

Board 369: Reimagining International Research for Students in a Virtual World

Dr. David B Knight, Virginia Tech

David Knight is an associate professor in the Department of Engineering Education at Virginia Tech. He also serves as Special Assistant to the Dean for Strategic Plan Implementation and Director of Research of the Academy of Global Engineering. His research tends to be at the macro-scale, focused on a systems-level perspective of how engineering education can become more effective, efficient, and inclusive, and considers the intersection between policy and organizational contexts.

Dr. Kirsten A. Davis, Purdue University, West Lafayette

Kirsten Davis is an assistant professor in the School of Engineering Education at Purdue University. Her research explores the intentional design and assessment of global engineering programs, student development through experiential learning, and approaches for teaching and assessing systems thinking skills. Kirsten holds a B.S. in Engineering & Management from Clarkson University and an M.A.Ed. in Higher Education, M.S. in Systems Engineering, and Ph.D. in Engineering Education, all from Virginia Tech.

Dr. Nicole P. Sanderlin, Virginia Tech

Nicole serves as Director of Global Engagement in the College of Engineering. She provides leadership for international initiatives and works closely with engineering faculty to develop new institutional partnerships and international opportunities for engineering students. She also provides support to the college's International Alumni Board and oversees the College's Global Ambassador Program. Nicole holds a Master's and Ph.D. from Virginia Tech's School of Public and International Affairs. Her research focuses on internationalization of higher education, faculty engagement, and international program assessment.

Dr. Jessica Deters, University of Nebraska, Lincoln

Dr. Jessica Deters is an Assistant Professor of Mechanical and Materials Engineering and Discipline Based Education Researcher at the University of Nebraska - Lincoln. She holds her Ph.D. in Engineering Education and M.S. in Systems Engineering from Virginia Tech, and her B.S. in Applied Mathematics and Statistics from the Colorado School of Mines.

Miss Alaa Abdalla, Virginia Tech

Alaa Abdalla is a first year PhD student in Engineering Education with a background in Mechanical Engineering. Her primary research interests are cultural factors in engineering learning, assessment methods, and design of learning environments. Her ultima

Ms. Katherine Maul, Purdue University, West Lafayette

Ms. Anne Victoria Wrobetz, University of Colorado, Boulder

Anne Wrobetz currently serves as the lead engineering faculty at Front Range Community College in Colorado, in addition to pursuing a PhD in Engineering Education as a Hybrid Student at Purdue University. She hopes to analyze the factors that impact nontraditional students' success and persistence in engineering, particularly at the community college level. Anne received a BS and MS in Civil & Environmental Engineering from the University of Colorado at Boulder. Since graduating in 2015, Anne has worked as a clean technology researcher and engineer in the environmental remediation sector. She has taught engineering at Black Rocket summer camps, the University of Colorado, and Front Range Community College.

Reimagining International Research for Students in a Virtual World

International research collaborations provide important opportunities to support innovative research and address the significant global challenges facing the world today. One way to develop researchers who are both interculturally competent and able to navigate global research networks within their field is 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]–[6]. However, in the midst of the COVID-19 pandemic, international collaborations and programs for students faced challenges in continuing their typical operations.

To strengthen international research collaborations of the future, this project is seeking to understand the challenges, benefits, and supports that were necessary during the pandemic disruption to provide international research experiences for students in a virtual environment. Although the project is not advocating for a replacement of international in-person experiences with virtual experiences, it aims to highlight program elements that were necessary during and after the disruption that programs may want to consider continuing into the future. Thus, this project aims to address the following questions:

- How could each element of an international research experience for students be translated into a virtual environment?
- What program structures would allow for these new virtual experiences?
- What support would program leaders need to implement such programs?

Advancing the understanding of how international collaborations can be adapted to a virtual environment will potentially transform how STEM educators conceptualize what it means to provide students with international research experiences, resulting in more effective and accessible program designs in the future.

Our poster presents summary findings from two different strands of data collected to date. First, it highlights findings from focus groups held with principal investigators from NSF's International Research Experiences for Students (IRES) and Partnerships for International Research and Education (PIRE) programs during Fall 2021. These focus groups were an opportunity for PIs to note how they managed the pandemic disruption, discuss innovations that could be carried forward into the future, and note elements of in-person international experiences that simply cannot be replicated. Second, the poster highlights preliminary findings from students' experiences who participated in an IRES or PIRE program during Summer 2022, which for many programs was the first return to in-person international research following the pandemic disruption. Interviews with these students provided us an opportunity to gain insights on how international research opportunities were both similar and different after pandemic disruption compared to students' experiences in these kinds of programs before the pandemic.

Summary of Findings from Program Leaders: Fall 2021

During the first phase of the project, we conducted eight focus groups with over 40 U.S.-based faculty principal investigators (PIs) who had experience running these programs to understand the benefits, challenges, and future potential of incorporating virtual elements into international research programs for students (note: refer to [7] for a complete description of this phase of the project). Invited PIs led National Science Foundation-funded IRES or PIRE programs that had begun in the 2010-2019 date range. Participants included a combination of lab- and field-based researchers from a range of STEM disciplines (e.g., engineering, math, physical sciences, life sciences)--this variation was intentionally sampled so that we could understand the range of the kinds of international student research programs that NSF supports. Interview topics included the following: potential benefits of offering international experiences in a virtual format, how to adjust program elements and structures to a virtual format, identification of needs for helping support programs to adjusted modalities. The research team coded data following an inductive, constant comparative method [8] to identify a set of codes that were ultimately consolidated into three high-level themes [9].

