Student Learning in International Research Programs: A Comparison Across Cultural Contexts

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Introduction

Engineering work is becoming increasingly global in nature, making it essential that engineering students develop global competence [1], [2]. However, traditional global programs (e.g., study abroad) present challenges for engineering students who often have to fit such experiences within a highly structured curricular schedule. Further, study abroad can be a financial burden for many students who are already paying significant amounts to attend college [3], [4]. One type of global engineering program that has the potential to address these challenges are international research experiences, which typically take place during the summer and provide students with a salary. Research has suggested that such experiences can meaningfully influence students' global competence [5], but few studies have explored how components of the experience may influence learning. This study compares two NSF-sponsored international research experiences for students (IRES) programs that send students to two different countries to identify differences in learning outcomes between the program participants. This work represents a collaborative effort among faculty members and graduate students from three engineering departments with the goal of creating research opportunities for students at various international sites using research-based educational practices. By understanding how context influences students' learning opportunities, faculty developing such programs may select research locations more intentionally or offer supplemental programming for students to ensure they achieve all of the program's intended learning outcomes.

Literature Review

Global education research has explored how learning outcomes may vary across different types of global programs. In particular, research has found correlations between global learning outcomes and variables such as duration of the program, language of the program, housing arrangements, and level of reflection incorporated into the program [6]. Global engineering programs take many formats, including courses, study abroad, internships, degree programs, and research projects [7]. However, few studies within engineering education have explicitly considered how these different types of programs influence learning outcomes. One exception is the work of Levonisova et al., who found similar results in terms of components that are related to learning in global engineering programs. Their study also suggested that study abroad, service learning experiences, and global courses are positively associated with engineering students' global preparedness [8].

Thus far, however, few studies have considered the location of a global program as a potential variable that may influence student learning outcomes. Level of foreign language required is

often cited as an important component of global programs [4], [9], [10], and this variable may be related to location. However, the papers that have studied language differences have focused on whether students must speak the foreign language, rather than whether a foreign language is present. In international research programs such as those considered in our study, students are rarely asked to speak the foreign language as a regular part of their work. Nevertheless, the existence of a language barrier can still have influences the student experience [11].

Domestic research programs have been adopted in many institutions across the United States. Research Experiences for Undergraduates (REU) is one of the well-known and widely recognized programs, established by the United States' National Science Foundation (NSF) with emphasis on increasing diversity and recruiting participants from underrepresented groups. In addition to disciplinary and interdisciplinary research experience, it has been reported that participants in REU programs gain skills in independent research, real-world problem solving, critical thinking, motivation to persist in science and engineering, and professional skills, such as communication [12]. Studies of international research experiences have shown similar outcomes, in addition to the global outcomes that are the focus global engineering programs in general [11], [13]. Wheatley et al. compared a single global research program across multiple years, and found that adjustments to their orientation seemed to help students achieve greater research focus earlier in the program, resulting in publishable material by the end [14]. Similarly, one study within engineering education compared domestic and global REU programs and found that global competence is a differentiating outcome between them [5], [15]. Although some components of the REU experience have been studied, thus far a comparison of global research experiences across multiple foreign countries has not been explored.

Purpose and Research Question

The purpose of this study is to explore what students learn through international research experiences through interviews conducted with each participant at the end of their program. Students from two International Research Experiences for Students (IRES) programs were included in the study: one program that sent students to China and one to Australia. By drawing from these two programs and comparing the results between them, the study addresses the following research question: *How does the location of an international research program influence what students learn from the experience?*

Program Descriptions

The NSF IRES program seeks to develop globally-engaged engineering and science researchers by funding research experiences for undergraduate and graduate students in these fields. The programs studied here are the recipients of two separate IRES grants, and the grant money covers all student travel, housing, and a stipend during their research experiences. Students for both

programs are recruited via an application process that requires submission of a resume and application essay describing their research interests. Students are recruited from departments with research closely related to the topics of the IRES programs.

