
AC 2011-323: GLOBAL ENGINEERING PROGRAMS: IDENTIFYING AND SUPPORTING A DIVERSE ARRAY OF LEARNING OUTCOMES

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Global Engineering Programs: Identifying and Supporting a Diverse Array of Learning Outcomes

Abstract

Engineers in both industry and academia recognize the global nature of the engineering profession. This has led to calls for engineering students to develop knowledge, skills, and attitudes necessary for success within a global profession. Many institutions are developing globally oriented programs specifically for their engineering students and are eager to know if these programs are helping students to develop attributes that meet program objectives, accreditation requirements, and the needs and desires of prospective employers. Administrators of such programs currently lack research data to support the learning objectives they are setting for their programs.

This paper presents results from a qualitative study that documented the individual learning outcomes of students involved in two global engineering programs. The first program provided a portfolio of experiences including foreign language instruction, one semester of study abroad, an internship in the U.S. as well as an internship abroad, and a two-semester global team design project. The second program was a one semester study abroad program designed specifically for engineering students. Interviews were used to elicit the learning outcomes of participants in these two programs.

Through the use of content analysis, more than 50 outcomes reported by participants in the two programs were identified. The most prevalent outcomes in both programs included cultural knowledge, foreign language skills, and openness to new experiences and other cultures. This study also found that learning outcomes varied between programs as well as between individual participants. Several participants joined programs having their own personal objectives and expectations of learning outcomes. In light of these findings, the paper proposes that global engineering program administrators should look beyond current assessment strategies and find ways to engage participants in active reflection while abroad in order to support a diverse array of possible learning outcomes.

Introduction

Engineers in both industry and academia recognize that engineering is a global profession (Committee on Prospering in the Global Economy of the 21st Century, 2007; Continental AG, 2006; National Academy of Engineering, 2004) and that engineers of today must be able to collaborate with colleagues and clients from cultures that differ from their own on projects of global impact (Downey et al., 2006). Engineering educators have also come to believe that

success in a global context requires students to acquire specialized knowledge and to develop new skills and attitudes (Alexander, 2007; Deardorff, 2004; Nguyen, 1998). As a result, many universities are seeking to infuse their curricula with a global perspective by offering globally-oriented course modules, study abroad programs, internships abroad, and/or international service projects (Downey et al., 2006; Grandin, 2006; Parkinson, 2007). Although many engineering schools have been developing and offering globally-oriented programs to their students, program developers have little research data on which to support the learning outcomes they are setting for their programs (Alexander, 2007; Kirk, 2008; Lohmann, Rollins, & Hoey, 2006). In addition, administrators of such programs struggle to make clear connections between desired learning outcomes and the kinds of experiences that will produce them (Alexander, 2007). Engineering schools and their program donors are investing significant amounts of time and money in the development of global experiences for their students and want to be assured that they are investing their resources wisely.

Administrators of many global programs hope to provide experiences from which participants can develop intercultural competence (Downey et al., 2006). However, focusing on such a broad construct may result in overlooking many important context specific outcomes. In addition, it has been suggested that qualitative measures alone may be insufficient for assessing intercultural competence (Deardorff, 2004; Patterson, 2006). This paper presents a qualitative study that documented the learning outcomes of participants in two global programs for engineering students. The research question guiding this study was:

What specific *knowledge, skills, and attitudes* did students gain from participation in their respective global engineering programs?

Interviews were conducted with participants during and after the two programs to document the experiences and learning outcomes of participants.

Learning outcomes refer to broad goals that describe what a student should know, think, or be able to do and are an essential component of individual assessments of achievement as well as program evaluations (J. O. Nichols & K. W. Nichols, 2000). Learning outcomes are often defined in terms of the *knowledge, skills, and attitudes* that students acquire as a result of specific educational experiences. This three domain classification of learning outcomes can be traced back to Bloom's (1956) taxonomy of learning outcomes and is commonly found within engineering education literature (e.g. Downey et al., 2006). Although no consensus exists on the definitions of these three domains, basic hybrid definitions were created for this study based on the usage of Besterfield-Sacre et al. (2000), Deardorff (2004), and Downey et al. (2006) in an attempt to represent the current usage of the three outcome domains within engineering education. These definitions are found in Table 1.

