Faculty Perspectives on how to Reimagine International Research for Students in a Virtual World

Katherine Maul
School of Engineering Education
Purdue University
West Lafayette, Indiana, USA
kmaul@purdue.edu

Kirsten A. Davis
School of Engineering Education
Purdue University
West Lafayette, Indiana, USA
kad@purdue.edu

Nicole P. Sanderlin
College of Engineering
Virginia Tech
Blacksburg, Virginia, USA
npsander@vt.edu

David B. Knight
Department of Engineering Education
Virginia Tech
Blacksburg, Virginia, USA
dbknight@vt.edu

***Abstract*— International research programs for students offer an important opportunity to support students in developing skills in both research and intercultural competence. During the COVID-19 pandemic, many of these programs made the shift to operating virtually, with likely impacts on program outcomes. The purpose of this study was to identify the approaches that program leaders used in adapting international research programs to the virtual environment and explore how these innovations could inform the design of these programs going forward. We conducted eight focus groups with over 40 U.S.-based faculty who had experience running these programs to understand the benefits, challenges, and future potential of incorporating virtual elements into international research programs for students. This paper reports the results of these focus groups and provides suggestions for future program design based on best practices and innovations identified through the development of virtual programs.**

Keywords—international programs, undergraduate research, virtual teams

I. Introduction

International research collaborations provide important opportunities to support innovative research and address the significant global challenges facing the world today. To develop researchers who are both interculturally competent and able to navigate global research networks within their field, it is important to provide international research experiences for students. Prior work has indicated that such experiences lead to a wide range of learning outcomes including intercultural competence, research skills, personal development, and, importantly, a new perspective on their career goals and trajectory [1]. However, in the midst of the COVID-19 pandemic, international collaborations and programs for students have faced challenges in continuing their typical operations. This environmental jolt has highlighted the need to develop international collaborations and student programs that can remain resilient and sustainable in the face of uncertain circumstances, and many programs learned how to leverage the virtual environment in new ways. Beyond enabling collaborations to remain intact, albeit differently than before COVID-19, offering virtual programs can improve access to international experiences for students who face barriers to participation, such as tight schedules, family responsibilities, or high cost of participation [2], [3].

To support these goals, our study aimed to explore the future of international research experiences for STEM students in the post-COVID era. This paper presents our findings from conducting a series of focus groups with faculty principal investigators (PIs) who have coordinated International Research Experiences for Students (IRES) or Partnerships for International Research and Education (PIRE) programs, both funded by the United States National Science Foundation (NSF). Throughout the paper, we will refer to these programs together using the more general term "international research programs." Based on these data, we address the following research questions:

1. What are the benefits and challenges of running international research programs in a virtual format?
2. What can we learn from the experience of shifting international research programs to a virtual modality that can inform the design of such programs going forward?

II. Literature Review

To provide context for the current study, we present prior research on the design and outcomes of international research experiences and virtual experiences for students.

A. International Research Programs for Students

Studying abroad has been the focus of programming and research related to students' development of intercultural skills. Overwhelmingly, this research suggests that students benefit most from intentionally designed programs that provide cultural mentoring and educational interventions [4]. However, STEM students have historically been underrepresented in study abroad programs because of their strict schedules, lack of support for intercultural learning, and high cost of participation [2], [3]. International research programs can help address these challenges by providing STEM students both international and technical experiences that include a paid stipend, allowing students to choose these summer programs in lieu of internships. The NSF-sponsored IRES and PIRE programs specifically seek to develop globally connected future researchers while also facilitating broader long-term collaborations between U.S.-based and international research groups [5].