China IRES

Five mechanical engineering students, 1 graduate and 4 undergraduates, completed a 10-week IRES program in Summer 2017. They spent one week of preparation before traveling to China, eight weeks of research in the Virginia Tech International Laboratory in China, and one week wrap up. The facility in China, which has been in operation from 2010, provides students with opportunities to engage in engineering analysis and practical problem solving in the field of bat biosonar sensing and bat flight. The old world is home to two families of bats, ld world leaf-nosed bats (Hipposideridae) and horseshoe bats (Rhinolophidae), with unique dynamic biosonar systems and highly maneuverable flight. These capabilities allow the bats to thrive in dense vegetation and offer valuable insights in technical sensing paradigms, sonar or otherwise. The significance of bat biosonar for engineering has been published elsewhere [16], [17]. In addition to gaining research experience, the IRES students participated in seminars and field trips during 8-week period in China. They also received mentorship from their peers, research team members, and faculty members. A summary description of the China IRES students for summer 2017 is included in Table 1.

Table 1. Description of China IRES Students

ID	Major	Year	Prior Research	Prior Time Abroad
Participant 1	Mech Eng	Rising Senior	3 semesters of research on-campus	None
Participant 2	Mech Eng	Graduate Student	Significant research experience	None
Participant 3	Mech Eng	Rising Junior	2 semesters of research on-campus	Europe several times: Western Europe, Czech Rep, Turkey
Participant 4	Mech Eng	Rising Sophomore	Minor	India as a child
Participant 5	Mech Eng	Rising Sophomore	Minor	South America, Canada, Vietnam, Thailand, and Singapore

Australia IRES

Two undergraduate students in civil engineering completed this 10-week IRES program in Summer 2017. The students had a one-week orientation during which they learned about international travel, research skills, and starting reading papers related to their research projects. Then they traveled to Brisbane, Australia and spent 9 weeks conducting research in the coastal engineering group at the University of Queensland. The students worked on a number of projects

with different faculty members on topics such as cleaning a local river, beach profiling with photogrammetry, the movement of coral rubble under varying wave conditions, and conducting drag experiments with varying airfoil designs. The project experiences were tied to the local coastal environment, and thus were unique from the types of research projects available at Virginia Tech. In addition to their research experiences, the IRES students attended regular research meetings and gained experience presenting the progress of their research work. They also received mentorship from PhD students, post-docs, and various faculty members within the coastal engineering group. A summary description of the Australia IRES students for summer 2017 is included in Table 2.

Table 2. Description of Australia IRES Students

ID	Major	Year	Prior Research	Prior Time Abroad
Participant 1	Civil Eng	Rising Senior	One-week research field experience	Prior research was in Dominican Republic
Participant 2	Civil Eng	Rising Senior	One semester on campus research	Family trips to Denmark and Sweden

Methods

To assess the experiences of students and the influence of the program on learning outcomes, students were invited to complete pre/post-program surveys and interviews. The surveys included a cultural intelligence assessment [18], a Global Competency Activity, and a Sojourn Readiness Assessment [19]. After completing the program, interviews were conducted with all participants to learn about their research, cultural, and professional experiences. For the purposes of this study, we focus on the interviews because of the limited number of participants so far. As the programs continue and grow in future years, we will continue collecting data and present our survey results at that time.

Data Collection

Individual interviews were conducted with each participant within one month after they returned from their IRES experience. One author worked with the students from the China program, and another worked with the students from the Australia program. The interviews were audio recorded and then transcribed for analysis. The students signed consent forms to participate in the study in accordance with the Virginia Tech IRB requirements. Interview questions were related to the goals of the program and focused on three main topics:

- What the participants learned about global engineering work
- What the participants learned about conducting research
- How the participants' goals, knowledge, skills, or attitudes had shifted

Sample questions for each of these topics are included in Table 3.