Table 1. Definitions of learning outcome domains

Domain	Definition
Knowledge	Facts Information
Skills	Abilities that require knowing how to do something. Application of knowledge.
Attitudes	Values (including adaptability, awareness, empathy, flexibility, openness, respect, etc.), opinions.

The Programs

GEARE program:

Two global programs for engineering students were the focus of this study. The GEARE (Global Engineering Alliance for Research and Education) program, established in 2003, was developed to be a comprehensive globally-oriented program involving both study abroad and work abroad experiences. Students in this program spend one semester studying at a partner university abroad, participate in two internships with a multinational company (one internship in the U.S. and the other abroad), and collaborate with students from international partner universities on an industry inspired team design project. In addition, students are required to take between two and four semesters of foreign language courses in the language of the target country as well as maintain a cumulative GPA of 3.0. Students in the GEARE program may choose from four international destinations: China, Germany, India, or Mexico. The GEARE program was developed by the School of Mechanical Engineering at Purdue University, but is now administrated by the College of Engineering thus allowing engineering students of any major to participate (Allert, Atkinson, Groll, & Hirleman, 2007). During the 2008-09 school year a total of 16 students participated in the GEARE program. The focus of this study was only on participants whose international destination was China.

Participants in the GEARE program for China study abroad at Shanghai Jiao Tong University taking engineering courses at what is one of the oldest and highest ranked universities in China. Although the GEARE program has many experiential elements and spans several semesters, the data collection portion of this study covered only two semesters of the program. The elements covered in this study included the study abroad experience, the internship abroad, and the first semester of the global team design projects. The study abroad experience occurred during the Spring semester of 2009 and the international internship occurred during the summer of 2009. While in China, participants also took two six-week courses which focused on Chinese history and culture as well as cross-cultural teamwork. All courses in the GEARE program were taught in English.

GEARE Junior Year program:

The second program in this study is the GEARE Junior Year program (now called “Engineering Term Abroad”). The GEARE Junior Year program was developed as a scaled-back version of the GEARE program and involves only the one semester study abroad portion of that program. It was developed to fill a gap in the portfolio of global programs offered to engineering students at Purdue. In 2008, enrollment in the GEARE program peaked at about 20 students. Administrators wanted to provide more opportunities for engineering students to be involved in international experiences and realized that the language and GPA requirements of that program were limiting their ability to recruit a larger number of participants. The GEARE Junior Year program did away with GPA and foreign language requirements and launched with only one international destination – China. The choice of this destination was a strategic decision on the part of program administrators and reflected recognition of the impact that China is having on the careers of many engineering graduates of today. The GEARE Junior Year program was also designed to seamlessly integrate with the mechanical engineering curriculum at Purdue University. The Spring semester of 2009 was the first semester that the GEARE Junior Year program was offered.

Participants in the GEARE Junior Year program study abroad at Shanghai Jiao Tong University along with participants in the GEARE program. The focus of the study presented in this paper was on the first cohort of participants in the program who went abroad during the Spring semester of 2009. In addition to engineering courses, participants took the same short courses on Chinese culture, history, and cross-cultural teamwork as the GEARE participants. All courses were taught in English.

Population and participants

GEARE program:

Participants in the GEARE program were junior and senior undergraduate engineering students enrolled at the West Lafayette Campus of Purdue University. Only participants from the GEARE program for China were invited to participate in this study. During the 2008-09 school year, seven students enrolled in the GEARE program for China. Three of these students were mechanical engineering majors, two were electrical and computer engineering majors, one was a materials science major, and one was a civil engineering major. Of these seven participants five were international students and only one was female. The fact that five of the program participants during the 2008-09 school year were international students is of particular interest because program administrators had originally conceived of the program as a way to provide *domestic* students with a global experience. Historical application data for the program were collected and show that an increasing number of international students have been enrolling in the

program. Four of the participants during the 2008-09 school year consented to participate in this study. These four participants were all international students. One was from Canada (but born in India), one was from South Korea, and two were from Indonesia. One participant was female. The GPAs of the four participants ranged from 3.6 to 4.0. All of these participants had significant previous travel experience, and one had previously studied abroad in China while in high school.