The first theme, *benefits of virtual programs*, identified new and enhanced modes of collaborating with international partners, improved accessibility for students, and new program structures (e.g., collaborative online international learning, or COIL) that had not been in place prior to the pandemic disruption. The second theme, *challenges of virtual programs*, noted difficulties in coordinating cultural and social activities, the strain placed on international collaborators, and obstacles to performing certain kinds of research remotely (e.g., field-based research). Third, *future ideas for international research programs*, identified brainstorming around innovative hybrid models for international research as well as ways to provide more support for international collaborators, the lack of which is a common policy critique of these programs by the PIs. As we describe in [7] and our poster will highlight, virtual components to such international programs can provide some new-found flexibility and offer a lower barrier of entry to international engagement for students from a variety of backgrounds. However, PIs widely agreed that virtual components should not replace in-person international experiences. Rather, they should be intentionally integrated into experiences as considered to be enhancements. Pre/post-travel programming, for example, could be improved by incorporating virtual elements for both students and international collaborators. Such intentionality could ensure that students are better prepared for their research abroad and help make it more likely that the research becomes a shared product, which can often be important for international collaborators to justify their time spent supporting these programs.

Summary of Preliminary Findings from Students: Summer 2022

During the second phase of the project, we conducted mid-and post-program interviews with 16 students who participated in one of 8 IRES or PIRE programs during Summer 2022. Students were invited by PIs from the first phase of the study who had resumed travel and were willing to send the recruitment invitation to their students. Some of the program locations included Grenoble, Glasgow, Vancouver, and Brunei. Students, who were a combination of graduate and undergraduates, belonged to a variety of disciplines, including, for example, humanitarian engineering, mechanical engineering, mining, electrical and computer engineering, and astrophysics. The topics included in the mid-program interview were as follows: Overview of the program so far, research skills gained in the program, student's view of global engineering. Topics covered in the post-program interview included the following: Recap of the experience, transition back home, research skills, global engineering skills, and highlighting two experiences which were significant to the student.

We are currently analyzing those interview data, but include here some of our preliminary observations:

- Students' views of global engineering expanded over the course of the international research experience.
- Virtual components and COVID-19 did not have a noticeable impact on students' experiences, at least as described by students' interviews (note: all of the students interviewed were from programs that resumed international operations).
- PIs talked about the potential benefits of virtual components more than the influence of those components on students' experiences.
- The discipline within which a student was working seemed to have an important influence on the nature of the research experience abroad.
- Consistent with our pre-COVID data collection, many students suggested that this experience helped them consider future careers as researchers or working abroad.
- Engaging in the experience helped students who had not traveled extensively broaden their horizons (i.e., comparing their international experiences to their home experiences).
- Mentorship structures with other students engaging in the research lab often were more heavily emphasized relative to research mentorship with host faculty.

Future Work

Our final round of data collection is returning to PIs to identify some of the unique structures of IRES/PIRE programs, some of which arose following the COVID-19 disruption. We are working to highlight these structures for the broader community in an effort to spark some new thinking around how to support student researchers as they engage in this kind of international work.

Acknowledgements

This material is based upon work supported by the National Science Foundation (OISE-2106093; 2106100). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of NSF. We appreciate all faculty and student focus group and interview participants who helped us understand their experiences managing and engaging in IRES programs around the world.

References

- [1] K. Davis, Y. Jalali, V. Lohani, D. Knight, and R. Müller, “Student learning in international research programs: A comparison across cultural contexts,” presented at the ASEE Annual Conference proceedings, 2018.
- [2] K. A. Davis and D. B. Knight, “Becoming a researcher: A narrative analysis of US students’ experiences in Australia,” presented at the Proceedings of the 8th Research in Engineering Education Symposium, 2019.
- [3] L. M. Hatfield, C. T. Amelink, N. P. Sanderlin, H. E. Lyne, and B. K. Jesiek, “Student outcomes of participating in an international research experience,” presented at the 2017 ASEE Annual Conference & Exposition, 2017.
- [4] B. K. Jesiek, Y. Haller, and J. Thompson, “Developing Globally Competent Engineering Researchers: Outcomes-Based Instructional and Assessment Strategies from the IREE 2010 China Research Abroad Program.,” *Adv. Eng. Educ.*, vol. 4, no. 1, p. n1, 2014.
- [5] D. B. Knight, N. Sanderlin, and K. A. Davis, “Assessing the Impact of IRES on Researchers, Research Outcomes, and Students: A Case Study Approach,” 2020.
- [6] C. Matherly, G. Ragusa, S. R. Phillips, and C. A. Chapman, “International vs. domestic research experiences for undergraduates (REU): A three-year assessment of the preparation of students for global workforces,” presented at the 2016 ASEE Annual Conference & Exposition, 2016.
- [7] K. Maul, K. A. Davis, N. P. Sanderlin, and D. B. Knight, “Faculty Perspectives on how to Reimagine International Research for Students in a Virtual World,” presented at the 2022 IEEE Frontiers in Education Conference (FIE), 2022, pp. 1–7.
- [8] M. Q. Patton, “Qualitative research and evaluation methods. Thousand Oaks,” *Cal Sage Publ.*, vol. 4, 2002.
- [9] J. Saldaña, “The coding manual for qualitative researchers,” *Coding Man. Qual. Res.*, pp. 1–440, 2021.