Table 3. Sample Questions

Topic	Sample Question
Global Engineering	How has the program changed your idea of what it means to be a global engineer?
Research	How has the program changed your idea of what it means to be a researcher?
Personal Development	In what ways was this experience helpful to you professionally?

Data Analysis

We used two rounds of coding to identify themes within the interviews. The first round of coding used a structural coding process that captured the major topics covered by the interview (*Global*, *Research*, and *Personal*). *Engineering* was added as a fourth structural code to differentiate between content students learned about a particular field of engineering versus learning about the research process. These codes were informed by common learning outcomes of research experiences and global programs for engineers that have been identified in the literature. The second round of coding used conceptual coding to explore each structural code in more detail by breaking them down into specific concepts learned by students [20]. Next, we quantized the results of each round of coding to more easily compare across programs [21]. This allowed us to analyze how the structural themes differed and identify concepts that were similar and unique between the two programs. Finally, we identified representative quotes that supported the results and characterize what was learned in each program.

Research Quality

In qualitative research, it is important to use multiple methods to improve the trustworthiness of the results [22]. In this paper, we have tried to provide detailed descriptions of the programs and the participants so that readers can determine transferability to their own settings. We have also provided several quotes and rich description of student comments to allow the reader to review our own conclusions. Finally, the lead authors met regularly throughout the project to continually review coding decisions and ensure consistency throughout the process.

Limitations

Despite our best efforts, this study has several limitations. First, the interviews were conducted by two different authors (one for China and one for Australia participants). Although the questions used in the protocols were similar, the interviewers may have different styles or use different follow-up questions to better understand the participants' comments. In addition, the interviewer for the Australia students traveled to Australia for a portion of their time abroad, so the students may have been more comfortable with this person than was the case in the other interviews. This decision was made because the two interviewers were each working closely with their respective programs and had easier access to the relevant students. This issue may be somewhat mitigated as both interviewers reviewed the codes for both programs. However, in

future we may make more of an effort to mix up interviewers across programs. A second limitation is the number of participants in this study, and their imbalance between the China and Australia programs. Because the Australia program had so few students, it is hard to draw very definite conclusions about their experiences. Nevertheless, the detailed qualitative nature of the data allows us to get an in-depth picture of their experiences despite the small number of participants. A third limitation is that the China program had younger students on average than the Australia program. This difference may have influenced the types of learning that was most prominent for each set of students, particularly within the *Engineering* theme. A fourth limitation is the differences in research content between the programs. The type of work may influence some of the themes that arise from the interviews, although we try to note this where applicable as we report the results. Finally, this study was limited to a comparison of two countries with drastically different cultures. In the future, we would ideally compare experiences across more countries to explore whether our findings in these programs are similar elsewhere.

Results

The results of the structural coding revealed some differences between the China and Australia IRES program participants. Table 4 shows what percentage of the codes fell into each of the main themes for the two programs.

Table 4. Percentage of Codes for Main Themes

Themes	Australia	China
Global	26%	67%
Research	26%	13%
Personal	30%	15%
Engineering	17%	5%

Note: Columns do not add to 100% due to rounding.

To explore differences between the programs in more detail, we present the conceptual codes for each theme in the following sections with supporting quotes.

Global

The global theme was by far the most common topic in the interviews with the students from the China program, and this theme covered a wide range of topics across both programs. Among the themes, the global theme resulted in the largest number of conceptual codes, which are listed in Table 5 below. The distribution of these codes between the Australia and China participant interviews is also depicted, revealing that although there were several areas of commonality between the global topics covered in the interviews, there were also codes that uniquely occurred in the China interviews, and one in the Australia interviews. These similarities and differences are explored further in the following sections.

Table 5. Distribution of Global Conceptual Codes

Global Code	Australia	China	Both
Cultural Differences			X
Cross-Cultural Skills		X	
Global Collaboration			X
Language Barrier		X	
Cultural Interest		X	
Generic Positive			X
Positive Relationships		X	
Cross-Cultural Teams			X
Cultural Awareness			X
Living Standards		X	
New Perspective		X	
Global Community	X		

Note: Codes ordered most frequent to least frequent.