GEARE Junior Year program:

Participants in the GEARE Junior Year program were all junior mechanical engineering majors. All twelve of the participants in the program consented to participate in the study. The majority of participants in this program self-identified as white (10 out of 12) and were from the Midwest. One participant was an international student (from South Korea) and two participants were female. The GPAs of participants in this program were considerably lower (average GPA = 3.1) than those of participants in the GEARE program. Seven of the twelve participants had only been abroad once before (Canada being the most common destination) and one participant had never been abroad. Only one participant had more than basic conversational skills in a foreign language and that participant was an international student from Korea (who was fluent in English).

Approval for this study was obtained from the Institutional Review Board (IRB) of Purdue University because of the involvement of human subjects. Participants were offered neither incentives nor compensation for participation in this study.

Method

Data Collection. Qualitative methods are best suited to situations where little is known about a given situation or phenomenon (Hancock & Algozzine, 2006). According to Cresswell (2008) qualitative research “relies on the views of participants; asks broad, general questions; collects data consisting largely of words (or text) from participants; describes and analyzes these words for themes; and conducts the inquiry in a subjective, biased manner.” (p. 46) Qualitative data is therefore very detailed, rich in context, and focuses on naturally occurring events in natural settings rather than on controlled experimental settings (Miles & Huberman, 1994). The subjectivity of qualitative methods, therefore, recognizes the connection between research subjects and their environments.

Miles & Huberman (1994) suggest several recurring features of qualitative research, explaining that qualitative research involves “intense and/or prolonged contact with the field.” (p. 6) As a result, the role of the researcher is to gain a “systematic, encompassing, and integrated” view of the context under study. They add that “the researcher attempts to capture data on the perceptions of local actors ‘from the inside.’” (p. 6) The focus is therefore on developing a deep understanding of the research subjects and their context.

The theoretical perspective of this study was constructivism. From this perspective participants are the source of knowing. The role of the researcher is therefore to report the perspectives of participants as directly as possible (Koro-Ljungberg, Yendol-Hoppey, Smith, & Hayes, 2009). Because the knowing in a constructivist study originates with participants, multiple “knowledges” may coexist simultaneously (Guba & Lincoln, 1994). As such, the purpose of this study was to describe the various perspectives of individual participants.

Interviews were the primary source of data for this study. According to Patton (2002), the primary purpose of interviews is to discover things that cannot be directly observed. Interviewing allows the researcher to enter a subject’s perspective (Creswell, 2008; Patton, 2002). During the interviews participants were asked open-ended questions in order to “yield in-depth responses about [their] experiences, perceptions, opinions, feelings, and knowledge.” (Patton, 2002, p. 4) Open-ended questions also allow participants to “voice their perspectives unconstrained by any perspectives of the researcher or past research findings.” (Creswell, 2008, p. 225)

Individual interviews with participants occurred half-way through the semester abroad and then again after participants had returned to Purdue University for the fall semester. The interviews in this study ranged in length from about 40 minutes to an hour and 45 minutes. The average interview time was just over 45 minutes. Interviews were semi-structured and each one started with a question protocol. Protocol questions asked participants to talk about significant experiences that they had had abroad as well as the knowledge, skills, and attitudes that they acquired from participation in the programs. The researcher then asked follow-up questions which probed deeper into participants’ learning experiences.

Data analysis. Each interview was recorded and the recordings were transcribed for analysis. Content analysis was used to identify learning outcomes described by participants. During the analysis process three passes were made through each interview transcript. The first pass involved only reading, the second pass focused on the creation of learning outcome categories, and the third pass focused on the refinement of the categories created in the second pass. The coded learning outcomes were then sorted into the three learning outcome domains of *knowledge, skills, and attitudes*.

Findings

More than 50 learning outcomes were identified by participants in the two programs which were the focus of this study. This paper provides an overview of the most common outcomes of each program and situates these outcomes within the various elements of each program.

GEARE program:

The most common learning outcomes of participants in the GEARE program related to various kinds of *cultural knowledge* and *foreign language skills*. Within the *knowledge* domain

cultural knowledge was the most common learning outcome, and more specifically, knowledge of *social culture*. For example, participants learned about ways in which Chinese people relate to each other. One participant explained that, “In China, they give more respect to the elders.” From the short courses that participants took on culture, history, and intercultural teamwork, participants learned about the differences between low and high context cultures. One participant felt that in China it was more difficult to read people’s physical reactions because, as he explained, he belonged to a low context culture. This participant went to explain that, “In a lot of the shopping and stuff we’ve done so far, you don’t see an immediate reaction on people’s faces here [in China]... I don’t know if they have just a different set of reactions that we’re not tuned to interpret.”

