalbotten, Haacker-Santos, and Zurn-Birkhimer, 2014; Sloan et al., 2020). Additionally, internship application materials are embedded with privilege and bias. For example, evidence shows that letters of recommendation are rife with bias that discriminates against women, people of color, and other marginalized populations (Bernard and Cooperdock, 2018; Dutt et al., 2016; Houser and Lemmons, 2018; Sloan and Haacker, 2020). Hiring committees bring several kinds of partiality to the selection process, such as first-impression bias, stereotyping and familiarity bias, and the halo bias, for example, by elevating a candidate who attended a prestigious school. This is important, because traditional measures of academic success are cumulative, in that one success leads to further opportunities, a phenomenon that Merton (1968) coined the Matthew effect.

Recognizing these barriers, the National Science Foundation (NSF) Research Experiences for Undergraduates (REU) program is explicitly designed to increase participation "of the nation's diverse talent in STEM," specifically that of "individuals from groups historically underrepresented in STEM fields" (NSF 2023:4). REU site programs typically take place in universities, field stations, and museums that host about 8 to 10 students for 8 to 10 weeks in the summer. The REU program often offers a more in-depth experience compared to a research assistantship, as it involves completing a research project with deliverables, and provides mentoring, professional development, and a cohort experience (Haacker and Dalbotten, 2020; McDevitt, Patel, and Ellison, 2017).

REU program coordinators play an outsized role in providing such immersive student research experiences. Program coordinators are responsible for the entire programmatic effort and the well-being of their participants. This includes recruiting diverse applicants, ensuring an equitable selection process, finding and preparing mentors, operating logistics, such as pay, travel, and housing, organizing professional development training, a final event, and program evaluation, and supporting students in their pursuit of graduate school, jobs, or attendance at conferences. On top of this, REU program managers set the tone and atmosphere of their program. They welcome students upon arrival, facilitate cohort-building, and provide ongoing support throughout. This must ensure that all interns are safe in the lab and field, and that bullying, assault, and harassment are not tolerated. It is a heavy load, and while it is rewarding to witness the impact on student lives, it is an effort that is not fairly compensated for financially, or adequately recognized by academia for those on the path to tenure. Still, these dedicated educators persist because of their awareness of the impact and passion to contribute to change.

During the COVID-19 lockdowns in 2020 – 2021, internship providers and students faced tremendous obstacles. According to the National Association of Colleges and Employers, about 60% of students between 2013 and 2017 participated in internships, but by 2021 that proportion had steeply declined to 21.5% (Hora et al., 2021; Koc et al., 2017). NSF REU programs, particularly in the Directorate of the Geosciences (GEO), fared better, with approximately 50% of programs having ran research internships, most of them remote, and another 25% having offered some kind of programming, such as professional and cohort

development (Sloan et al., 2020). For the REU hosts that continued remotely during the COVID-19 pandemic, rapid adaptation to online mentorship and research was critical. These programs focused primarily on scaling up remote programming for students and enhancing the remote experience - although there was apprehension on how to properly engage students from a distance (Erickson et al., 2022). Adapting to remote mentorship demanded innovative solutions, of which included increasing digital communication skills and remote collaboration (Sloan et al., 2020).

The relatively high number of GEO REU sites that were active in summer 2020 was in part a result of the NSF GEO REU Network, which provides "guidance on creating and running an engaging and inclusive REU program" (Sloan and Haacker, 2020). March – May of 2020, the GEO REU Network ran weekly meetings to support program coordinators. During and after the summer of 2020, coordinators expressed that the network support encouraged them and that the ideas for adapting inspired them with modified models of programming. At the end of one of these informal zoom conversations, one coordinator said "I was going to cancel my REU program, but after hearing your ideas, I am going to put something together for the students." Another coordinator wrote via email that "The Network was essential when we all had to confront the COVID pandemic and its impacts on our REU sites." The GEO REU Network also provided online professional development workshops to about 50 REU interns in 2020, interns whose programs had been canceled and who were invited into one of three pop-up or temporary REUs. This series has been continued based out of the National Center for

Atmospheric Science and was held in 2021, 2022, and 2023, serving over 1,000 students combined.