Prior research on international research programs has primarily explored student learning outcomes from these experiences. In general, prior studies have agreed that international research programs can support students in developing both research and cross-cultural skills [6], [7]. Further, these programs can help students develop a sense of the international scope of their field and make assessments about their interest in pursuing a research career [8], [7]. Specific outcomes of an international research program may be related to

This material is based upon work supported by the National Science Foundation under Grant # OISE-2106093.

program design decisions, such as the country to which students travel or the structure of the international research program itself [6],[9]). One prior study identified five different program structures for international research programs and analyzed how these structures related to both student, faculty, and institution outcomes of the program [9]. In our prior work, we explored how programmatic components of international research programs, such as research project structure, housing options, and mentoring influenced student learning outcomes [1]. Our current project builds on that work to explore how these programmatic components can be shifted into a virtual environment.

B. Virtual Experiences for Students

Previous work on virtual undergraduate research has focused primarily on the creation of virtual laboratory experiences for classes. Although these studies explore a variety of formats to conduct experiments virtually [10], [11], [12] and suggest that students benefit from such experiences [13], [14], this work only describes one component of what has traditionally been included in an international research experience. Other research has explored the benefits and challenges of global virtual team projects, indicating that students gain both teamwork and intercultural skills from these experiences [15], [16]. These studies also reveal that significant effort, intentional design, and planning go into making these projects an effective learning experience [17], [18]. During the COVID-19 pandemic, virtual team projects, virtual exchange, and cooperative online international learning (COIL) experiences have grown in popularity, and new research has confirmed earlier findings and begun to explore student experiences in these programs in more detail [19], [20]. Although these findings about virtual experiences can be applied in a research program, we believe it is also important to consider the unique factors that are important to an international research experience.

C. Faculty Experiences Transitioning to Virtual Education

During the COVID-19 pandemic, faculty have had to transition many different types of classes and other learning experiences into virtual formats. A number of studies have explored the experiences of faculty during this transition, which may relate to the experiences of faculty in our study working with virtual IRES programs. For example, some studies found that many instructors spent more time than usual checking in on students related to their wellbeing [21], [22]. Educators also reported that abrupt changes to learning environments (e.g., switching to completely remote instruction in the middle of the Spring 2020 semester) increased the difficulty of their transitions between teaching styles and learning tools [21]–[23]. Experiences that had previously required participants meet in person, such as makerspaces, laboratories, or Research Experiences for Undergraduates (REUs), underwent the most dramatic changes. However, some of these programs were able to use the pandemic to implement strategies to increase accessibility and flexibility [23]–[25]. In summary, the research in this area suggests that instructors spent a lot of time figuring out how to balance the best interests of their students with the restrictions due to the pandemic. We anticipate that IRES PIs may have faced similar challenges as they adapted their programs to the virtual environment.

III. Methods

To collect data for this project, we conducted eight focus groups with principal investigators (PIs) who had experiences running international research programs. The details of our participants, data collection, and data analysis are described in the following sections.

A. Participants

We recruited participants for this study by searching for IRES and PIRE grants on the NSF website. We filtered for projects that had been initiated between 2010-2019 because we wanted participants who had at least a year of their IRES/PIRE program completed and who had been involved in one of these programs recently. We then randomly selected half of the programs on the remaining list (while maintaining the initial distribution across years) and contacted the PIs to invite them to participate in our study. 32 PIs participated in seven focus groups following this recruitment approach. We held one additional focus group as a workshop at a conference focused on international engineering education, where we had 10 additional participants. In total, we had 42 participants across eight focus groups. All participants signed consent forms to be a part of this study, which was approved by the [University] Institutional Review Board.

B. Data Collection

Each focus group lasted between 60-90 minutes and had between 4-6 participants. The only exception was the workshop at the conference which had 10 participants. The focus groups were led by two researchers, one who facilitated the conversation and one who took notes and managed the recording. All focus groups were conducted via Zoom, recorded, and transcribed for analysis. The focus groups covered four main topic areas, which are listed in Table 1 along with example questions.