Similarities in Global Codes

Cultural differences were the most common topic for students when asked about the global aspects of their experience, and this topic came up multiple times in both sets of interviews. This topic connected with the idea of developing cultural awareness that both groups discussed, where they built upon their observations of cultural difference to say that they became more aware of how cultures might be different. For example, one of the Australia participants said:

"I would say it's kind of like, being able to understand that cultures are different and you can't reach out to everyone the same way. And just knowing how to do that, I guess would be a skill that you'd have to go abroad to learn."

Another area of similarity between the programs was their discussion of need for global collaboration on a large scale and their experiences working on cross-cultural teams. Both groups found these experiences positive, and commented on the importance of learning such skills. One of the China participants described their experience this way:

"They came from different background like my Chinese co-workers, actually some of my coworkers were also Indian and one of them was Pakistani. They all had different views on how to do things. I helped them, they helped me, and they definitely offered a lot of insight."

Global knowledge, skills, and attitudes were cited by students from both programs as important outcomes of their IRES experience, with focus on improved cultural awareness and ability to work in cross-cultural teams.

Differences in Global Codes

Despite having many commonalities, there were notable differences between the China and Australia interviews in the global topics that were covered. The China participants were more likely to focus on global topics than any other theme, and also covered a wider variety of concepts in their comments. One notable area of difference was that the China participants discussed some challenges they faced living in a new culture, including the language barrier and different living standards. For example, one student said:

"I think the biggest issue was that I was working with a grad student, a master's student, and her English isn't the best it was sometimes. We would constantly have to talk about things that I would talk with [other student] for like two minutes I would talk to her for 10 minutes for the same idea, that was probably the biggest issue."

On the other hand, the China participants also had more positive experiences to share about developing cross-cultural skills, positive cross-cultural relationships, and interest in the culture they were exploring. An example of this is a student who said:
"The Chinese students that spoke English, it was very helpful to have them. They were very friendly and very eager to help us and they were able to explain cultural stuff to us and I mean not just like basic translation but also if you had some question about something, you know like why is this the case, they kind of give their taste, that's very interesting to be able to get sort of insight like that was very valuable aspect of the program."

The Australia participants discussed their global experiences positively, but at less length than the China participants. One topic they covered that was unique was the idea of becoming part of a global community of researchers. Both participants brought up this idea, and one of them described this idea this way:

"I guess by expanding your network and understanding that there's a lot more people out there than you think there are, and they're more willing to help you than you think they are. And so, it's just one big community. It's a bigger community than you think it is. Just, from a global perspective as opposed to being in the U.S."

Thus, although global topics were discussed by participants who went to China and Australia, there were differences in both the *quantity* and *nature* of their comments.

<u>*Research*</u>

Although students from both programs felt that they learned about research and developed research skills, this was a greater focus in the interviews with the Australia participants. Similar to the global theme above, there were some topics that came up in both sets of interviews, but

several that were unique to either Australia or China participants. The distribution of the conceptual codes is summarized in Table 6 and discussed in more detail below.

Table 6. Distribution of Research Conceptual Codes

Research Codes	Australia	China	Both
Research Process			X
Development of Research Skills		X	
Understanding Literature			X
Purpose of Research		X	
Role of the Researcher	X		
Independent Work	X		
Teamwork	X		
Making Research Decisions		X	

Note: Codes ordered most frequent to least frequent.

Similarities in Research Codes

The most common topic discussed by participants from both programs was how they had learned about how the research process worked. This included understanding what steps to take to move a project forward, who needs to be involved in a research project, how to identify research questions, how to conduct an experiment, and the "messy" nature of research in general. Most students had not done much research before and were surprised to find that it was not like their prior experiences writing research papers or lab reports, where they were following a formula. One student in the China program explained:

"The only research experience I had before was as a lab assistant, so from what I observed I thought research was just reading papers, doing calculations, yeah like really boring [...] so I had no interest in research. But then after the program, I found research very interesting, from doing experiments, collecting the data, analyzing the data, and then afterwards I think the most interesting part is the engineering applications that will come of the research."

