EXTERNAL EVALUATION OF UNAVCO VIRTUAL SUMMER INTERNSHIPS, SUMMER 2020

Heather Thiry, Ph.D.
GOLDEN EVALUATION & POLICY RESEARCH
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Executive Summary

In spring of 2020, campuses and workplaces across the nation abruptly closed and shifted to remote operations due to the covid-19 pandemic. Many summer research opportunities and internships for students were cancelled. UNAVCO received funding from the National Science Foundation to create remote versions of their three summer internship programs. These internships are designed for students underrepresented in the geosciences and they target students at different stages in their education, from community college through graduate school. In these internships (Geo-Launchpad (GLP), Research Experiences in Solid Earth Science for Students (RESESS), and UNAVCO Student Internship Program (USIP)), students participate in professional development workshops and activities, and receive mentoring from professional scientists to complete a research, or pre-research, project in the geosciences. The general goals of the programs are to: 1) engage students in an extended technical or research project, 2) provide students with an overview of geoscience careers, 3) develop students’ professional networks and skills, 4) provide mentoring in completion of an open-ended project, and 5) enhance students’ capacity to pursue and be successful in geoscience careers. Due to covid-19, all three internships programs and their professional development offerings were shifted to a virtual environment for summer 2020. External evaluation of the virtual internships included pre-post intern and mentor surveys and end-of-summer focus group interviews with interns.

Key evaluation findings are:

Similar to findings from the external evaluation of previous years of GLP in-person internships, interns across all three virtual programs made the strongest gains in knowledge and awareness of geoscience career paths and in their capacity to use the major instrumentation or software in their discipline. However, technical gains were slightly less in the remote internship than the in-person internship, which likely represents the loss of introduction to technical instrumentation that must be operated in person or that is more suited to a face-to-face environment.

There were some differences in interns’ reported outcomes among programs, notably the RESESS interns reported the most gains from the virtual internship, followed closely by the GLP interns. Though USIP interns noted many positive outcomes in the focus group interview, the survey results showed that they remained steady in most areas, with slight increases in the career/professional domains and technical skills.

Mentors rated interns equivalently, but slightly lower, than interns’ self-reported gains from the internship. Overall, interns reported higher career interest
than observed by mentors, which might be expected because interest is difficult to objectively observe. On the other hand, interns and mentors observed almost equivalent rates of learning gains in other areas, such as organizational skills, technical skills, and intellectual gains (i.e., capacity to conduct research). Therefore, interns provided relatively accurate self-assessments of their learning gains from the internship. Overall, mentors observed relatively strong professional and scientific learning gains from interns.

**Knowledge of Career Paths and Resources**

The professional development aspects of the program, such as mentoring in career development and awareness, seemed to translate the most effectively to a virtual environment. Across the board, interns’ strongest growth was in awareness of career paths in the geosciences and knowledge of career resources.

- The percentage of interns who felt that they were aware of career resources in geoscience rose from 50% to 100%.
- In interviews, interns highlighted that the Career Circles were the most effective program element in building their knowledge about geoscience career options and their understanding of how to pursue a career in the field.

**Technical Skills**

Interns reported growth in their understanding of technical tools and software in the geosciences and their ability to apply those tools to analyze data or for other scientific purposes. Generally, RESESS and GLP interns reported stronger gains in technical skills than USIP interns, who entered the internship with a robust understanding of technology and instrumentation used in geoscience.

- For instance, 100% of USIP students entered the internship with an existing awareness of the major tools in the discipline, while only 30% of RESESS/GLP interns did. The percentage of RESESS/GLP with awareness of the major technical tools in the discipline rose from 30% to 83% from the internship.

**Career Preparation**

Interns made substantial progress in feeling prepared for a geoscience career, especially in their understanding of the everyday work of geoscientists. Surprisingly, there were few to no differences across programs in interns’ perceptions of their readiness for a geoscience career, as interns from all programs felt that the internship had increased their readiness for a geoscience career.
Interns made the strongest gains in understanding the everyday work and practice of scientists. For instance, 50% of GLP interns, 17% of RESESS interns, and 50% of USIP interns felt they understood the work of geoscientists at the start of the internship. At the end of the internship, 100% of GLP interns, 67% of RESESS interns, and 100% of USIP interns felt they understood the nature of everyday work in professional geoscience.

Collaboration and Networking

Interns gained the ability to interact with mentors and to view peers as colleagues. They gained less capacity to network with scientists, perhaps due to the limited interactions with other scientists on a day-to-day basis. Interns also appreciated having a partner to collaborate with on scientific projects. Interns reported that the partnerships went well, but there were some challenges related to communication and project coordination in the virtual environment.

• RESESS interns made the strongest gains in collaboration and networking. Only half of RESESS interns knew how to interact with a mentor to benefit their scientific development at the beginning of the internship, yet 100% had this capacity at the end of the internship.

Scientific Communication Skills

Interns made slight gains in their scientific communication skills, though somewhat less than in previous external evaluations of in-person internships. Surprisingly, interns remained steady in their ability to prepare a scientific poster, as nearly all interns entered the program feeling that they had the ability to create a poster (rising from 82% to 100% of interns).

• RESESS interns gained the most ability to communicate scientific findings in professional venues. For instance, only 50% of RESESS interns felt that they could prepare a scientific poster when they entered the program (GLP interns and USIP interns reported higher rates). At the end of the internship, 100% of interns in all programs felt that they could prepare a scientific poster and 55% of those students marked “strongly agree.”

Intellectual Gains

Interns demonstrated slight growth in many areas related to scientific thinking and their capacity to conduct research. Interns remained steady in some areas, such as understanding important concepts in their field, problem-solving skills, and readiness to conduct research. The virtual environment may not lend itself
as well to developing deep understanding of scientific thinking and research processes. Interns demonstrated greater growth in concrete cognitive areas and less growth in more abstract, conceptual processes, such as problem-solving or generating a research question.

- Interns reported the most growth in their understanding of how the content of the internship connected to their studies (rising from 80% to 100% of interns who understood the connection over the summer).

**Organizational Skills**

Interns reported slight gains in project management and organizational skills on the survey. Mentors also observed growth in interns’ ability to organize their tasks and meet deadlines. However, in interviews, interns reported that they struggled with time management and procrastination in the unstructured environment of virtual scientific work.

**Career Interest and Self-Efficacy**

Interns’ interest in a geoscience career and confidence that they could do well in a geoscience career remained relatively constant throughout the internship, mostly because interns entered the program with very high interest in a geoscience career. Therefore, the internship served to sustain that interest, rather than build it.

- The percentage of interns who strongly agreed that they were interested in a geoscience career rose from 66% to 78%.

**Mentor Outcomes**

Mentors’ general ability to supervise, guide, mentor, and provide career advice to interns remained steady over the summer, because many mentors already had strong mentoring ability and experience. However, mentors reported increases in their ability to mentor in a virtual environment, particularly their capacity to design projects and tasks for students to complete remotely.

- 64% of mentors felt that they could effectively develop virtual projects in geoscience for students at the beginning of the summer, while 93% believed that they could do so at the end of the summer.
- The percentage of mentors who felt they could effectively address mentoring challenges in a virtual environment rose from 80% to 100%.
Implementation of the Virtual Internships

Orientation and Onboarding

For the most part, interns reported that the orientation and onboarding process was smooth, including completing UNAVCO paperwork, acquiring their laptops, and becoming acquainted and introduced to each other and their projects. In particular, interns valued the team-building exercises at the beginning of the summer. One of the GLP teams had difficulty in receiving credentials and data from USGS which hindered their ability to engage in the project for part of the summer. However, those interns will be continuing with USGS on a contract basis, so they have the opportunity to complete their projects in more depth. Additionally, a few interns noted that mentors had used technical language that they did not understand at the beginning of the project and would have appreciated a less technical project introduction.

Technical Communication Tools

On the survey, interns reported that Google Calendar and Zoom were the most effective communication tools (100% of interns rated them effective or highly effective), while they rated Slack as the least effective (67% rated it effective or highly effective). However, in interviews, the interns noted that they preferred Slack to email and they appreciated that correspondence was faster in Slack. They also valued the “fun” Slack channels and politically-motivated Slack channels that arose over the summer which provided opportunities for more informal communication and for interns to get to know each other.