TABLE I. Focus Group Discussion Topics

Discussion Topic	Sample Question
Introduction	COVID has brought about many challenges for international research programs, and we will discuss those in a moment, but we want to start by discussing any benefits you see to offering these types of experiences in a virtual format. What are benefits for: Students, Faculty, Collaborators Abroad, Research Projects?
Program Elements	We identified this list of key program elements through our prior study of international research programs (listed posted in chat). Which elements do you think would be hardest/easiest to transition to a virtual environment?
Program Structure	If you were going to design a new NSF track of international research programs that takes into account the ideas we have discussed, how would you structure it?
Identifying Needs	Building on the ideas identified during the brainstorming, brainstorm what resources, training, or other support would be needed to implement these programs. What would you need to be successful?

C. Data Analysis

We analyzed the focus group data using an inductive, constant comparative method [26]. Because of the exploratory nature of this work, we did not use an existing framework to

create a coding scheme but rather allowed the data to drive the codes. We started by listening to the focus group audio files, reading the transcripts, and discussing observations as a research team. Then, one researcher iteratively coded the focus group transcripts and the other team members reviewed the results. Through this process, the initial set of codes was consolidated into a smaller set of codes and finally three high-level themes [27].

D. Ensuring Research Quality

We used a number of approaches to establish the trustworthiness of our qualitative study [28]. First, the research team met together regularly throughout the data collection and analysis process to discuss and reach consensus regarding the findings [28]–[30]. An audit trail was maintained documenting these discussions and the decisions that were made during the data analysis process [28]. We only included topics in this paper if they were mentioned in a minimum of three different focus groups to make sure that outliers were not reported [29]. Finally, the research team sent a report to participants with early findings from the study [29], [30].

IV. Results

We group the results below by the three higher-level themes we found in the focus group discussions. Within each section, we describe the common codes that occurred within that theme and include representative quotes from the focus groups.

TABLE II. Focus Group Conversation Themes

Theme	Common Codes
Benefits of Virtual Programs	New and enhanced collaboration opportunities Improved accessibility for students New program structures
Challenges of Virtual Programs	Coordinating cultural and social activities Strain on international collaborators Obstacles to doing some types of research remotely
Future Ideas for International Research Programs	Hybrid international research programs Providing more support to international collaborators

A. Benefits of Virtual Programs

Despite the many challenges of running virtual programs, focus group participants identified a number of benefits from using this format. Three common topics within this theme were: 1) the development of new or enhanced collaboration opportunities, 2) improving accessibility for a wider range of students, and 3) virtual work spurring the design of new program structures.

Focus group participants noted that new or enhanced collaboration opportunities came with virtual international research programs. All but one of the focus groups discussed this topic. One PI mentioned that their international research program had increased access to government officials because of their virtual program. They were able to put together:

> "A couple of panels with fairly high level people in public health type positions in both Zambia and Zimbabwe, two of the countries that we're working in, and they basically attended a Zoom seminar where we had these really sort of like deep discussions about the ethics surrounding international research at this moment in time."

Similarly, other participants mentioned that the increased use of Zoom meetings made existing collaborations that previously occurred over email more straightforward. Most PIs said that virtual programming allowed for longer relationships with foreign collaborators since their interactions were not restricted to a limited period when the student participants were abroad.

The next most commonly mentioned benefit to virtual programs is their improved accessibility compared to traditional international research programs. Six out of eight focus groups mentioned accessibility, and many of the PIs focused on a specific underserved population. Different people spoke about accessibility in different ways. For example, one PI described the additional accessibility offered by virtual international research programs by saying:

> "There's a student who's been working in my lab, who's the parent of a five-year-old and a three-year-old, and she actually only applied to do and did an IRES this year through [university]. And the only reason she was able to do that [was] because it was virtual. And so she didn't even apply until they were sure it was going to be a virtual thing. And so she had a really productive, good experience and was able to [use her] multilingual background to good effect. And she also established connections with researchers in different parts of the country she otherwise wouldn't have."