A second area of similarity were comments about learning how to find, read, and critically analyze relevant literature. Students from both programs felt that they had a better sense of why literature review was important in the research process and how to identify literature that would help their research study. One of the Australia participants put it this way:

"Being able to discern whether or not that paper is good and if the information is relevant is a big thing. Information relevancy was I think a huge part of it because you would read 20 pages in this research document but you only needed this one section that applied. You had to hunt through and be like, 'Okay, this is important. This doesn't deal with it' and then go onto the next

paper and then go through a textbook, 'All right. Here's another paragraph that's pretty good. Mark this down.'"

From their comments, it is clear that participants in both the Australia and China IRES programs felt that they developed important research skills through their experiences.

Differences in Research Codes

On the other hand, there were several codes that were unique between the two programs. These codes may indicate different emphasis in research skills from the programs, or perhaps topics that came up in the mentoring relationships through each program. China program participants were more likely to make comments about coming to understand the purpose of their research. For example, one student said:

"I think something that's really important is knowing why you're doing the research, which is something I didn't know at the beginning. It's important to know that what this research will lead to and why this research is important rather than just analyzing the data."

Several of the China participants also discussed the idea of making decisions in research, and how you have to be able to make adjustments as you go. One participant explained:

"I feel like important thing is decision making. Nobody goes to research and 100 percent knows what to expect, like you don't make a whole bunch of experiments and say I'm gonna do this I'm gonna do this, and this is the result I'm gonna get. [...] There comes a point where you have to sit down and think, that didn't go how I was expecting, where am I gonna go now, you need to be prepared to make kind of important decisions."

The Australia students talked about the fact that research requires both independent and team work. This may have been a result of the research group environment that they worked in, where several researchers were working separate projects but would come together to share their results and get feedback. One of the participants described the environment like this:

"More human interaction than I thought there was going to be. A lot more teamwork. A lot more people willing to help you. I thought it was kind of like a thing you do on your own, but there's a lot of people, a lot of people have lots of ideas and everybody is willing to help."

Along these lines, one of the Australia participants also mentioned the importance of incorporating non-coastal engineers into the research process. He talked about how they visited an island and talked to the locals there about the phenomenon they were studying, saying:

"He had experienced this phenomenon we were looking at. He had firsthand accounts. He had seen it. He had been there where it was happening for a long part of his life."

The research theme had many similar topics between the tracks, but there were also several topics that were different between them. It is possible that these differences may be related to the specific projects or research group contexts at each of the program sites, although we do not have enough details to say this for sure.

Personal

Although research was a large focus of the IRES experience, personal learning had slightly more codes than the research theme for both the China and the Australia program participants. For this study, we operationalized the *Personal* theme to include any general skills or perspectives that are transferrable across contexts. This helped to differentiate this category from the *Research* and *Engineering* themes. The Australia participants talked about all the themes fairly evenly, but the personal theme was their most common theme overall. For this theme, the most common conceptual codes were consistent across both tracks, and the differences were more minor and had fewer occurrences than in the previous two themes. The distribution of conceptual codes is shown in Table 4 and explained in more detail below.

Table 7. Distribution of Personal Conceptual Codes

Personal Codes	Australia	China	Both
Career Goals			X
Interests			X
Real World Experience			X
Awareness of Unknown	X		
Use of Existing Skills		X	
Personal Awareness			X
Empathy		X	
Time Management	X		

Note: Codes ordered most frequent to least frequent.

Similarities in Personal Codes

Both the Australia and China IRES program participants talked about how their research experiences sparked new career goals and interests. Several students discussed being uncertain about whether or not to go to graduate school, and being able to "test out" the research work encouraged their interest in doing so. One China participant put it this way:

"I didn't want to do graduate school so much because [...] I don't like taking classes that much. However, doing research I did enjoy that a lot. [...] After talking to [graduate student], you know he takes only one or two classes but then most of his time is spent researching, so I definitely am more interested in doing research and going to grad school."