Nevertheless, the vast majority of interns (90%) had problems with unreliable wifi which occasionally hindered their ability to participate in Zoom meetings or complete work tasks. A few interns even experienced extended wifi outages. One team of GLP interns also had problems with laptops that occasionally went black during Zoom meetings.

Stipend

All of the interns (100%) were highly appreciative of the stipend and they felt it was an appropriate amount of funding. About 1/3 of the interns spent it on living expenses, about 1/3 spent it on software, supplies, and other work-related expenses related to their computer or home office, and 1/3 put it in emergency savings accounts (many of these students commented that they had no savings).

Mentoring and Support
Overall, interns were highly satisfied with the mentoring and support that they received during the virtual internship. However, they were not entirely comfortable in the virtual environment and most would have preferred an in-person internship, if it had been available. The virtual internship was successful enough that 56% of interns stated that they would participate in one again, although the remainder were not sure (assuming that the choice would be between an in-person or virtual internship).

- 100% of interns found their mentor(s) to be helpful and supportive.
- 89% of interns received the support that they needed to be successful.
- All interns (100%) were appreciative of the support and encouragement that they received from UNAVCO program staff.
- However, interns generally wanted more interaction over the summer (only 33% were satisfied with the amount of interaction they had).
- No interns felt more comfortable in the virtual environment than in-person, so there was a strong desire for a face-to-face internship, if that had been possible.

Advice for Future Implementation

Mentors and interns stressed the importance of flexibility and adaptability in the scientific work and tasks to ensure a successful internship and experience. Career Circles and other professional development offerings maintained their effectiveness in the virtual environment, so those offerings could even be expanded if future virtual internships are a necessity. Finally, interns and mentors strongly emphasized the importance of frequent communication throughout the internship, particularly via video chat. Interns appreciated the team-building activities in the beginning of the internship and requested more social activities or informal activities for them to get to know each other throughout the summer. Overall, interns and mentors developed the relationships they needed to be successful and to support the interns' development; however, those relationships required frequent communication, intentional and clear communication, and strong encouragement and support from mentors.
Introduction

Despite recent attention and efforts to foster inclusiveness in STEM fields, women, low-income, and marginalized racial/ethnic groups continue to be severely underrepresented in most fields within the geosciences. To provide equitable access to STEM careers and to meet national workforce needs, participation in the geosciences must be broadened to women and students from traditionally underserved populations. To this end, UNAVCO offers three summer internship programs for students at different stages in their education, from community college through graduate school. In these internships (Geo-Launchpad (GLP), Research Experiences in Solid Earth Science for Students (RESESS), and UNAVCO Student Internship Program (USIP)), students engage in professional development workshops and activities, and receive mentoring from professional scientists in completing a research, or pre-research, project in the geosciences. The general goals of the programs are to: 1) engage students in an extended technical or research project, 2) provide students with an overview of geoscience careers, 3) develop students’ professional networks and skills, 4) provide mentoring in completion of an open-ended project, and 5) enhance students’ capacity to pursue and be successful in geoscience careers. Recruitment and selection for the three internship programs occurred in early 2020, prior to the widespread closures and stay-at-home orders from COVID-19. Subsequently, UNAVCO received National Science Foundation funding to shift the internships to a virtual environment to continue to engage and serve students through these pre-professional opportunities during the COVID-19 pandemic.

Evaluation Design and Methods

The external evaluation of the UNAVCO virtual internships parallels the previous evaluations of the GLP program. The evaluation contains summative elements to document student and mentor outcomes from the internship and formative elements to provide guidance and feedback if there is a need to conduct virtual internships again in the future. The goals of the evaluation were similar to prior external evaluations of the GLP program, with the added goal of documenting outcomes from the virtual component of the internship and soliciting feedback about the efficacy of various aspects of the internship, such as technical communication tools, professional development opportunities, and virtual networking and
mentoring. The evaluation used mixed-methods measures, including pre-post surveys of interns and mentors and focus group interviews with each group of interns.

Evaluation Questions

The external evaluation was guided by the following questions:

1. Has interns’ knowledge about geoscience career options, and their capacity to pursue these careers increased from their participation in the virtual internships?

2. Has interns’ capacity to engage in scientific research, especially technical, networking, and scientific communication skills, increased from their participation in the virtual internships?

3. Which program elements are most and least effective in a virtual environment?

4. Are there differences in outcomes across programs?

5. Has mentors’ ability to provide mentoring in a virtual environment increased?

6. How might the internship be modified, if needed, for future virtual internships?

Evaluation Instruments

Data were collected using a modified version of the Undergraduate Research Student Self-Assessment (URSSA) instrument (Hunter, Weston, Laursen & Thiry, 2009). The URSSA was developed with funding from the National Science Foundation to assess students’ personal, professional, and intellectual outcomes from participating in undergraduate research, including REU experiences. The survey items are rated on a 5-point Likert scale (1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree). Survey scales include networking/collaboration, intellectual gains, scientific communication, organizational skills, technical skills, career knowledge and career preparation. The networking/collaboration scale was added specifically for the UNAVCO internships to align with the focus on professional networking and scientific collaboration within UNAVCO programs. The survey also measured other aspects of the internship experience, including the impact of the internships on students’ educational and career aspirations. Items were also added
this summer to solicit feedback about the virtual nature of the internship, the virtual communication tools used, and access to support and mentoring in a remote environment.

Mentors completed a survey that paralleled the intern survey in some areas. Mentors were asked to rate their interns’ growth and development in certain areas, such as scientific communication skills and capacity to pursue a geoscience career. Mentors also provided feedback on the mentoring experience and the virtual aspect of the internship.

Intern and mentor surveys were administered as pre-post surveys at the beginning and end of the internship. Surveys were sent to participants’ e-mails through SurveyMonkey. E-mail reminders were sent every four days to participants who had not responded. A total of three reminders were sent after the initial survey distribution for the pre- and post-surveys. All interns completed the pre-survey, although two students did not complete the post-survey. All interns participated in the focus group interview. All but two mentors completed the pre- and post-surveys.

Interns were also interviewed as a cohort group for each internship program at the end of the summer. Intern focus group interviews lasted about 30 minutes. The interview protocol covered the following topics: intern recruitment, onboarding process, mentoring, professional and scientific learning gains from the internship, career aspirations, and formative feedback about the virtual aspects of the internship. Mentors were not interviewed because there were multiple sets of mentors. Instead, open-ended survey items were added to the survey to address the topics that would have been covered in the interview, such as growth and development as a mentor, observations of interns’ professional growth and learning gains, and feedback about the virtual nature of the internship.

Analysis Methods

The analytic methods described in this section apply to all data collected for this report. The quantitative data were organized in a Microsoft Excel spreadsheet where descriptive statistics were computed. Frequencies and means are reported for most of the items. Groups of items were clustered into scales to assess student outcomes in a given domain. The average of the individual items that comprise each scale was computed for the scale mean. Items were rated on a 5-point Likert scale.
Tests of statistical significance, such as t-tests or one-way ANOVAs, were not conducted due to the small sample of participants.

Write-in responses to open-ended survey questions and interview transcripts were entered into NVivo qualitative analysis software and coded using procedures developed by Spradley (1980). Each new idea raised in a written response was given a unique code name. As these same ideas were raised by later respondents, each segment was added to an existing code reflecting that idea. At times, participants’ responses were brief and represented a single category, but more frequently, responses contained ideas that fit under multiple categories, and these were coded into each category separately. Codes were organized into larger, descriptive categories, or “domains.” Domains were generated deductively, from the program goals, and inductively, from the data itself. The domains and codes within them reflect the major themes that manifested in the interviews.