Additionally, other types of caretakers, minoritized groups in science, and students who were not U.S. citizens were all mentioned as groups who could benefit from virtual international research programs. One PI talked about virtual conferences lowering the barriers for non-US citizens to engage as well, especially for researchers from countries without large science grants. She shared her experience with conference travel:

> "I was able to send a bunch of Panamanian students to U.S. conferences that I never could have afforded to fly them up to, but they get [to present at] an international meeting. And I think the same thing is true with faculty. Oftentimes, faculty have the money one way or another, but they don't have the time. And so you can participate in something with a very low…there's a low cost to you [to] participate. See if it looks interesting, get involved, if it works, if it doesn't, you didn't just spend a week traveling all around the world to discover it's not a good fit."

The lower cost to attend virtual events was a common discussion point in the focus groups. Specific ideas for designing international research programs that support minoritized populations in science will be discussed more in the Future Ideas section below.

The third most common benefit to virtual international research programs that was discussed in the focus groups was how the experience of running these programs had spurred ideas for new program structures. This topic will be discussed in more detail in the Future Ideas section below. Here we'll focus on new ideas for virtual cultural activities that programs have already implemented. Multiple participants mentioned trying to bring some form of their foreign collaborator's culture to their students in the United States since travel was not possible. One researcher described how she had her students join their university's Polish club so they would have others with whom to discuss Polish culture. She said they did activities:

> "On a bi-weekly basis here, during the semesters, during the academic year. In the meetings, we do the movies, we go to certain parts of New York that is, you know, inhabited by Polish people, we go to concerts, [...] we do cooking together."

Other focus groups mentioned having U.S. students travel within the United States to cultural festivals or religious sites to get a feel for their collaborator's culture. Another PI talked about having students from both countries buy all the ingredients for a recipe and cook it together over Zoom. Although PIs agreed that these experiences could not replace the experience of traveling abroad (as we describe in the next section), they suggested that some of these creative approaches could be used in future international research programs to help prepare students to travel abroad or provide a hybrid option.

B. Challenges of Virtual Programs

Focus group participants shared many difficulties regarding the shift from in person to virtual international research programs. The top three challenges that came up across focus groups were: 1) coordinating cultural and social activities virtually, 2) the strain virtual programs put on international collaborators, and 3) the obstacles to doing some types of research remotely.

Unsurprisingly, the largest challenge mentioned in the focus groups was coordinating cultural and social activities. This topic was discussed across all of our focus groups. A common sentiment was that completely virtual international research programs were "better than nothing," but significantly lacking compared to programs where students could go abroad. One PI used the following analogy to describe international programming without a travel component:

> "I could teach you all the equations and the physics behind riding a bicycle. But until you ride the bicycle, you have no understanding [of] what's going on. And it's kind of the same thing. I could do all these pre-travel videos and crash courses on the Korean language, we could go over their, you know, blueprints of their hardware. Yeah, it exposes it a little bit. But until there are boots on the ground…"

Other participants discussed that language barriers were exacerbated over Zoom as well as challenges in reading body language. One PI suggested leveraging students at the foreign university as both language and culture translators to help with these issues. In addition to the cultural and social aspects, many faculty mentioned that students missed out on the personal growth opportunities associated with spending a summer in a different country. Focus group members conveyed a large sense of loss to the experience when students cannot travel, even if they could not articulate exactly what was lost. Although most participants felt that virtual IRES programs were worth running, a few participants felt the lack of travel made the experience worthless and went as far as stating they would rather return their funding to NSF.

A second challenge that was mentioned frequently in our focus groups was the additional strain placed on international collaborators when running international research programs virtually. Six out of eight focus groups mentioned this as a specific challenge to virtual international research programs. This strain was often the result of time zone differences and lack of internet infrastructure to support remote work at the international locations. One PI mentioned that he pays his colleagues in Mongolia to help organize logistics for their international research program, but those services are not needed for virtual work. Because IRES and PIRE grants do not allow paying foreign colleagues for research, this PI could not compensate his collaborators at all if they only work together virtually.