Similarly, students discovered new subjects or areas of research that they had not covered in classes which shifted their ideas about what they might want to research in graduate school. An Australia program participant explained:

"I really enjoy doing the coastal stuff because it wasn't just geotech, it wasn't just water. It was a mixture of both. If you have a mixture of both you can also throw on environmental effects. Now you have got the whole kit and caboodle right here in one very broad but also very in-depth subject."

Aside from professional lessons, some participants also mentioned things they had learned about themselves through the experience. These lessons included understanding their personal motivations, recognizing strengths, or developing self-confidence. Relevant to the latter, one of the Australia participants said:

"I guess part of the outcome would be I'm not as afraid to do things that seem difficult or scary or that would make someone apprehensive. Applying to a program that's going to send you to Australia with some guy you don't know, that was pretty much the height of should I do this?"

Participants in both programs highlighted positive outcomes of the IRES experience on their personal career goals and understanding of themselves.

Differences in Personal Codes

Although the differences between programs were less prominent for this theme, there were still some codes that were unique to each program. One that was particularly interesting was the idea of "empathy" that emerged in some of the China interviews. This connected back to the global skills several students mentioned, but represented more personal reflection on the experience of being in a new country. One student described how their experience struggling with the language barrier in China might relate back to the experiences of international students in the United States:

"I guess I saw from the other side and I was definitely hoping people to give me same patience. I think I have more patience with people and more I guess willingness to work with them to improve their skills because they are very eager to learn English when they come to America for school."

On the other hand, the Australia participants discussed an increased awareness of how much they did not know and had yet to learn. They were impressed by the expertise of the faculty mentors in their research group, and described sometimes feeling that topics of discussion were advanced for them. One of the participants said:

"[One thing I learned was] that I don't know a lot. A lot of the times we would have every Friday there was a meeting with all the professors and the coastal research group. Then we would all present something. Sometimes [one of the professors] would. Some of the topics were just over my head. [...] There's a lot to learn and there's a lot to learn about a lot of things, which is exciting and scary."

Similar to the differences seen in the research theme, these differences may be connected to the specific context of each program, including both the research group and faculty mentors. Nevertheless, on the whole the personal theme was more aligned between the China and Australia programs.

Engineering

This theme was separated from the research theme to differentiate between what students learned about research process and skills and what they learned about engineering specifically. This theme was proportionally more common in the Australia participant interviews than those of the China participants. As a result, there were more conceptual codes in the Australia interviews than appeared in the China interviews. The distribution of conceptual codes is shown in Table 8, with further discussion below.

Table 8. Distribution of Engineering Conceptual Codes

Engineering Codes	Australia	China	Both
Knowledge Gained			X
Access to Resources			X
Engineering Perspective	X		
Connections to Classes	X		

Note: Codes ordered most frequent to least frequent.

Similarities in Engineering Codes

Participants from both programs talked about specific engineering skills and concepts they learned through their IRES experiences. This included things they learned by reading more thoroughly in the literature, interacting with experts in their field, and through the process of conducting research. Participants in both programs learned about new engineering topics not yet covered in their classes, as described by one of the China participants:

"I never realized this part of engineering existed until this research, it is called digital signal processing [...] recording the signals to analyze the signals, like I never knew this stuff existed. I was talking to you know the older people, they said yes you will learn this eventually, but being able to get hands on experience beforehand will hopefully be helpful; that was my favorite part of research."

Another area of similarity were discussions around the access to new resources that the participants had at their host universities. In particular, the unique labs or equipment that is not available at Virginia Tech were frequently discussed as major benefits of participating in the IRES program. One Australia participant said:

"It's funny cause I had my water resources class say that you could use this equipment in a lab. It's all this equipment that you probably won't ever get to use until you go out, maybe you go out in a job [...] I was like, 'oh, I already used it.'"