Program Descriptions

The UNAVCO internship programs focus on providing professional opportunities to conduct research, or pre-research, for diverse students at different stages in the educational pipeline. The GLP program focuses on community college students and provides pre-research opportunities for interns to engage in a technical task with a mentor. Interns worked in pairs in the virtual internship. The RESESS program for geoscience majors offers the opportunity for interns to engage in a scientific research project with a mentor. RESESS interns worked in pairs. The USIP program for graduate students also provides an in-depth, open-ended research experience with a mentor for interns. USIP interns worked individually on their projects. Additionally, UNAVCO provides professional development seminars for interns that introduce them to important career skills, such as resume writing and informational interviewing. UNAVCO also offers Career Circles in which professional geoscientists in different careers discuss the nature of their work and their personal career path. The remote format for the Career Circles allowed for national representation of geoscientists, rather than relying on local scientists for in-person sessions. The internships culminated in a virtual poster session in which interns communicated their results via flash talks of their virtual posters and the audience could interact with interns in virtual break-out rooms following the main poster session. RESESS interns also participated in scientific writing workshops and completed a scientific report.
Evaluation Findings

This section reports results from the data collected from the GLP, RESESS, and USIP virtual internship programs in summer 2020. The section briefly presents the demographics of program participants, and then provides context by describing interns’ motivations to participate in the virtual internship. The report is then broken into the following sections to report internship outcomes: Career knowledge, Technical skills, Career preparation, Collaboration and networking, Scientific communication, Organizational skills, Intellectual gains, Career interest and self-efficacy, and Career intentions. These sub-sections describe outcomes in these areas from the pre-post intern survey, intern focus group interviews, and pre-post mentor survey. The report concludes with a section related to the implementation of the virtual internship and recommendations for future implementation.

Student and Mentor Demographics

Four GLP interns, six RESESS interns and 2 USIP interns completed the survey. Overall, given the goals of the UNAVCO programs to broaden participation in the geosciences, the interns were quite diverse. The background and demographics of the interns were as follows:

GLP:

- 4 interns
- 50% male and 50% female
- 100% White/Caucasian
- 25% received a Pell grant (indicator of low-income status)

RESESS:

- 6 interns
- 50% female, 33% male, 17% identified as non-binary (1 student)
- 33% Hispanic/Latinx, 33% White/Caucasian, 17% African-American, 17% Asian/Asian-American, and 17% American Indian/Alaskan native (totals do not equal 100% because one student marked White and Asian descent)
- 66% first-generation college students
- 83% receive a Pell grant

USIP:
- 2 interns
- 100% female
- 100% White/Caucasian
- 50% first-generation college student

Interns’ motivations for participating in the internship

Interns expressed a variety of reasons for choosing the UNAVCO internship. Interns’ motivations did not differ dramatically across programs. Several interns stated that they wanted to gain experience in the field of geoscience, others wanted to gain a better understanding of what a geoscience career would be like, and a few interns wanted to gain skills and develop their capacity to conduct research.

Interns’ Professional and Scientific Outcomes

Although there were some differences across programs, interns displayed growth in almost all areas. Similar to previous years of GLP in-person internships, interns across all three programs made the strongest gains in knowledge and awareness of geoscience career paths and in their capacity to use the major instrumentation or software in their discipline. However, technical gains were slightly less in the remote internship than the in-person internship which likely represents the loss of introduction to technical instrumentation that must be operated in person or that is more suited to a face-to-face environment. Due to the virtual nature of the internship, interns mostly relied on software such as ArcGIS and Python. Nevertheless, interns’ gains in professional and scientific areas were similar to those from in-person internships.
There were some differences in interns’ reported outcomes among programs, notably the RESESS interns reported the most gains from the virtual internship, followed closely by the GLP interns. Though USIP interns noted many positive outcomes in the focus group interview, the survey results showed that they remained steady in most areas, with slight increases in the career/professional domains and technical skills. Overall, interns in all programs reported the strongest gains in knowledge about careers, and, to a lesser extent, technical skills. GLP interns gained career interest, while interns in the other programs remained steady/declined slightly in that area. The RESESS program seemed to adapt to a virtual environment the most effectively, and this may be because the interns are independent enough in their studies to benefit from the virtual environment, but not so advanced in their studies that they were already familiar with concepts or tools used in the internship. The educational stage of the RESESS program and nature of the research projects may lend itself to a virtual environment slightly more so than the GLP program for novices and USIP program for graduate students. Nevertheless, interns from all programs reported gains in many professional and scientific domains.
Table 1. Professional and Scientific Outcomes, by internship program

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<th>Geo-Launchpad</th>
<th>RESESS</th>
<th>USIP</th>
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<td></td>
<td>PRE</td>
<td>POST</td>
<td>DIFF.</td>
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<tr>
<td>Career Knowledge</td>
<td>3.83</td>
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<tr>
<td>Technical Skills</td>
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Mentors’ Ratings of Interns’ Learning Gains

Mentors rated interns equivalently, but slightly lower, than interns’ self-reported gains from the internship. Overall, interns reported higher career interest than observed by mentors, which might be expected because interest is difficult to objectively observe. Nevertheless, mentors did perceive relatively high interest in geoscience careers among interns. Interns also rated their growth in collaboration/networking and scientific communication as slightly higher than observed by their mentors, yet mentors still observed moderately strong gains in these areas (about 4 on a 5-point scale). On the other hand, interns and mentors observed almost equivalent rates of learning gains in other areas, such as organizational skills, technical skills, and intellectual gains (i.e., capacity to conduct research). Therefore, interns provided relatively accurate self-assessments of their learning gains from the internship. Across the board, mentors observed relatively strong professional and scientific learning gains from interns.
Mentors also described interns’ scientific and professional learning in response to an open-ended question. Mentors were asked to write about interns’ greatest scientific or professional outcomes from the summer and some mentors described several outcomes. Not surprisingly, mentors focused on what is more readily observable, such as gains in scientific communication skills and ability to use technical tools and software. The most common response was scientific communication skills, especially in relation to the preparation of the scientific poster and reports. Some mentors also described interns’ increased ability to follow through on tasks and to meet deadlines. Some mentors described gains in career preparation, but not necessarily in terms of the skills they learned in seminars, such as interviewing or resume preparation. Instead, mentors mentioned that interns had gained the skill to be flexible and adaptable in work environments and to deal with challenges, essential “soft skills” for scientists. Finally, a few mentors noted that interns were more prepared to conduct research or had gained a better understanding of the research process. Following are a few typical observations from mentors:

*Probably time management and organization skills because the RESESS program has such a strong structure. Poster construction and oral*
presentations were outstanding, so clearly those were areas where a high
degree of progress was made as well. – RESESS mentor

Time learning ArcGIS is probably the greatest hard skill. But really, I
think things like this, especially with the difficulties imposed by COVID-
19, help my student gain skills in dealing with challenges in a
professional environment, and how to adapt and be nimble when
circumstances require. How to perform under pressure, when things are
difficult. Those skills I think are important. And doing a poster
presentation - that is huge, even if it was virtual. – GLP mentor

Persistence. The students were met with several roadblocks throughout
the course of their internship, but they maintained focus and completed
their tasks with resources available to them. This required some creative
thinking and adaptation in order to still be successful. – GLP mentor

Visualizing data, presenting research to a general audience, designing
posters and presentations, understanding the complexities of the research
process. – RESESS mentor

Figure 3. Interns’ Strongest Learning Outcomes, as observed by mentors

<table>
<thead>
<tr>
<th>Interns' Strongest Learning Outcomes</th>
<th>% of Mentors Reporting Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific Communication Skills</td>
<td>55%</td>
</tr>
<tr>
<td>Technical Skills</td>
<td>27%</td>
</tr>
<tr>
<td>Organizational skills</td>
<td>27%</td>
</tr>
<tr>
<td>Career/Professional Preparation</td>
<td>27%</td>
</tr>
<tr>
<td>Intellectual Gains/Capacity to Conduct Research</td>
<td>18%</td>
</tr>
<tr>
<td>Career Knowledge</td>
<td>9%</td>
</tr>
</tbody>
</table>

% of mentors reporting outcome, some reported more than one outcome
For the most part, mentors rated interns’ gains slightly lower than the interns themselves across all of the programs, with the exception of a few areas for USIP interns. Largely, mentors did not always observe the career knowledge that interns gained from the program as interns rated their own growth in this area as higher than mentors did. Interns also rated their gains in collaboration/networking higher than mentors did. The discrepancies were slightly more in the Geo-Launchpad group, perhaps because of the novice status of the GLP interns. GLP interns perceived strong gains because they could reflect on how much they had learned and grown from the summer internship which they entered as complete novices, while mentors could observe, from their more experienced vantage point, how far they still have to go. Conversely, mentors, at times, observed more growth in the USIP interns than they observed within themselves. Overall, however, mentors’ and interns’ ratings of interns’ development did not differ dramatically. Moreover, our prior research through CU-Boulder on undergraduate research experiences has shown that mentors, because of their more advanced scientific status, can more accurately assess some learning gains in students than they can perceive in themselves (e.g., research skills, etc.). However, some developmental outcomes, such as confidence or interest, are difficult to observe and are more accurately self-reported.