Participants also learned about the *national culture and politics* of China. Some participants were surprised by the level of patriotism that they encountered. At the end of the program one participant explained what he had learned in this way:

I guess the affection that the Chinese have for their own culture and their pride for it is something else that I will take away. They’re incredibly proud of their achievements, perhaps owing to their history. [You] rarely hear people talk ill about government or society or whatnot, whereas in the West, you hear it all the time.

Participants were surprised to discover that, for its size, China is a rather homogeneous country. The same participant explained:

What did I learn about China? For one thing, China is unique. I don’t think you can have that size of...a country of that size with that many people and still be so homogenous. It amazed me. You have a Mao statue in Chongqing. You have a Mao statue in Tibet. You have a Mao statue in Shanghai. You can get by with Mandarin, you know, Putonghua [the standard Chinese dialect], in Chongqing, or Beijing, or just about anywhere. In Tibet you can get by with Chinese and not have to know any Tibetan.

Participants learned about *engineering culture* in China as well as about China’s engineering achievements. Two of the participants set the personal goal of finding a research experience while in China. Both were successful in finding research groups in join. However, only one participant remained involved to the end of the semester. The other found the language barrier in his research group to be insurmountable. In describing his research experience, one participant explained, “I was quite surprised by the facilities and equipment... I kinda underestimated the engineering in China.” The internship experiences abroad also provided an opportunity to learn about engineering in China. One participant was impressed by the engineering feats that China has accomplished, explaining:

I did see a lot of engineering being put into practice as in like applications in China, and it's just great how the Chinese engineers can do that. I mean, they put ...they're the third nation who's able to put man in space. I think that's a major jump for them, major development for them.

Participants did not get to experience the life of a Chinese student firsthand because they were taking special courses taught in English. As a consequence, they did not feel that the classes they took in China differed significantly from those that they had taken at Purdue. One participant explained, "Probably, like in general, I would say the coursework is more or less as challenging as it is in Purdue. We use the textbooks from the United States." However, participants learned about *engineering education* in China from their Chinese classmates. The participants were surprised to discover that their Chinese classmates attended class from eight in the morning until five or six o'clock in the evening every day. One participant explained, "What I first noticed and surprised me is: How can they take like 10 courses in one semester? And because it's like a lot and they're like very diligent, I think."

Participants learned about the *food culture* in China. Not only did they learn what people eat, but they learned about how people in China socialize while eating. One participant explained what he learned about dining culture this way: "And another thing is...like in terms of dining, Chinese like to eat together, so it's like a communal thing. Like, they wait for each other. Usually, back in the States, you just go ahead and start. If somebody hasn't arrived, I'll start anyway." Participants also learned about the cuisine of different regions of China. The same participant explained that, "in Tibet, they eat yak meat which is not of my taste. It's too hard and too chewy. Yeah. Well, but the idea...it's interesting to try new kind of stuff." Another participant described how western food is more expensive in China, "Even like salad costs more [in China], while in the States salad is like the lowest one. And like here [in China], like pizza, it costs like expensive, while in Purdue, at least, sometimes they give you free pizza if you attend the call out."

Within the *skills domain*, *foreign language skills* were the most prevalent outcome. When asked what skills he had developed from the program, one participant replied, "Chinese language skills, definitely. I'd say I've at least doubled my vocabulary since I've come here." Another participant expressed similar sentiments, explaining how his internship experience had helped him to improve his Chinese language skills, "I think I improved a lot compared to the first time when I got there [to China], especially during work. Because when the Chinese engineers are speaking to each other, they will use Chinese." When asked the same question, a third participant (an international student) started out with a similar response, but then added something quite surprising: "Well, first of all, like some Chinese improvement, like [a] little Chinese improvement. Actually, my English got a little better in Shanghai, [a] little better because I had some interactions with American friends, like more than in Purdue." At Purdue, the participant explained, international students tend to be isolated from their American peers.