Challenges and the strategies that internship providers and their support networks employed to overcome them in the first couple years of the pandemic are well-documented (Chin, 2020; Collins et al., 2022; Erickson et al., 2022). Less research has examined how internship programs have changed from this experience and the ongoing or novel challenges that internship providers face amidst a changing COVID-19 landscape. To investigate this gap, the GEO REU Network teamed up with researchers from Texas A&M University at Galveston to survey the 81 site programs in the NSF GEO Directorate.

II. Methodology

The purpose of the study was to examine the effects of COVID-19 on NSF GEO REU site programs for the academic year 2021 – 2022 or summer 2022. A survey was sent out to members of the GEO REU email listserv that serves the REU programs in the Division of Atmospheric and Geospace Sciences (AGS), Division of Earth Sciences (EAR), Division of Ocean Sciences (OCE), and the Office of Polar Programs (OPP). The survey instrument went through several rounds of review to ensure that the questions and response categories were well phrased and would yield valid and reliable results. The instrument included 18 questions that asked program coordinators for basic information about their REU programs, student recruitment, application, and enrollment processes, and their experiences administering the

program. See the appendix for a copy of the survey questions (which will be made available via a public repository upon publication).

The online survey was administered via Qualtrics to the target population, which included both the PIs and Co-PIs of NSF GEO REU site programs. PI and Co-PI contact information was compiled from the NSF website (https://www.nsf.gov/crssprgm/reu/reu_search.jsp) into a mailing list that was then uploaded into Qualtrics and used to distribute the survey. This included a total of 87 PIs and 45 Co-PIs or program coordinators. The survey was live for approximately five weeks from September 6th to October 13th, 2022. One week after first receiving an invitation to participate in the survey, those who had yet to respond received a reminder email that was automatically generated by Qualtrics. One week after reminder emails were sent out, a separate email with an anonymous link to the survey was sent via the REU-GEO listserv, which is hosted by the GEO REU Resource Center. The listserv is a forum primarily for PI and Co-PIs of GEO REU site programs. The intent behind distributing the survey via both the listserv and the mailing list was to improve the response rate by initiating multiple modes of contact. Utilizing the listserv may also have widened the pool of respondents.

III. Results

Respondent and Program Characteristics: We received 47 completed responses to our survey, of which nearly two-thirds (62%) of respondents identified as Principal Investigators (PIs), less than one-third (28%) identified as Co-PIs, and a tenth (10%) identified as program coordinators.

Respondents reported that their programs annually hosted 11 students on average (SD = 5.18), with about a third (64%) providing computational experiences, over three-quarters (81%) providing field-based experiences, and nearly all (87%) providing lab experiences for their REU students. All but two respondents (96%) reported running their program in person in 2022, with one reported having run a hybrid program and another reported having canceled their program.

Student Application Numbers: Our first set of questions asked respondents about their student application process. We were particularly interested in the number of applications received and any perceived shifts in the demographics of the applicants. On average, respondents reported having received 132 applications (SD = 95). However, there was quite a bit of variation between programs, with over half (51%) of the respondents reporting having received fewer than 100 applications and nearly a quarter (19%) reported having received over 200 applications (see Figure 1). When asked how the number of applications compared to those received on average pre-pandemic, almost half (43%) of the respondents reported having received fewer applications, while over a third (38%) reported having received about the same, and a little over a tenth (13%) reported having received more (see Figure 2). Most (57%) respondents noticed no difference in the demographics of applicants. However, of those who did, half (50%) reported having received fewer applications from students from marginalized backgrounds, while over a quarter (29%) reported having received more.