Table 2. Mentors’ Observations of Interns’ Learning Gains, by program

<table>
<thead>
<tr>
<th></th>
<th>Geo-Launchpad</th>
<th>RESESS</th>
<th>USIP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mentor</td>
<td>Intern</td>
<td>DIFF. (M-I)</td>
</tr>
<tr>
<td>Career Knowledge</td>
<td>4.33</td>
<td>4.67</td>
<td>-0.34</td>
</tr>
<tr>
<td>Technical Skills</td>
<td>3.78</td>
<td>4</td>
<td>-0.22</td>
</tr>
<tr>
<td>Career Preparation</td>
<td>4.43</td>
<td>5</td>
<td>-0.57</td>
</tr>
<tr>
<td>Collaboration/</td>
<td>4.23</td>
<td>4.58</td>
<td>-0.35</td>
</tr>
<tr>
<td>Networking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scientific</td>
<td>4.07</td>
<td>4.15</td>
<td>-0.08</td>
</tr>
<tr>
<td>Communication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organizational</td>
<td>4.04</td>
<td>3.97</td>
<td>0.07</td>
</tr>
<tr>
<td>Skills</td>
<td></td>
<td></td>
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</tbody>
</table>
Career Knowledge

The professional development aspects of the program, such as mentoring in career development and awareness, seemed to translate the most effectively to a virtual environment. Across the board, interns’ strongest growth was in awareness of career paths in the geosciences and knowledge of career resources. However, all interns demonstrated growth in all areas of career knowledge. The program elements such as Career Circles and other supplemental programming fostered students’ awareness and understanding of career paths in the geosciences and the educational background or credentials, and professional experiences needed to enter those careers.

Figure 4. Interns’ Gains in Career Knowledge, all intern programs

Interns’ Gains in Career Knowledge, all intern programs

<table>
<thead>
<tr>
<th>I am aware of the career resources available to learn about a career in the geosciences.</th>
<th>PRE</th>
<th>POST</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am aware of the various career options in the geosciences.</td>
<td>3.44</td>
<td>4.11</td>
</tr>
<tr>
<td>I understand the skills I need to pursue a geoscience career.</td>
<td>3.67</td>
<td>4.33</td>
</tr>
</tbody>
</table>

Interns made similar growth in all areas of career knowledge, including understanding the skills needed for a geoscience career and awareness of career paths. Students made the strongest gains in their awareness of career resources available to learn about geoscience careers. In fact, the percentage of interns who felt that they were aware of career resources rose from 50% to 100%. The percentage of
interns who strongly agreed that they were aware of career resources in the geosciences rose from 8% to 44%.

Figure 5. Interns’ Awareness of Career Resources, all internship programs

In interviews, interns reflected on the benefits of insight into professional science and scientific workplaces during the internship. Interns from all programs found this insight to be the most valuable aspect of the internship. For example, a GLP intern commented:

[The greatest benefit was] just being immersed in the geoscience world, and getting more experience and just like exposure to these things is so valuable... just being able to work with USGS a little bit and see the process the federal agencies go through.

Similar to previous external evaluations of in-person internship experiences, interns found the Career Circles to be the most helpful aspect of the program in shaping their career knowledge and understanding the various career pathways in the geosciences. Also similar to previous years, interns identified with the geoscience professionals in the Career Circles and felt comforted and encouraged that those professionals had taken non-linear and non-traditional paths to achieve their success. For example, a GLP intern commented:
The career circles, it's just, there's a lot of anxiety and insecurity involved with trying to take your path in life and hearing everyone's experiences and how their paths weren't straight, and there were a lot of times where they felt like things were going poorly and yet they still ended up in amazing places in their lives. And that was just really encouraging to hear.

Many interns commented that the Career Circles were the most valuable aspect of the internship because of their impact on interns' career growth, awareness, and professional development. A RESESS intern commented:

*I think the career circles were really, really helpful. That was probably the best part of the internship is just, chatting with people in the [geoscience] community. I think that's really helpful.*

Other interns valued the exposure to different career paths, and the support they received in preparing for those various types of careers, as noted by a GLP intern.

*It's been eye opening as far as the career building aspect of it. Just getting help with resume building and interviewing things like that. It's definitely interesting to see just the different career fields that are out there that are open. It's definitely been rewarding in that aspect.*

Because many interns did not know scientific professionals or role models in their families, the access to mentors and scientists through the internship was important in shaping their professional paths. RESESS interns gained a sense of what graduate school would be like, knowledge that they were not able to gain from their families or social networks because most did not know anyone who attended graduate school, as described by a RESESS intern.

*I think it helps clear up a lot of misconceptions and stuff that I had about future/grad school and stuff like that, just cause I don't really know many college graduates, let alone graduate school people.*
Technical Skills

In several iterations of the in-person GLP internship program, technical skills and capability to use major instrumentation in the discipline was the most prominent gain from the internship, but in the virtual internship, it was the second most significant gain. Still, interns reported increased understanding of the technological tools in their field and increased capacity to use those tools. Additionally, there were a few differences among programs. Mainly, the graduate interns of the USIP program already entered the internship with a relatively strong understanding of the instrumentation and technical tools widely used in the geosciences, while the RESESS and GLP interns showed more room for growth. For instance, 100% of USIP students entered the internship with an awareness of the major tools in the discipline, while only 30% of RESESS/GLP interns did. Therefore, there was little room for growth (as measured by the survey) for USIP students, while the percentage of RESESS/GLP with awareness of the major technical tools in the discipline rose from 30% to 83%.

Figure 6. Interns' Gains in Technical Skills, all internship programs

Overall, the interns made progress in their awareness of instrumentation and technical tools as well as their ability to use the tools. However, interns displayed the strongest growth in their capacity to employ the tools of the discipline, perhaps because of the hands-on nature of the projects in which students actively engaged with geoscience data and tools.
Career Preparation

Interns made substantial progress in feeling prepared for a geoscience career, especially in their understanding of the everyday work of geoscientists. Interns’ self-efficacy, or belief that they can succeed in future geoscience education or careers, remained stable, mostly because interns began the program with very high self-efficacy (rated between “agree” and “strongly agree” on the likert scale on the pre-survey). Still, interns gained insight into the work and practice of professional geoscientists and, therefore, felt more prepared to eventually enter into geoscience careers. Surprisingly, there were few to no differences among programs in interns’ perceptions of their readiness for a geoscience career. For instance, 50% of GLP interns, 17% of RESESS interns, and 50% of USIP interns felt they understood the work of geoscientists at the start of the internship. At the end of the internship, 100% of GLP interns, 67% of RESESS interns, and 100% of USIP interns felt they understood the nature of everyday work in professional geoscience.
As noted, interns’ strongest gains were in deeper insight and understanding of the work of professional geoscientists. Overall, the percentage of all interns who understood the everyday work of professional geoscientists rose from 34% to 79%.

Interns gained a sense of what it is like to be a professional geoscientist, and they described this benefit in interviews. Just as importantly, interns felt welcomed...
into the geoscience community which gave them a sense that they belonged and could succeed in the field, as described by a GLP intern.