The third most common challenge to virtual international research programs was that research in some disciplines is hard to conduct remotely. Five focus groups discussed this topic in detail. This challenge was primarily experienced by researchers who did field work to collect their data. Some programs were able to have data and materials collected by their collaborators sent to the United States, like one PI whose collaborators mailed them jaguar fecal samples. But for those options to work, PIs needed to have the lab space and equipment available at their U.S. institution to conduct the required analyses. Additionally, the U.S. students lost the chance to learn how to collect data in the field. Many of the focus group participants who required field work for their research said they would not consider doing a 100% virtual international research program because of how much their work relied on in-person work.

C. Future Ideas for International Research Programs

Focus group participants suggested a wide variety of creative suggestions for how future international research programs could incorporate virtual activities to improve the student experience. Most of the suggestions fell into one of two categories: 1) identifying opportunities for hybrid international research programs which mix virtual and in-person work, and 2) providing more support to international collaborators to recognize the significant amount of work required from them in coordinating international research programs.

Some PIs had creative suggestions for how to design hybrid programs based on their experiences running virtual programs. The most common suggestion along these lines was to incorporate virtual pre-travel and post-travel activities, which would allow the international research program to extend beyond the limited time abroad. Focus groups members felt that this would benefit both students, who would be better prepared for their time abroad, and international collaborators, who would be more likely to get publications from an extended program.

Other creative suggestions focused on how adding virtual components to an international research program could improve accessibility for different populations of students. For example, one researcher made his international research program more accessible to underrepresented groups in STEM by offering a hybrid version of his international research program in addition to the one that traveled the whole summer. He described his two programs as:

> "A short term visit by a larger cohort of students, and then a subset of them would stay a longer period of time. And so what I found is that a lot of students were hesitant, if especially if we're trying to target students who are from groups that are historically marginalized in the field, then a lot of students are hesitant to apply for a full 10 week or a summer or a semester or whatever length the program is, in part because they don't want to quit their jobs, they think they're not going to get it back or so on. But [if they] go for a week or two, and then come back home, and they're exposed to that site, then they realize, oh, this is really cool. [...] Eventually, most of our participants were ones who did the short term experience one year and then the long term experience the next year. And so that created a pool of applicants for the long term experience. But it also created a pool of applicants who otherwise would never have been applying. So it enabled us to target a population that we're really trying to serve."

Other focus group participants mentioned that virtual pre-travel programming could help facilitate additional mentoring for marginalized students before they set foot in another country.

Finally, some focus groups members suggested that virtual components could lead to different structures of international research programs that could better support the needs of the research projects. For example, one PI wanted to structure their international research program so that students could travel twice in a year to visit the foreign partners while remaining connected virtually in between trips. The PI who followed this approach said he structured the program that way to accommodate both the climate where they were traveling and the different vacation schedules of the U.S. and partner universities. He also said:

> "Our research necessitated two trips. It was much more logical to do this, because we have equipment that runs out of batteries, needs to be fixed, whatever. Arguing for an extra set of plane tickets was a little bit of a challenge. So like, flexibility in [asking IRES for unique program structures]. But having the fact that they went there twice over a period of 12 months, I think invested students much more in the whole project."

Other PIs also suggested that more flexibility in program structures would be useful when applying for IRES or PIRE grants. Overall, many focus group participants saw adding virtual components to international research programs as an opportunity to offer additional flexibility to the schedule and provide more support to students as they prepared to travel abroad.

The second topic that PIs discussed frequently regarding the future of international research programs was their desire to provide benefits to their international collaborators. This problem was present even before the COVID-19 pandemic, but virtual programming put additional strain on international collaborators (as discussed earlier under Challenges). The current IRES and PIRE guidelines do not allow foreign collaborators to be paid for research. Every focus group participant who mentioned this situation said it was a problem, some going as far as to call the policy "distasteful." A few PIs had workarounds where they paid their collaborators for providing translation services or bought lab materials, but these strategies were often context-specific or required creativity to identify. Participants suggested that being able to add collaborators as co-PIs on an IRES or PIRE grant would be the ideal way to recognize their contributions. Others suggested alternative approaches that could be built into international research programs, such as one PI who made the following suggestion:

> "Another thing I think NSF could do [...] often they're reluctant to support foreign scientists to travel to the US. But it'd be really great in this situation, if they could support the travel of that foreign advisor to the U.S. At some point, maybe the students go there at the beginning, the foreign advisor comes towards the end, just to have that back and forth if NSF was willing to support that, I think that would be really useful and maybe make it more attractive to the foreign supervisors that they would get some travel out of it, you know, because right now, they don't, they don't really get anything out of it, aside from the research output of the students."