[INSERT FIGURE 1 HERE]

[INSERT FIGURE 2 HERE]

Post-acceptance Student Withdrawal: Because we were interested in how the pandemic impacted student enrollment, we asked about the number of students who declined to participate after having accepted a spot in an REU program. Over half (55%) of respondents reported having at least one student pull out of their program after having accepted, while over a third of respondents (39%) reported having three or more students withdraw post-acceptance (see Figure 3). Of the 24 students who withdrew, only one reported that it was due to concerns about contracting COVID-19. None reported having students withdraw from the program because of them having contracted COVID-19. While nearly a third (29%) of students cited a family member in need of assistance as their reason for pulling out, most students (80%) stated that it was because they had accepted a different internship opportunity.

[INSERT FIGURE 3 HERE]

Direct Impact of COVID-19 on Programs: We asked respondents how the pandemic impacted key elements to successfully running their REU programs (see Figure 4). Respondents reported that the biggest impact was on the level of student participation. Nearly three-quarters (72%) reported that student participation had been affected, and when asked to elaborate, most (73%) reported interruptions or cancelations to their regular scheduling usually related to COVID-19. The most common reason cited for the disruption was that participants had to be

isolated in quarantine, after having been exposed to or tested positive for COVID-19. Despite this, less than a third (29%) of respondents reported that having to move to an online or hybrid model affected their programs.

Pandemic Impacts on REU Cohort-building and Supervision: According to respondents, the second biggest impact of the pandemic was on cohort bonds, with over half (52%) reporting small or moderate impacts and over a tenth (15%) reporting greater impacts. Similarly, most (57%) respondents reported negative impacts of the pandemic on student networking opportunities. Student communication with program leadership, however, was less impacted, with only half (50%) of respondents reporting any impact, and of those, most (61%) reported only small impacts. Likewise, only a little over a quarter (28%) reported moderate or greater impacts on student supervision, and even fewer (15%) reported similar impacts on aligning mentor-mentee expectations.

[INSERT FIGURE 4 HERE]

Lack of Institutional Support: One barrier to running programs reported by the majority of respondents (70%) was the issue of accessing support services at their home institutions. More than one quarter (28%) struggled with accessing administrative or financial support, and another quarter (28%) reported difficulty with accessing student health services. Over a quarter (26%) of those who reported having issues cited problems with securing housing accommodations for students. About one quarter (24%) reported difficulties with being able to

provide students with food services. Accessing COVID-19 guidance or support, as well as issues with technical support, were also common, with nearly a quarter (20%) and over a tenth (15%) of respondents citing those problems, respectively.

Creative Adaptations to the Pandemic Situation: To help overcome COVID-19 impacts on key elements to program success, respondents implemented numerous and innovative strategies, which generally fell into three categories, increased communication, creative research and professional development structures, and social activities:

1. Communication: Well over two-thirds (80%) of respondents reported scheduling frequent one-on-one meetings with students to check on them and their progress in the program. Over half (61%) used social media platforms, such as Slack and GroupMe, to communicate with students. At the same time, several REU program coordinators commented that such platforms were less helpful in an in-person setting than they had been in previous years when programs were online.

2. Creative research and professional development structures: Many respondents (61%) utilized paired group work to enhance student research experiences, and almost half (49%) provided students with unstructured workspaces, such as open meetings or virtual office hours. Several respondents (61%) also utilized the summer professional development workshops provided by the GEO REU Resource Center.

3. Augmented social activities: Over three-quarters (80%) offered structured social activities, such as field trips, while over a tenth (15%) reported success with unstructured social activities, such as having graduate assistants invite REU students to participate in out-of-program activities like playing trivia or going to the movies. In all, most (85%) respondents reported being satisfied with how their REU program ran (see Figure 5).

[INSERT FIGURE 5 HERE]

IV. Concluding Discussion

During the year surveyed, NSF GEO REU PIs and Co-PIs reported high levels of program satisfaction, despite facing myriad ongoing and novel challenges related to the COVID-19 pandemic. Many of these challenges reflected a changing COVID-19 landscape, with which program coordinators proved especially resilient. Despite nearly half of respondents reporting having received fewer applications compared to pre-pandemic years, they were able to meet diversity goals, with two-thirds (63%) of participants across all reporting GEO REUs self-identifying as underrepresented racial or ethnic minorities (Rom, Grant, and Morris, 2021).