*I think just gaining confidence, I'm pretty new to the science community. So to kind of have my toes in the water a little bit, and just to immerse myself in the actual geoscience community and seeing how welcoming people are and how willing they are to help you out in your career. I couldn't be more grateful.*

RESESS interns felt more prepared for graduate school because they gained some insight into what graduate school might be like through managing a research project with deliverables and deadlines, as described by a RESESS intern.

*It's not exactly what like grad school research or further research would look like, but it was nice to get that sense and pace. And it was nice to have already set deadlines, you are producing a poster, paper and a presentation. And to have a mentor. I think that was nice.*

Another RESESS intern commented on the value of the professional development in terms of becoming prepared to pursue a career in geoscience and gaining the confidence that she could be successful.

*I think personally I expected the research part to be the most beneficial and I think it really was, but I think I got a lot more in terms of professional development. I wound up doing additional informational interviews. Being forced to build a resume that focuses on my science background really helped me see I do have the skills that I need to do this. I think it helped a lot in that respect.*

**Collaboration and Networking**

Interns reported stronger gains in collaboration and networking from the virtual internship than is typical; however, this is likely related to the addition of survey items related to mentoring and peer interactions, in addition to the usual items related to interactions with professional scientists. Therefore, the survey items were expanded to include more of the type of collaboration and networking that UNAVCO interns experience during the program. In all, students made slight gains in their ability to work collaboratively on scientific projects (e.g., rising from mean of 4.3 to 4.56 on a 5-point scale for item related to comfort level with collaboration), or in networking with geoscience science professionals (e.g., rising from 3.66 to 3.77 on 5-point scale for item related to comfort level in networking with geoscientists). However, interns reported stronger gains in their ability to interact with mentors and
in their understanding of how peers can benefit their careers. Therefore, intern
development in general scientific collaboration and networking with professional
scientists was slightly reduced due to the virtual nature of the internship; yet the
continued significant focus on mentoring led to stronger gains in mentoring and peer
relationships.

Figure 10. Interns’ Gains in Collaboration and Networking, all internship programs

There were slight differences among programs, although interns from all
programs consistently gained skill in working with mentors and peers. However, GLP
interns and USIP interns entered the program with moderate ability to interact with
a mentor to benefit their professional growth (e.g., GLP students generally moved
from “agree” on the pre-survey to “strongly agree” on the post-survey); however,
RESESS interns entered the program with less self-reported experience and ability
in this area. For instance, only half of RESESS interns knew how to interact with a
mentor to benefit their scientific development at the beginning of the internship, yet
100% had this capacity at the end of the internship. In all, knowledge of how to work
with mentors was interns’ greatest gain in the area of collaboration and networking.
Interns also reported whether they found it beneficial to work with a partner during the internship (RESESS and GLP interns responded to this question, while USIP interns did not because they worked individually). For the most part, interns found it highly beneficial to work with a partner and were appreciative to have the opportunity to collaborate on a project. However, because of the virtual nature of the internship, there were some difficulties with communication and coordination of projects. Following are a few typical comments from interns in response to the open-ended survey question:

This program worked surprisingly well considering its remote nature. I found working with a partner, even virtually, to be very helpful and even fun, and I feel like my partner and I were able to connect very well.

Working with a partner had its pros and cons. My partner was wonderful, but trying to collaborate on a project remotely proved challenging. It was much harder to work out who should do which parts of the work in real time, and it was difficult to work on building a genuine connection when all of our meetings had to focus on work in order to be time efficient. Overall, it has worked out, but I think it is better suited for an in-person experience than an online one.

It was really helpful to have a partner, especially because of the online format. We mostly communicated over slack and zoom and functioned pretty similarly with other partnerships I've had. We just spent a lot of
the time dividing up the work accordingly and making sure neither of us was getting stuck with more work.

In interviews, interns noted that they received professional benefits from interacting with their mentors and peers; however, they reported fewer gains from broader networking with the geoscience community of scientists than interns in previous years. Most likely, the reduced networking was a result of not physically being in the scientific workplace where interns might interact with other scientists apart from their mentor and peers. Interns described the initial process of becoming acquainted virtually as “awkward” because of the remote environment, but all noted that the team-building exercises helped greatly in facilitating collaboration and increasing comfort in the virtual environment. Certain exercises, such as the “take a stand” exercise helped interns to recognize that they had similarities with each other and shared interests and values. An USIP intern stated: “I liked especially the team-building seminars the first two weeks. It was something new for me.”

Overall, interns benefited greatly from the support received from their mentors and from the collaboration that resulted from team projects. For instance, a GLP intern commented:

I was terrified at first that I would do something wrong or something would happen. And because of the remote nature of it, that I wouldn’t get help. But I was supported all the way through, and I was so lucky, that I got to have my partner because a lot of the times we were in the same boat. And we were always able to work through it. But I’ve definitely learned that I can pretty much accomplish anything that I put my mind to.

Interns also felt that they had built a network of professionals, both mentors and program managers at UNAVCO, that they could rely on and who would support them in the future. For instance, one of the GLP interns commented:

It was really nice building a network. Like I feel like I could email [the UNAVCO managers] a year from now and just say, Hey, I’m working on this or I need some help, and would you help me out with this? So it’s nice to, to have that aspect of the internship, just building a network.

Interns also appreciated receiving career advice and observing the professional paths of the scientists that they interacted with during the virtual internship, as noted by a GLP intern:
So just being able to speak with everybody and meet all these new people and network and get career advice and learn their career experiences. It’s really opened my eyes. I’m still exploring exactly what I want to do when and find my specific niche, but it’s given me some extremely valuable information going forward.

RESESS interns also interacted with a graduate assistant who they praised as supportive and a helpful near-peer mentor. RESESS interns also felt it was easier, at times, to communicate with the graduate student because communication could be more frequent and more informal in nature than with mentors. For instance, a RESESS intern described a graduate assistant:

*He’s awesome. They way he communicated was very helpful. He was more he was a more informal mentor and it helps to go with the flow. And so it helped with information going back and forth.*

Scientific Communication

Interns made slight gains in their scientific communication skills, though somewhat less than in previous external evaluations of in-person internships. Surprisingly, interns remained steady in their ability to prepare a scientific poster, as nearly all interns entered the program feeling that they had the ability to create a poster (rising from 82% to 100% of interns). This finding may be because several interns were graduate students and a few interns had participated in previous research experiences or other opportunities. Interns also showed slight growth in their ability to present geoscience concepts to a general audience and to use data to discuss important geoscience concepts. Interns did not report growth in their ability to critically read journal articles in their field, but this skill was emphasized less in the virtual internships.
Similar to growth in networking and collaboration skills, RESESS interns demonstrated more growth in scientific communication than interns from other programs. For instance, only 50% of RESESS interns felt that they could prepare a scientific poster when they entered the program. In contrast, 100% of GLP and USIP interns felt the same (note: GLP students marked “agree”, while USIP students marked “strongly agree”). At the end of the internship, 100% of interns felt that they could prepare a scientific poster and 55% of those students marked “strongly agree.”

RESESS interns participated in a writing seminar during the internship. Interns noted that it was helpful in learning how to write an abstract and getting feedback on their work. A few of the exercises, though interesting, seemed slightly less connected to the research within the internship, such as examining identity in writing. However, RESESS interns agreed that the writing seminars “definitely help us for professional development in the future.”

Organizational Skills
Interns gained some ability to manage projects and complete work by deadline; however, growth was slightly less than in previous evaluations of the GLP program, most likely because the RESESS and USIP interns were more advanced students and had already developed skills in this area. Nevertheless, interns enhanced their ability
to manage their time and stay on track of a large-scale, extended scientific project. In general, interns were confident time management skills, yet still felt that they had room for growth in overall project management abilities.

Figure 13. Interns’ Gains in Organizational Skills, all internship programs

In general, GLP and RESESS interns demonstrated greater growth in project management and time management than USIP interns, who began the internship with strong beliefs in their skills in this area. For instance, 66% of RESESS interns, 75% of GLP interns, and 100% of USIP interns entered the internship able to manage multiple tasks on complex projects. At the end of the internship, 100% of interns felt they had this ability.