Several participants suggested an exchange model along these lines to try to create more benefits for their international collaborators. Alternatively, some participants suggested that strain on the international collaborators could be reduced by allowing PIs to pay an international postdoc or graduate student to help oversee the international research program on-the-ground.

Support for international collaborators was especially important for PIs whose collaborators are located in countries without large grant offerings to fund their own research. This situation makes working in those places even more difficult when the U.S. researchers cannot pay their non-US citizen collaborators. One PI said:

> "There are these real digital divides, but one of the barriers is we have great programs that fund IRES and things, but there are barriers to using funding to actually work with partners that face digital divides. So that actually reinforces very specific, frankly, neocolonial geographical connections. So it makes it harder to work with partners in parts of the global south because we can't use funding for certain things that we actually need in order to do this kind of work."

Several PIs mentioned that their foreign colleagues lacked infrastructure to do virtual work, which made remote collaboration much more difficult. Overall, nearly every focus group participant highlighted the significant contributions that

their international collaborators made in making international research programs possible and wanted explicit support and acknowledgement of these contributions to be possible as part of future international research programs.

V. Discussion

In this study, we asked faculty PIs about the benefits and challenges of running virtual international research programs to explore what lessons from the COVID-19 pandemic can be applied to enhance the design of future programs. The results for Research Question 1 (benefits and challenges) indicated that virtual programs can help address many of the reasons STEM students are unable to study abroad, such as strict schedules and lack of support for intercultural learning within these fields [2], [3]. Focus group participants noted that virtual international research programs offered more flexibility and a lower barrier for entry into intercultural learning than programs requiring travel abroad. These characteristics can improve the accessibility of international research programs for minoritized groups. The flexibility of virtual programs can also open doors to new collaborations abroad that were not feasible in person and provide opportunities for ongoing collaboration outside the traditionally limited time window. On the other hand, we found that students in virtual programs need extra support connecting with colleagues and learning about cultural differences. Although such support is recommended in international education generally [4], virtual programs offer unique challenges in this regard. Program leaders in our study implemented creative approaches to address this challenge, such as leveraging local opportunities to engage with the collaborator's culture (e.g., restaurants or festivals), however they frequently noted that these experiences could not compare to actually traveling abroad. This finding corresponds to literature noting that instructors spend more time supporting their students during virtual learning [21], [22]. Virtual programs also presented challenges for certain types of research that could not be conducted remotely and placed additional strain on collaborators abroad, especially in low-resource settings. Overall, our focus group participants identified a range of both benefits and challenges to virtual international programs.

Our results for Research Question 2 (design of future programs) suggests that incorporating virtual elements can open the door to new structures for international research programs going forward. For example, previous research highlights the advantages of pre- and post-travel activities in international research programs to enhance student learning outcomes [1]. Our current study suggests that these pre- and post-travel activities can be easier to facilitate using virtual collaboration. Multiple focus group participants noted that they had never offered pre- or post-travel programming before the COVID-19 pandemic forced their programs to be virtual, but had realized the benefits of these program elements for both students and international collaborators. Pre-travel activities can help students learn about the collaborator's culture or the research they will carry out, while post-program activities can make it feasible for students to publish the results of their work [1]. Achieving publications is also important for international collaborators, who contribute significantly to the successful implementation of international research programs, but are not formally recognized or funded through the current system. Focus group participants highlighted this as a key issue that needs to be addressed in future program offerings. The increased comfort with virtual collaboration that has resulted from the pandemic can be intentionally designed into future international research programs to improve outcomes for both students and international collaborators.