Student selection processes were further complicated by the high number of students who declined participation after having accepted. Having students pull out of programs often results in significantly more work for program coordinators. They must now try to fill those slots with students who contribute to a balanced cohort, help meet diversity and program goals, and who

are interested in accepting the opportunity. This takes additional time in what is already a very time- and effort-intensive and constrained process; it is now late in the season for making offers, and the pool of desired applicants is smaller.

The most common reason given by students withdrawing after having accepted a spot in an internship was that they had accepted another internship opportunity. Given the increased stress and workload this creates, future research could explore which students are receiving more than one offer, which programs are making the offers, and when the programs are making offers. For example, are students from marginalized backgrounds or those with majority identities receiving more than one offer? Future research could examine whether students are declining these positions to be able to accept offers with other REUs programs in particular, or with non-REU internships with other organizations, such as National Oceanic and Atmospheric Association, the General Services Administration, or the private sector. If students are declining participation to accept positions in other REUs, the NSF could consider policies to help alleviate this problem, such as broader and more rigorous enforcement of the March 15th acceptance deadline that the GEO REU recommends for its REU site programs. NSF might also encourage program coordinators to create a wait-list of candidates who are on stand-by, a list that will likely have as much potential as the first-choice candidates.

Success was also widespread, despite this being the year that many respondents transitioned their programs from online to in-person. Similar to the previous couple of years, COVID-19 disruptions, particularly from students or personnel having to quarantine, caused missed,

rescheduled, and sometimes canceled programming. Several respondents discussed the importance of being flexible and able to transition online or function in a hybrid fashion when needed, a skill many had doubtlessly honed over the last couple years. Experimentation during the previous years may also have contributed to program success, as many respondents reported positive outcomes from the diverse and varied strategies implemented to help overcome COVID-related challenges. Nonetheless, consistent with previous studies on the effects of COVID-19 on internships (see Chin, 2020; Collins et al., 2022; Erickson et al., 2022), we found difficulties with cohort development and social networking commonplace. This may be unsurprising, given the pervasive disruptions of COVID-19 on programming. However, it could also reflect higher levels of anxiety (Mundasad, 2023) and diminished development in social and executive functioning skills (Aizza, Porter, and Church 2023) among young people post-pandemic.

Changing student needs, emotional, cognitive, and social, are an important consideration, as REU PIs and Co-PIs continue to adapt their programs to a changing post-pandemic landscape. So too is the loss of institutional and cultural knowledge, given the high number of staff and faculty turnover amidst the Great Resignation (see Sull, Sull, and Zweig, 2022). Nearly two-thirds of responding internship leads reported having difficulties accessing institutional support services essential to program success, although no one service proved more problematic to access than the other. This suggests that staff turnover was a generalized and widespread challenge for program coordinators seeking essential support at their home institutions. Future research could more closely identify the strategies program coordinators employed to help

overcome these institutional barriers to success, and specific ways that the GEO REU Network provided support. Future research could also more carefully examine how the need for various student support services have changed, and whether institutions are responding to those changes as they rebuild their support systems post-pandemic. While overall our research demonstrated the resilience of GEO REU leaders, it also pointed to several ongoing and novel pandemic-related challenges, particularly in recruitment and program administration, which warrant closer examination, as NSF REU programs continue to adapt to post-pandemic changes.

V. Conflict of Interest, IRB, & Data Availability Statements

The authors state that there is no conflict of interest to disclose.

This research was approved by the Texas A&M University Institutional Review Board. It was deemed exempt.

The data underlying this study are not publicly available due to privacy issues. Due to the small N in this study and risk of respondents being identified by their survey responses, the researchers do not have IRB approval to publicly share the data. They are available from the corresponding author upon reasonable request.