Intellectual Gains

Interns demonstrated slight growth in many areas related to scientific thinking and their capacity to conduct research. Interns remained steady in some areas, such as understanding important concepts in their field, problem-solving skills, and readiness to conduct research. Interns made some growth in understanding how the content of the internship related to their studies and coursework. Overall, the virtual environment may not lend itself as readily to the growth of scientific thinking processes and skills for novice students, such as problem-solving or generating research questions. For instance, the proportion of students who could formulate a research question in their field rose from 75% to 80%. Interns
did gain an appreciation for how the internship related to their studies, rising from 80% to 100% of interns who understood how the internship connected to their studies.

Figure 14. Interns' Intellectual Gains, all internship programs

There were few differences among the programs, mostly because many interns began the internship with a sense that they could conduct research and knew how to formulate research questions and other cognitive scientific tasks. For instance, 50% of GLP interns, 66% of RESESS and 100% of USIP students knew how to formulate a research question at the start of the internship, while 75% of GLP students and 100% of RESESS and USIP students could do so at the end of the internship. In all, GLP and RESESS students reported more gains in scientific thinking than USIP students, who were further along in their studies and development as scientists.

Interns learned about the process of doing research and the nature of scientific work. For example, they learned that error and failure is a part of the process and not necessarily a reason to give up on a task or idea, as stated by a RESESS intern: “I think research is a lot of work and the errors, that comes with it. Like, it's fine. If there's some would say that's part of the process.”
In particular, the USIP interns benefited from the open-ended nature of their projects which allowed them more autonomy and a chance to experiment, explore, and gain new understandings and skills. For example, one of the USIP interns stated:

*It was very open-ended though in a way, and it was kind of fun because I got the leeway to play around with it and learn a lot of coding. And I think now I have this product that I would like to share with people and put it somewhere.... I started learning all of my coding last fall, so I knew a little bit of Python. I never took a class, so it was all just sort of fumbling around with it. But I know a lot more now.*

**Career Interest and Self-Efficacy**

Interns remained steady in their interest in a geoscience career, namely because they started with very high interest in pursuing a career in the discipline. In fact, interns’ interest in a geoscience career and confidence that they could do well in a geoscience career remained relatively constant throughout the internship. Because all interns entered the internship with very strong interest in geoscience careers and maintained that interest throughout the internship, there were no differences among the various programs. For example, students were more likely to “strongly agree” with these items at the end of the internship, as the percentage of interns who strongly agreed that they were interested in a geoscience career rose from 66% to 78%. Therefore, all of the virtual internship programs served to sustain students’ already high interest.

Figure 15. Interns’ Interest in a Geoscience Career, all internship programs

"I am interested in a geoscience career."

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

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<th>PRE</th>
<th>POST</th>
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<tr>
<td>17%</td>
<td>17%</td>
<td>11%</td>
</tr>
<tr>
<td>66%</td>
<td></td>
<td>78%</td>
</tr>
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</table>
In interviews, interns in all programs expressed high interest in future geoscience careers. Rather than increasing their existing high interest, interns more often commented that the internship had influenced their career direction (discussed in next section) or introduced them to the wide variety of career paths within geoscience fields (discussed in career knowledge section).

Influence on Career Intentions

In interviews, almost all interns commented that the internship had solidified that geoscience was the right career direction and had confirmed that it was the career path they would pursue. A few interns reported that they had discovered which particular path within geoscience they wanted to pursue after being exposed to various fields and careers from the informational interviews, Career Circles, and other programming. For instance, a RESESS intern described a new interest in a field within geoscience:

I think the career circle was really helpful. I think meeting everyone was really nice. After my informational interview, cause Andy recommended the person to me, after I had it with them, I changed the direction I wanted to go for graduate school just because the research was so similar. And so that was really nice.

Another RESESS intern noted that it had confirmed previous plans for graduate school. Interns also received career support from their mentors which helped to influence their career directions.

[The internship confirmed] going to grad school, for sure. And the connections I made with my mentor and the people, she recommended me to some people that she knew and that helped me.

Additionally, one of the USIP interns was inspired to pursue a new career direction based on one of the Career Circles. She stated:

I would say yes [it influenced my career direction]. The fact that we learned so many skills and the Career Circles. We met people, they showed me, opened some view to future. I got into geosciences basically because I liked science and I liked being outside. So mostly I've been doing coding right now and dealing with data sets that other people
collected, even in my PhD work. And that’s really cool, but I want to go collect my own data. And the very first week we had somebody who worked for the Hawaiian volcano observatory who described her job. And I was like, that’s it. I absolutely want her to job. I want her job plus a little more research time. So yeah, I would say it helped me to have a goal in mind.

Mentors’ Development of Mentoring Skills

Mentors reported slight growth in their ability to mentor students and design projects and activities for them in virtual environments. Mentors demonstrated the largest growth in understanding how to design tasks and projects for a virtual environment. Mentors’ ratings of their general mentoring skills remained constant during the remote internship. Mentors also reported slight gains in their knowledge about geoscience career options and pathways.

Figure 16, Gains in Mentoring Skills, all mentors

Mentors demonstrated a little bit of growth in their knowledge of geoscience career paths and their ability to provide geoscience career advising to mentees. For the most part, mentors began the summer with relatively abundant knowledge of different career opportunities in geoscience, yet a few mentors reported growth in their understanding over the summer (generally rising from 80% of mentors to 90% or 95% who agreed that they had geoscience career knowledge and could provide career advising to mentees).
Likewise, most mentors had substantial prior mentoring experience, so they entered the internship program with strong beliefs in their ability to support students’ technical and professional development, particularly for diverse students. The one area where mentors demonstrated growth was in their ability to mentor interns in a virtual environment. Although most mentors began the summer with confidence in their ability to mentor interns remotely, the proportion of mentors who expressed confidence in this area grew over the summer (from 71% to 93% of mentors).

Mentors also gained confidence and capacity in their ability to design projects and activities in a remote environment for interns. For example, only 64% of mentors felt that they could effectively develop virtual projects in geoscience for students at the beginning of the summer, while 93% believed that they could do so at the end of the summer. Additionally, 84% felt they could develop open-ended tasks for students in a remote environment at the beginning of the summer, while 100% felt they could do so at the end of the program. Mentors’ beliefs in their ability to communicate with interns virtually remained unchanged over the summer, because they entered the internship with a strong belief that they could effectively communicate remotely with mentees. However, mentors did gain confidence in their ability to address mentoring challenges in a virtual environment (rising from 84% to 100% of mentors).

In response to an open-ended question, mentors reflected on how virtual mentoring was different from in-person mentoring and what they had learned about mentoring over the summer. The main difference between virtual and in-person mentoring identified by the mentors was communication challenges related to the online environment. For instance, some mentors noted that mentees turned their video off which made it more difficult to read social cues, gauge engagement, and fully communicate. Some mentors also noted that students had more distractions in the home environment which also made meetings more challenging. On the other hand, one of the faculty mentors who had previously sent students to RESESS noted more communication over the summer because of the use of video chats in addition to email check-ins. A few mentors also commented on technical and scientific challenges, such as greater difficulty in problem-solving in a virtual environment as opposed to face-to-face meetings. Two mentors noted no differences between virtual and in-person mentoring. Typical comments were:

- **Obviously, the lack of in-person interaction made for a very different experience. In some cases, the students would have their camera off, which leads to the missing element of being able to read facial expressions.**
• It was more challenging to track progress and help them solve problems. Also, the level of science required for them to understand was higher because they weren't able to do more basic lab/field work.
• When students elect to leave their webcams off, it can be hard to gauge non-verbals. Students experience a higher degree of distraction depending on their living conditions (familial support/lack of support; care taking responsibilities; etc). Supportive messaging needs to be more constant to "drown out" competing messaging at home.
• Other than being virtual, it was the same or at least felt the same.
• I suspect that much of my interaction with my student would have been through email anyway this summer. The virtual situation actually helped increase interactions (again, speculating against what I think it ‘would have been like’), because we were both comfortable and familiar with video chat. In the past, I've sent students to RESESS, and only communicated over email with them while they were up in Boulder for the summer. So increased familiarity with video-chat is a benefit.