Based on the results of this study, we suggest that future IRES programs continue to creatively explore how virtual and hybrid program elements can support a wider range of program structures. In particular, we are excited about the possibilities identified through this study to increase accessibility for a variety of marginalized populations in STEM fields by exploring alternative program structures. Future programs and future research should continue to experiment and assess these opportunities to make international research programs accessible to all students. Virtual educational experiences often lower student barriers to participation [23]–[25], and our results support this trend. More work could also be done to develop program structures that better support international collaborators. Extending program lengths through the use of virtual collaboration can improve the likelihood of publications, which is an important outcome for collaborators. However, our focus group participants consistently highlighted that formal support and recognition for collaborators would significantly improve international research programs, especially with the additional strain that comes from operating virtually. Our future work on this topic will include a survey of the broader community of PIs who have experience running international research programs and interviews with students who have participated in virtual or hybrid programs.

References

[1] D. B. Knight, N. Sanderlin, and K. A. Davis, "Assessing the impact of IRES on researchers and research outcomes: A case study approach," 2020. [Online]. Available: https://global.eng.vt.edu/Resources/IRES.html

[2] J. M. Grandin and E. D. Hirleman, "Educating engineers as global citizens: A call for action / A report of the national summit meeting on the globalization of engineering education," *Online J. Glob. Eng. Educ.*, vol. 4, no. 1, pp. 1–28, 2009.

[3] B. K. Jesiek, "Internationalizing engineering education: Looking forward, looking back," *J. Int. Eng. Educ.*, vol. 1, no. 1, p. Article 1, 2018, doi: 10.23860/jiee.2018.01.01.01.

[4] M. Vande Berg and R. M. Paige, "Why students are and are not learning abroad," in *Student learning abroad: What our students are learning, what they're not, and what we can do about it*, Vande Berg, Michael, R. M. Paige, and K. H. Lou, Eds. Sterling, VA: Stylus, 2012, pp. 29–58.

[5] National Science Foundation, "International Research Experiences for Students (IRES) Program Solicitation," Alexandria, VA, Program Solicitation NSF 20-598, 2020. [Online]. Available: https://www.nsf.gov/pubs/2020/nsf20598/nsf20598.htm

[6] K. A. Davis, Y. Jalali, D. B. Knight, V. Lohani, and R. Müller, "Student learning in international research programs: A comparison across cultural contexts," Salt Lake City, UT, Jun. 2018.

[7] L. M. Hatfield, C. T. Amelink, N. Sanderlin, H. E. Lyne, and B. K. Jesiek, "Student outcomes of participating in an international research experience," Columbus, OH, Jun. 2017.

[8] K. A. Davis and D. B. Knight, "Becoming a researcher: A narrative analysis of U.S. students' experiences in Australia," Cape Town, South Africa, Jul. 2019.

[9] N. Sanderlin, K. A. Davis, and D. B. Knight, "Design considerations for an international research program for students: Learning from existing programs," Virtual, Jun. 2020.