Thus, participants of both programs felt that they gained useful skills and knowledge through working with experts in advanced lab settings that are unique from what they can access at home.

Differences in Engineering Codes

The Australia program participants also talked about two more topics that the China participants did not discuss: gaining a new engineering perspective on the world and connecting their work back to their classes at Virginia Tech. The former topic was described by one of the participants in the following way:

"Just a different way of looking at things. One of the reasons why I got into physics and then through physics, engineering, I enjoyed understanding how things work. [...] Now whenever I go to a beach or a river or something I can look at it and understand why it's the way it is, which adds another layer to the enjoyment."

Both participants discussed being able to apply their work in their classes in the fall semester fall semester following their research experience. One of the participants stated:

"And there was this, you know, it's in my classes, there was stuff that I saw there that I've been able to apply in class, which is really cool."

In general, the biggest difference between the two programs for the engineering theme was simply that the Australia participants spent more time talking about things they learned in this area. This might be because both of these participants are interested in continuing to study the same topic in the future, because the China participants were less far along in their field of study, or simply because the China students had more cultural topics to discuss in the course of the same interview.

Discussion

In this study, we sought to understand how the location of an international research program might influence what students learn from the experience. We compared end-of-program interviews with seven participants from China and an Australia-based IRES programs to see how the topics discussed in the interviews were similar and different. We found that the participants in the China program focused much more heavily on global topics, including cultural skills that they developed, cross-cultural challenges, and their interest and enjoyment in experiencing a new culture. Although the participants from the Australia program mentioned several global topics and skills, their interviews were more evenly distributed across the four themes highlighted in this study (global, research, personal, engineering). When talking about skills gained, these participants were more likely to focus on research or engineering related skills. Their global discussions also tended to be at a more general level, for example, talking about working on global teams rather than looking at aspects of Australian culture specifically. There were also differences across programs in terms of specific research and personal skills, possibly related to the specific research projects and research environments that the programs focused on. Thus, although the participants of both of these IRES programs felt that their experiences had influenced them in positive ways, their conversations revealed different focuses of their learning between programs.

These findings are important as we work to design global engineering programs that achieve different kinds of outcomes. Our results suggest that choice of location abroad may be a factor to consider when designing a global engineering program, dependent on the goals of the program. It is important to emphasize that students on both programs did experience cultural differences and felt that they had gained important cultural insights. However, it was clear that the students who traveled to China had a more intense cultural experience, were more often out of their comfort zone, and felt that they had developed specific skills to work with people whose first language was not English. These results are supported by prior studies, which have compared domestic and international service learning programs [23] and domestic and international REU programs [15]. In particular, Niehaus and Crain found that the *intensity* of an experience influenced the outcomes for students, and that international experiences tended to be more intense [23]. In our comparison, the China program provided more cultural intensity, but both programs seem to have provided research intensity (i.e., opportunities to be challenged and develop). However, the cultural experience may have outshone the research challenges for the China participants, as they certainly focused more on those topics during their interviews.

Both IRES programs have several more years remaining, and we plan to continue collecting data from both programs. As we build up a larger pool of participants across years, we will also explore the results of the pre/post surveys for cultural intelligence that we have administered. We are curious to see whether the results of these surveys will support the results suggested in the

interviews we have analyzed so far. The results we have identified this year have also sparked some ideas for change in the 2018 IRES programs. In particular, we plan to incorporate more of a reflection element into the programs this year, which we hope will help the Australia students consider more deeply the cultural influences they see at work and the China students make connections between what they are learning and their classes and work back at Virginia Tech. In future years, we are also interested in following up with IRES participants a few years later to see how the IRES experience might influence their decisions about graduate school, research focus, and other career opportunities. Although not identical, these IRES programs both present unique opportunities to develop both students' cultural and research skills as well as their personal interests, goals, and professional skills.

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