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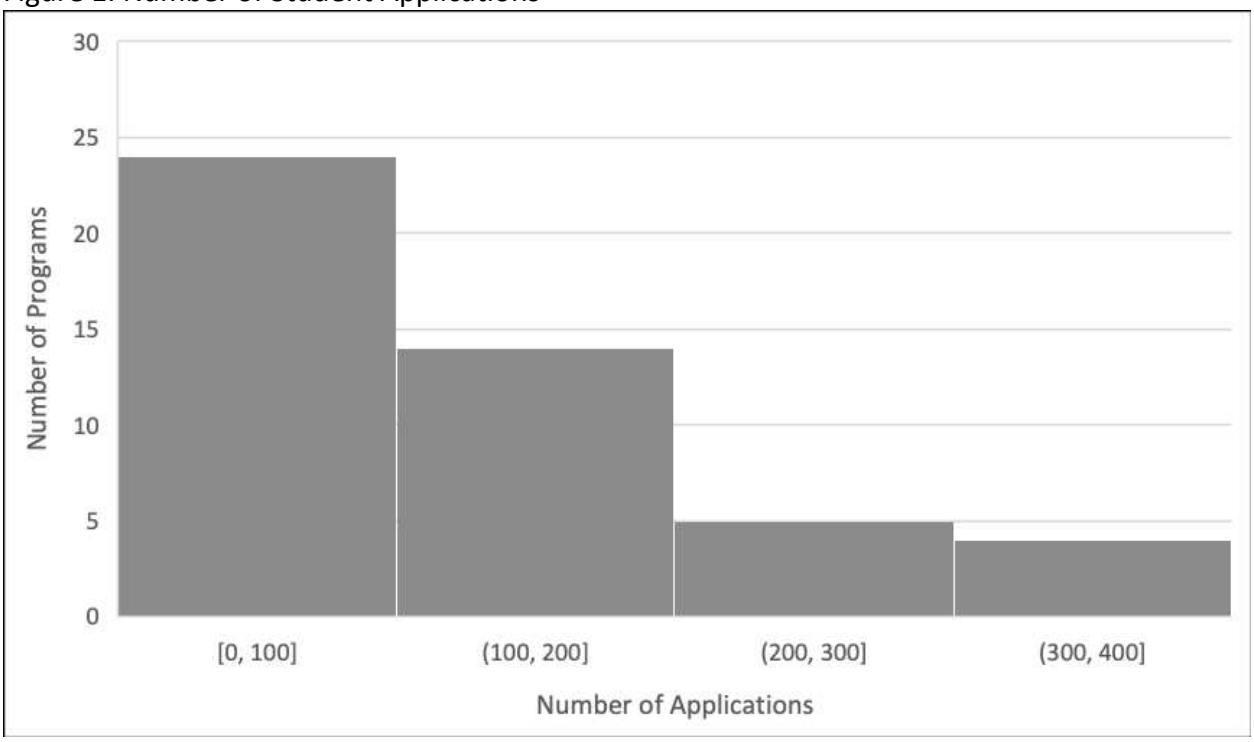