[10] M. Bal, "Virtual manufacturing laboratory experiences for distance learning courses in engineering technology," San Antonio, TX, Jun. 2012.
[11] J. Bourne, D. Harris, and F. Mayadas, "Online engineering education: Learning anywhere, anytime," *J. Eng. Educ.*, vol. 94, no. 1, pp. 131–146, 2005, doi: 10.1002/j.2168-9830.2005.tb00834.x.
[12] T. C. Harmon, G. A. Burks, J. J. Giron, W. Wong, G. K. W. K. Chung, and E. L. Baker, "An interactive database supporting virtual fieldwork in an environmental engineering design project," *J. Eng. Educ.*, vol. 91, no. 2, pp. 167–176, 2002, doi: 10.1002/j.2168-9830.2002.tb00689.x.
[13] E. D. Lindsay and M. Good, "Virtual and distance experiments: Pedagogical alternatives, not logistical alternatives," Chicago, IL, Jun. 2006.
[14] M. Koretsky, C. Kelly, and E. Gummer, "Student perceptions of learning in the laboratory: Comparison of industrially situated virtual laboratories to capstone physical laboratories," *J. Eng. Educ.*, vol. 100, no. 3, pp. 540–573, 2011, doi: 10.1002/j.2168-9830.2011.tb00026.x.
[15] C. Miranda, D. L. Martinez, and M. Forget, "Geographically distributed teams in engineering design: Best practices and issues in cases of international teams working from different continents," Columbus, OH, Jun. 2017.
[16] H. Zaugg, A. Parkinson, S. P. Magleby, and R. Davies, "Summary findings on the use of global virtual teams to achieve selected global competence learning outcomes for engineering students," Atlanta, GA, Jun. 2013.
[17] T. Clear *et al.*, "Challenges and recommendations for the design and conduct of global software engineering courses: A systematic review," Vilnius, Lithuania, Jul. 2015. doi: 10.1145/2858796.2858797.
[18] H. Zaugg, A. Parkinson, S. P. Magleby, C. G. Jensen, R. Davies, and A. G. Ball, "Best practices for using global virtual teams," San Antonio, TX, Jun. 2012.
[19] S. S. Joshi, B. S. Garcia, N. A. Peach, F. J. Montalvo, and K. A. Davis, "Global Learning at Home: Understanding Students' Experiences in Global Virtual Team Projects," in *Proceedings of REES AAEE 2021*, Perth, Australia, 2021, p. 9. doi: https://aaee.net.au/wp-content/uploads/2021/11/REES_AAEE_2021_paper_276.pdf.
[20] Stevens Initiative, "2022 Virtual Exchange Impact and Learning Report," The Aspen Institute, Washington, DC, 2022.
[21] J. Jurkiewicz, B. Hempel, M. Redman, H. Murzi, C. Dominguez, and A. Ford, "Give Them Grace: An Autoethnographic Study on Instructors' Adaptation to Online Technology in Education as a Result of COVID-19," Virtual Conference, Jul. 2021. [Online]. Available: https://peer.asee.org/37225
[22] S. C. Davis *et al.*, "Pandemic Pivots Show Sustained Faculty Change," Virtual Conference, Jul. 2021. [Online]. Available: https://peer.asee.org/37557
[23] P. Morreale, A. C. Gates, E. Q. Villa, and S. Hug, "Faculty Development for Research Inclusion: Virtual Research Experiences for Undergraduates," Virtual Conference, Jul. 2021. [Online]. Available: https://peer.asee.org/37179
[24] A. Boklage, R. M. Carbonell, and M. J. Borrego, "Lessons Learned: Making Shifts: Faculty Development Shifts in a University Makerspace During the COVID-19 Pandemic," Virtual Conference, Jul. 2021. [Online]. Available: https://peer.asee.org/37449
[25] M. Chierichetti, P. R. Backer, L. E. Sullivan-Green, and L. Rosenfeld, "Learning from the Voices of Faculty: An Analysis of the Impact of Shelter-in-Place on Faculty at San Jose State University in Spring 2020," Virtual Conference, Jul. 2021. [Online]. Available: https://peer.asee.org/37428
[26] M. Q. Patton, *Qualitative research and evaluation methods*, 3rd Edition. Thousand Oaks, CA: Sage Publications, 2002.
[27] J. Saldaña, *The coding manual for qualitative researchers*, 2nd Edition. Thousand Oaks, CA: SAGE Publications, 2013.
[28] J. A. Leydens, B. M. Moskal, and M. J. Pavelich, "Qualitative methods used in the assessment of engineering education," *J. Eng. Educ.*, vol. 93, no. 1, pp. 65–72, 2004, doi: 10.1002/j.2168-9830.2004.tb00789.x.
[29] S. B. Merriam and E. J. Tisdell, *Qualitative research: A guide to design and implementation*, 4th ed. Newark: Wiley, 2015.
[30] A. K. Shenton, "Strategies for ensuring trustworthiness in qualitative research projects," *Educ. Inf.*, vol. 22, pp. 63–75, 2004.