In an open-ended question, mentors reflected on what they learned about mentoring from the virtual internship experience. By and large, mentors reported that they had learned new tools and practices for effective mentoring in virtual environments. Mentors also gained enormous personal and professional satisfaction from advising students and observing their growth and development over the summer. All mentors, with the exception of one who had extensive previous experience, commented that they had gained greater ability to mentor students, particularly in virtual environments. Following are a few typical responses:

I learned how to implement new techniques to stay in contact and up-to-date with interns via establishing multiple meeting times per week with each intern. I learned that students feel much more comfortable communicating on a video call platform (e.g., Zoom, Skype) rather than communicating purely through email. I learned how to connect with students in both a personal and professional/research-oriented manner.

I learned how to assess and adapt to students' background knowledge and get them up to speed on the details of the research project, as well as managing multiple students working on the same project.
I gained confidence in assigning complicated, challenging problems to high-achieving students like the interns I worked with. Delegation with little time to provide one-on-one guidance has always been difficult for me to do. These students are exceptional and were able to perform well and understand the overall goals of the tasks I assigned.

As a community college professor, I never thought I’d get much of a chance to develop relationships with my students in this way - not the way we do with our advisors in grad school, or even in four-year traditional colleges. But because these opportunities (Geolaunchpad, RESESS in particular) are available, it allows me to really direct my advice and do the type of mentoring that I would do at a four-year school, only in a much more compressed time frame. I only see my students for four semesters, tops, so being able to direct them into programs that I know are impactful really helps me do that mentoring that is sometimes lacking at a CC - and, it helps me extend that relationship out beyond their graduation date, at least one more semester!

Implementation of Virtual Internships

Interns provided extensive feedback about the nature, logistics, and implementation of the virtual internship. Interns responded to open-ended survey questions and discussed the remote nature of the internship during focus group interviews. Overall, interns were highly satisfied with the logistics and implementation of the internship, although they did express that they missed the opportunity to interact in-person.

Orientation and onboarding

For the most part, onboarding and logistics worked quite well across all of the programs, with a few glitches in some areas. For example, GLP interns stated in the interview that they had received their laptops and other paperwork and materials to get started in a timely manner, but the laptops had a few bugs. Students mentioned that the laptops didn’t hold a charge well and that the screens would occasionally go black during remote meetings. Although, not all GLP interns experienced technical issues with their laptop computers. One of the teams of GLP interns also experienced challenges in getting the required clearance and access through USGS so they could access data, software and other tools needed for their project. In all, the process was quite lengthy. GLP interns also had problems connecting to the remote server and downloading data. Overall, there were multiple logistical and technical challenges for the GLP interns in working on their USGS projects. GLP interns did note that UNAVCO program managers and USGS supervisors were very supportive
throughout the challenging process. The other GLP team did not experience quite the same difficulties because their data was online, rather than on a secure server. RESESS students, for the most part, reported that the onboarding process went very smoothly, and they were satisfied with the logistics. However, a few RESESS interns noted that they were slow to get oriented to their research project and they wished they had started sooner. They also commented that research mentors had used technical language at the beginning of the project, and they could have used more of an introduction to the terminology and concepts prior to the start of actual project work.

Technical tools and communication

Interns were overwhelmingly positive about the technical tools used during the internship. In interviews and on the survey, interns found Slack, Zoom, and Google classroom to be useful tools. Interns preferred Zoom and Slack because of the more synchronous and real-time aspects of those platforms, as a RESESS intern summed up the feelings of the group:

*I liked zoom the most, obviously longs meetings tire me out, but it's the closest that I think we could have gotten to like talking to each other in real time. I feel like after that it’s probably Slack it felt like there's space where it can be a little bit more informal, but also ask the research questions we needed to. And using Slack was much quicker than just emailing someone.*

Interns also valued the informal channels on Slack that allowed them to have fun and get to know one another. Several interns also commented on the creation of the Global Social Change channel and how that was important to them.

Interns mostly liked Google classroom and calendars although a few had difficulty with time zone management within google calendar, for instance now knowing whether a 2pm meeting was Mountain time or their own time zone, for interns who were not based in Colorado.

However, interns at USGS noted that the organization used Microsoft Teams which they did not like as much as Zoom and other platforms. Several GLP interns reported that Microsoft Teams was more choppy than Zoom and it was not as easy to have a video chat as it was on the Zoom platform.
In an open-ended survey question, interns were asked whether they experienced any difficulties with technology over the summer. Overwhelmingly, 90% of interns reported that they had difficulties with unstable or unreliable internet, and one student reported a complete loss of internet access for nearly two weeks over the summer. Following are a few typical comments:

*I had issues with internet speed. When needed I used my phone hotspot.*

*Yes, I had internet issues. Power went out in my block.*

*I did. My family downgraded our wifi in the middle of the summer, but certain rooms had better connections that others. I tried to be in those rooms whenever I could.*

*I live in a very populated area so sometimes the wifi would be very slow or sometimes not work at all >.*

**Mentoring and support**

This sub-section of the report details findings related to the mentor and support provided to interns in the summer program. First, interns’ survey responses and feedback from the interviews are described. Second, mentors’ advice for future implementation is discussed.

**Interns’ experience of mentoring and advice**

Overall, interns were highly satisfied with the mentoring and support that they received during the virtual internship. However, they were not entirely
comfortable in the virtual environment and most would have preferred an in-person internship, if it had been available. The virtual internship was successful enough that 56% of interns stated that they would participate in one again, although the remainder were not sure (assuming that the choice would be between an in-person or virtual internship). The figure below details interns’ responses to items about their comfort level in the virtual environment. For the most part, about half of interns struggled to stay focused in the remote environment and were not entirely comfortable (as no interns agreed that they were more comfortable learning and interacting in a virtual environment).

Figure 18. Interns’ Comfort Level in Virtual Environment

Despite a preference for an in-person scientific environment, interns felt that they received the support that they needed during the summer internship. Indeed, 89% of interns felt that they received the amount of support that they needed during the summer, despite the different nature of the interactions compared to an in-person internship.
Overall, 100% of interns found their mentors to be helpful and supportive.

In an open-ended survey question about the support received from their mentor, interns reported that they felt supported, although some missed in-person interaction and conversations. For example, some interns missed peer interactions or
spontaneous conversations that can happen when working nearby other people. Also, one intern would have preferred if her mentor could have actually helped her at her computer with some of the technical work. Despite the challenges, all interns felt that they were adequately supported over the summer and all found their mentors to be helpful.

It was a great experience, my mentor supported me and helped me a lot despite the difficulties of remote working.

My partner and I had all the support we needed and more, I would say. We build a very strong relationship with our mentors and they were always on hand to answer any questions we had and help us with assignments.

I did receive the support I needed. I still would have liked more support - though this is not a comment on my mentor-mentee relations. This is a comment on the fact that when we work in an in-person setting, it allows more side conversations, peer learning, and interaction with other professionals (I'm sorry I do not have great suggestions for how to improve this if the internships are virtual in the future).

It was definitely more difficult not having our mentor there to actually be able to help on our computers. They still supported us and since we couldn't do anything on our project for most of the summer it was okay. Being able to text my mentor and communicate quickly in that way helped a lot. The fact that we had to use Microsoft teams instead of zoom didn't help at all.

In interviews, all interns echoed their comments from the survey and reported that their mentors were available for help and support. All interns had regularly scheduled meetings with their mentors, yet also found them very available and accessible at other times, as noted in this comment from a GLP intern:

We would meet once a week, but they were always available throughout the week for emails or a couple of times phone calls. They were very, very fast to reply during business hours and stuff like that. So it was really easy to get a hold of them.
On the other hand, a few GLP interns noted that they would have liked to have had more contact with their mentors, but this was largely because they got a late start on their project and did not have as much contact during the initial process, other than trouble-shooting logistics.