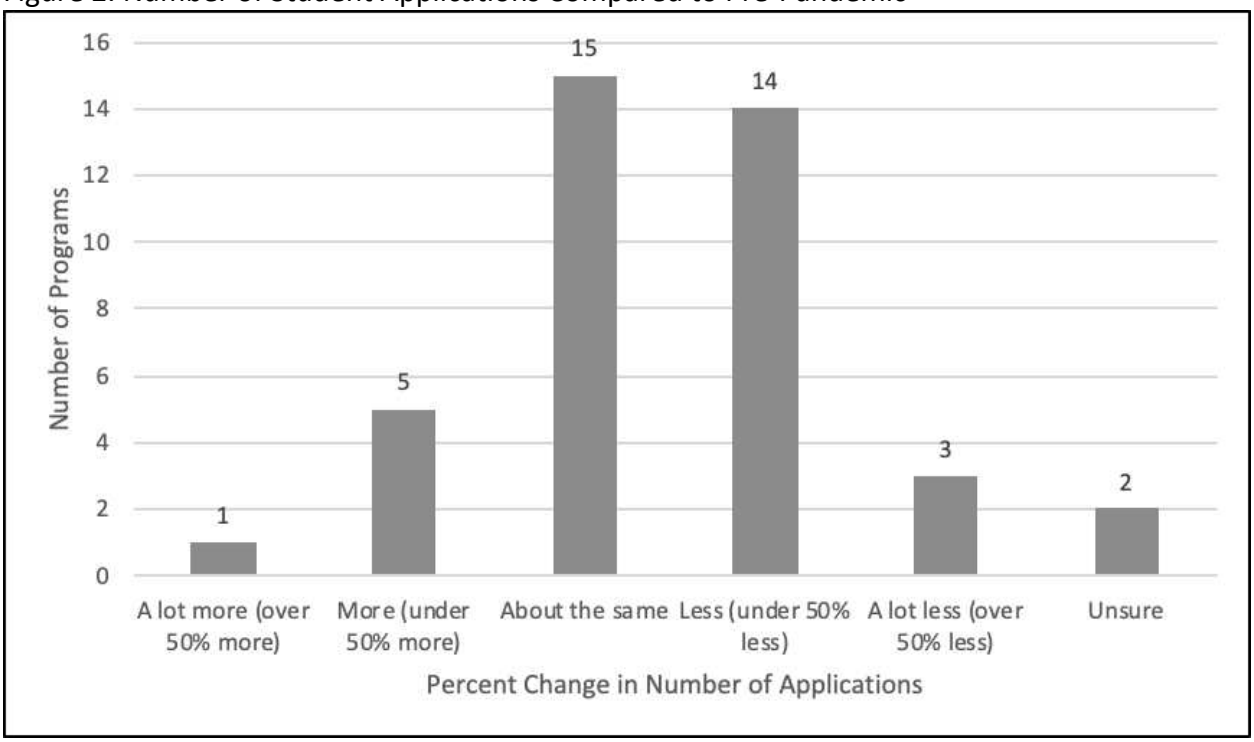
Figure 1. Number of Student Applications



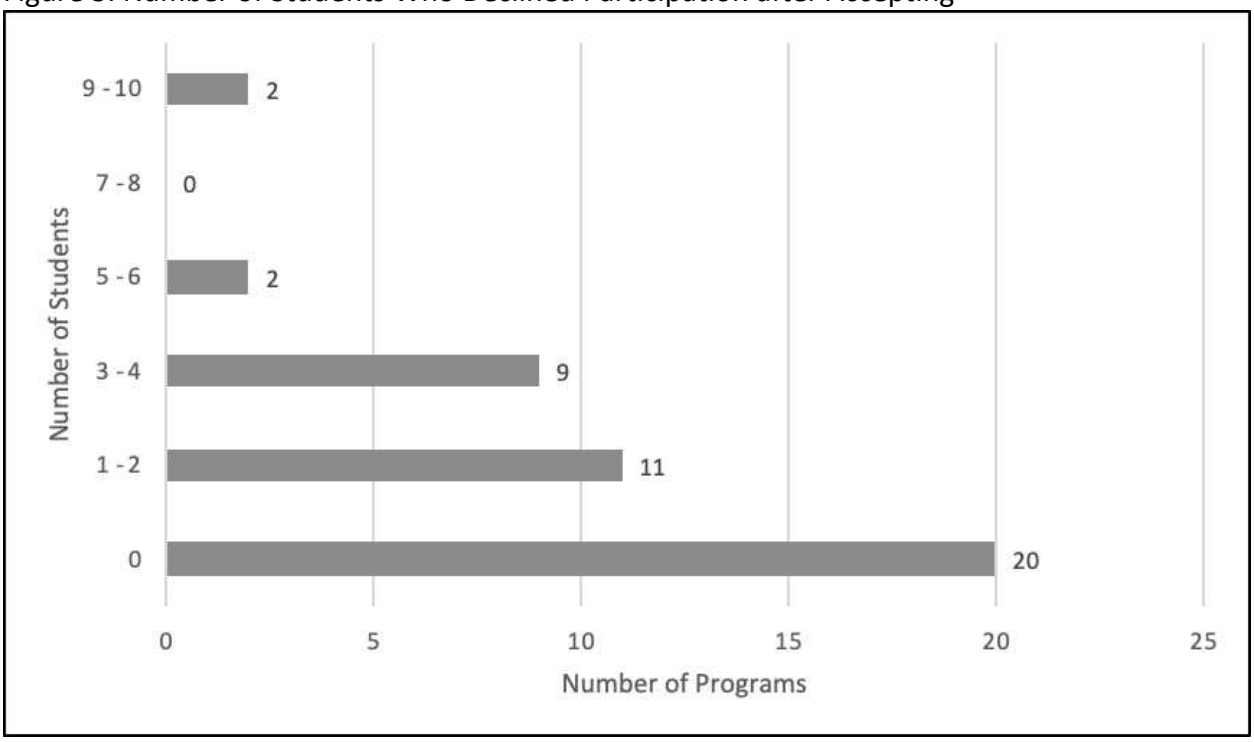
N = 47

Figure 2. Number of Student Applications Compared to Pre-Pandemic



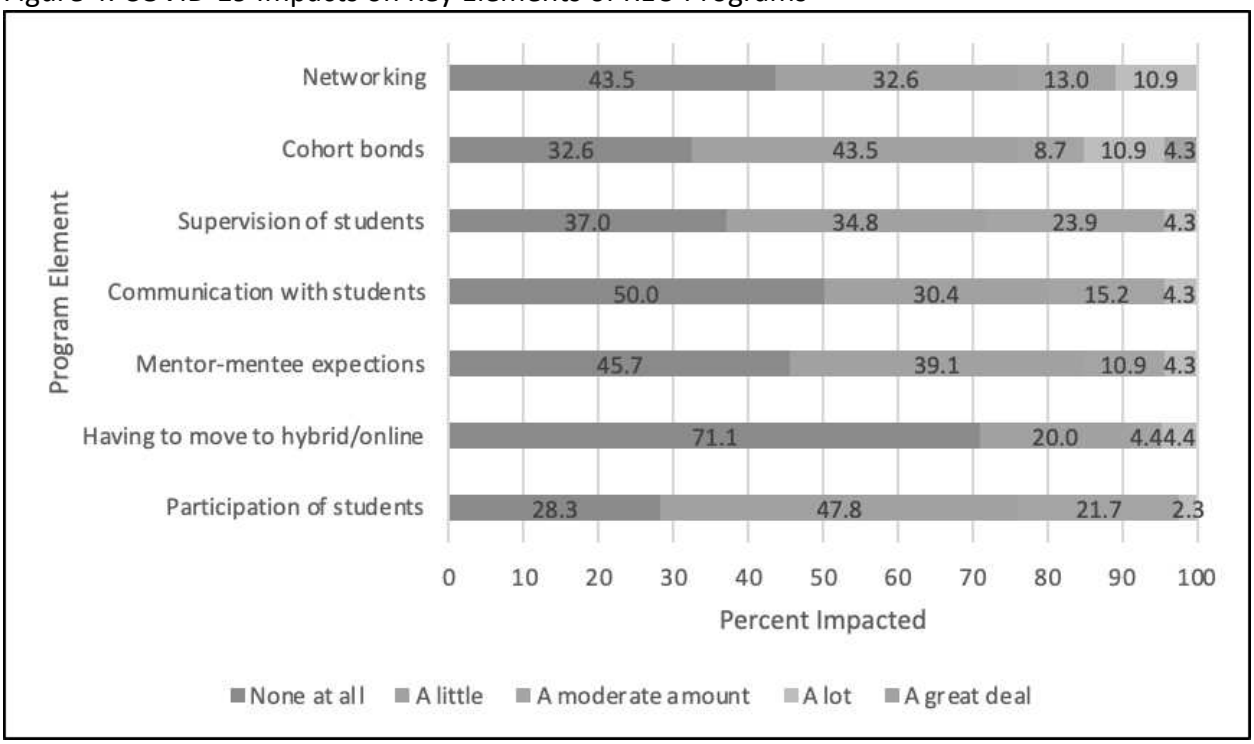
N = 40

Figure 3. Number of Students Who Declined