Interns from all programs noted the importance of regular, weekly meetings with mentors to help their progress and scientific development. They also preferred to communicate during those meetings through video platforms, rather than Slack or other venues, as noted by a RESESS intern.

*I think regular meetings worked for also, I personally asked my mentor for one on one meetings to talk about either about the project or outside of the project. I liked the Zoom meetings. I can show what I'm not understanding or share my screen as opposed to like try and like type it on the email or a Slack message. I feel like that probably helped the most.*

An USIP intern stated that it was easy to connect with her mentor and she also iterated that regular meetings were valuable.

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Mentors’ advice for virtual mentoring

Mentors were asked to provide advice for other mentors who may be involved in virtual internships, in order to identify effective strategies and challenges in remote mentoring. For the most part, mentors discussed communication or interactional challenges, although a few also provided advice related to project design. Similar to the interns, almost all mentors emphasized that regular communication and check-ins were key to establishing relationships, assuring progress, and identifying issues or problems early. Other mentors highlighted the importance of being clear, intentional and supportive in communication since interactions are more limited. Some mentors also addressed issues related to project design, notably to allow for more student input in project design and direction, and, most importantly, to be flexible and adaptable with goals and strategies. One mentor specifically advised to provide mentoring with the remote environment in mind, and not simply to negatively compare virtual mentoring to in-person mentoring; but, instead, interact regularly with interns, show them support, and draft thoughtful
emails to provide support, guidance, and advice. Carefully crafted emails provide some advantages; for instance, interns can read them at their own convenience, reflect on the feedback and advice, and they can provide fodder for discussion during a follow-up, personal meeting. Following are some typical comments from mentors:

- **Have frequent communication with students and interns.** Having weekly meetings (or more) helps provide a comfortable way for students to stay in contact with mentors and address problems that can be hard to communicate via email/text.

- **Regular check-ins are vital for success.** Check-ins do not all have to be about the technical work. Providing a space for students to feel supported and safe in sharing their struggles (and empathizing with those struggles) is just as important.

- **Establish realistic goals and be ready to modify them as the internship goes on.** This is good advice for a normal (non-virtual) experience, but even more so for a virtual one.

- **Be flexible, expectations may change due to limitations and unexpected challenges in the virtual environment.** You may not be able to tackle as much as hoped or expected, and that’s ok.

- **Try to create several versions of the project plan in advance - an "ambitious" plan, "moderate" plan, and "conservative" plan in terms of progress/scope.** That way you can dial back expectations in the face of challenges and know how to redirect the project.

**Logistics and other feedback**

As noted previously, interns were mostly satisfied with the logistics, organization and implementation of the internship. Overall, interns felt supported. A few interns offered advice for implementation, which was often specific to their particular experience. For example, a GLP intern noted support from UNAVCO but offered advice to USGS for the specific logistics on securing intern credentials in a timely manner.

- **I think UNAVCO did such an amazing job, honestly, especially with a very short amount of time they had to prepare this.** It felt really streamlined and, with the team building in the beginning, it was good. And they set up a Slack channel to try to still give us the experience interacting with the other interns. And the classes [seminars and Career Circles] worked really well. They checked up on us a lot. It was a really
great experience. I mean, USGS, they just need to, look into how they can streamline that [onboarding] process and make sure that if they’re trying to get someone access to a file, that it happens more quickly.

**Stipend**

Interns were granted a $2500 stipend for the summer and provided with laptops. Interns were highly appreciative of both the stipend and laptops. For instance, in an interview, one of the USIP interns brought up the stipend as an example of how supportive the program was, by saying, “They gave us an extra stipend for work-related expenses, and that was amazing, just as an example of how UNAVCO supported us.” On the survey, interns were asked in an open-ended question how they used the stipend and whether it was an adequate amount of money. All interns felt it was an adequate amount of money. Interns were split as to how they used the money, about one third used it for living expenses, about a third used it for savings/emergency fund (often remarking that they did not have adequate savings), and about a third used it for office supplies, software programs, computer expenses, and other expenses related to the internship. One intern used the money for both savings and to travel across the country from her family’s house [where she had spent the summer] to her university. Overall, interns were highly grateful for the stipend.

**Advice for future implementation**

Interns and mentors provided advice for future implementation of virtual internships. As already described, mentors suggested that regular check-ins and video-chat meetings are essential. Mentors also stressed that is was important to be flexible in project design and tasks. Some mentors also saw increased importance in being supportive and understanding of interns. Interns also provided advice for future implementation. Most of the interns, especially RESESS interns, would have liked more social activities to get to know each other in more casual and informal ways and to develop strong relationships with their peers. For instance, they suggested virtual game nights or virtual happy hours. Interns themselves could select and design the social activities so that they have more ownership and buy-in of the team-building aspects of it. Interns also missed the opportunity to learn from each other and work shoulder-to-shoulder with each other on projects, so perhaps more structured opportunities for peer learning or scientific engagement with peers could be built into the internship as well.
It is challenging to bring interns on board in a virtual environment, and interns stressed the importance of launching projects quickly. In particular, USGS was slow in providing data access to students, due to bureaucratic hurdles, and RESESS interns also noted that they started their projects slowly and would have appreciated getting up to speed more quickly. RESESS students also noted that it was difficult when mentors used technical jargon at the beginning of the project, because they didn’t understand or have the background to interpret it. For instance, a RESESS intern stated:

I feel like we didn't know what we're doing until like week three. And I feel like they could have, had us talk to our mentors and get the research portion of it started a lot earlier. I thought it was really slow with that aspect of it. And another part is, I guess they've got mentors that just have been doing it for so long that they use the terminology a lot. I felt like kind of embarrassed. I was like, wait, what was I supposed to know? Like I'm an undergraduate student. So I'm like, I don't really know this.—RESESS interns

In response to the desire to get oriented to projects faster, interns suggested that they could meet their mentors, other interns, and get a brief overview of their projects a week or two ahead of the formal start of the program. This would have been difficult in the spring, but could be possible if there is a need for another virtual internship. One of the RESESS interns stated:

If it is another online internship, you should gather all the interns and like have them come up, or introduce them to the research aspect early on. To be told our project, and already meet with our mentors before the internship started. I think having that connection, the first week, or even before, that would be good. Just to help like speed along the process, but they did a good job, even though they only had like a month to prepare.—RESESS intern

Other advice for future implementation of virtual internships is to focus time explicitly on time management techniques and organizational skills in virtual environments. Some of the interns struggled with time management and organization, so professional development could be organized around that theme and it could be part of check-ins with mentors and UNAVCO staff. Even though interns
reported some growth in organizational skills, they have never described struggles with time management in previous internships. This struggle seems to be unique to the unstructured nature of the virtual environment.

Conclusion

In conclusion, the UNAVCO internship programs transferred to virtual environments quite effectively for all three programs. In particular, the professional preparation and career knowledge aspects of the internship (e.g., seminars, Career Circles) were highly effective in virtual environments. Indeed, the virtual nature of the internship even provided opportunities, such as engaging a national network of geoscience professionals for career seminars, that are not available for in-person offerings. Interns also gained technical skills at similar, though slightly lower, rates as they did in in-person internships. Scientific communication skills, especially learning how to prepare posters and gaining the ability to discuss data and scientific results, were also fostered in the virtual environment. Mentoring was a fourth aspect of the internship that was quite effective in the virtual environment, though it required very frequent, clear, and intentional communication. All interns across the three programs felt supported by their mentor(s) and all appreciated the regular, ongoing communication and guidance they received from their scientific mentors, internship program staff, and faculty mentors. Areas that were more challenging to replicate in a virtual environment were networking with professional scientists (on a day-to-day basis, rather than through seminars and other offerings) and spontaneous and informal interactions (peer-to-peer or intern-mentor) related to their projects or geoscience. Finally, although mentors observed increased organizational skills in the interns over the summer, interns reported that they struggled with organization and time management in the unstructured nature of remote environments. All in all, most, if not all, elements of the UNAVCO internships transferred to virtual environments and interns demonstrated growth in all of the professional and scientific areas targeted by the program.