Participation after Accepting



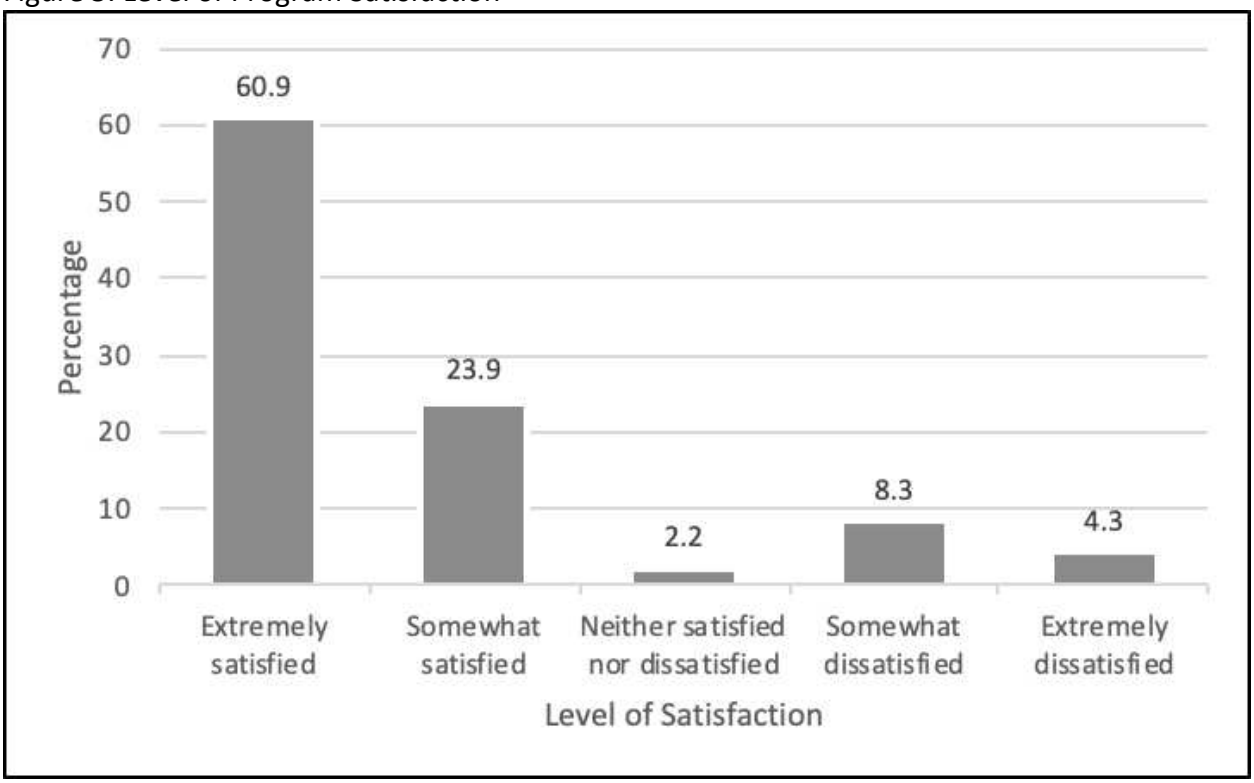
N = 44

Figure 4. COVID-19 Impacts on Key Elements of REU Programs



N = 46

Figure 5. Level of Program Satisfaction



N = 46