The participants in the GEARE program exhibited relatively few *attitudinal outcomes*. However, some attitudinal outcomes stood out for certain individuals. Two of the participants spoke at length about developing flexibility, or learning to be adaptable. One participant stated simply, “I guess I became even more flexible, to be adjusted to different cultures.” He went on to explain how he “couldn’t get all of the things that I liked in the States in China.” But, he learned to get along without those things; particularly, he explained, the foods that he enjoyed eating at the Purdue dining courts. The other participant talked about how the language barrier forced her to be more flexible. She explained, “You have to adapt even though you do not know their language.”

Participation in the GEARE program convinced some participants that they should consider an international career. Before enrolling in the GEARE program, one participant was already planning to pursue an MBA at some point in the future, but his experience in China reinforced this interest and gave it new focus. He saw huge market potential in China, explaining, “When Starbucks is closing their stores over here in the U.S. they’re opening new stores in China. So I think it’s [China is] a great market to pursue in terms of business and management and...yeah, I’m seeing it as an opportunity, as a resource, especially for the next 10 or 15 years for me.”

Having lived abroad previously, one participant didn’t think that his experiences in China changed his perspective or values in any way. He did, however, admit to feeling, “like maybe I can live here [in China]. Like, maybe I can just live here later in my life and I can interact more deeply. Before, I didn’t even think about living here or making Chinese friends.”

Some outcomes weren’t universal but were very significant for individual participants. One participant described himself as very shy and quiet. However, as a result of his experience in China he felt that he had become more “vocal.” After returning to Purdue he explained how his friends had noticed a change in his personality. He explained: “After I came back from China my personality changed a little, I guess. I got more vocal among my friends...I’m still quiet, but it changed a little...My personality changed, I guess. And, my friends say that too. Like, ‘You changed!’”

GEARE JY program:

The most common learning outcomes reported by participants in the GEARE Junior Year program were various kinds of *cultural knowledge, foreign language skills, and openness to new experiences and other cultures*. Within the *knowledge* domain *social cultural knowledge* was the most common learning outcome. One of the specific things participants learned about social culture in China was how Chinese people pay for dinner when dining out together. One participant explained what he learned in this way, “The big dinners. Like the one person expecting to be the one to pay. We’re used to breaking the bill. Like we ask for the bill and we ask for it split.” The participants also learned what Chinese students like to do for fun. Another

participant explained, “Probably one of the most interesting [things I learned] was what they do in their spare time, for fun. They go to KTV [Karaoke TV].” The participants also learned how etiquette is different in China. Participants noticed that Chinese people interact differently in public than Americans do, as one participant explained:

I noticed the physical barrier is almost non-existent here [in China]. Everyone has their bubble, but here it's, you know, you get used to sort of pushing your way through a crowd, as well as you know, when you're in line, you have to hold your own because the first come first serve comes before any kind of line etiquette.

Participants also noted that people tended to stare at them a lot. Participants felt that they learned to ignore the staring and adapted to having much less personal space.

Within the *knowledge domain* participants also learned about the conditions in China. The *economic conditions* were of particular interest, as many participants were expecting China to be a poor third world country. They were surprised to find that Shanghai is a very modern city. One participant explained, “I kind of imagined China as a bunch of farmers in the field, in the rice paddies, or something. Shanghai was definitely a lot different than that.” Later in the interview, this participant added:

Even in Suzhou and Hangzhou, where it was more rural and stuff, it's definitely a lot more advanced than I thought it would be. Everybody's carrying iPods, and the buildings look pretty nice. The streets are so much cleaner than the U.S.

Within the *skills domain*, *foreign language skills* was the most common outcome even though foreign language training was not a formal part of the program. Three participants, however, had taken a semester or two of Chinese language classes on their own in preparation for participant in the program. Even though formal language classes were not a part of the program, most participants learned at least a few words or phrases in Chinese from their fellow participants or from Chinese friends. When asked what he had learned in Chinese, one participant explained, “Mostly just like practical phrases, like different types of food, like just meats and noodles, rice. I learned how to count...”

Non-verbal communication skills were an outcome that participants felt were particularly important as they faced a significant language barrier every day. Participants not only learned how to express themselves non-verbally, but also how to read the body language of others. One participant explained, “I've sort of developed a way to do things without actually saying words.” When asked what skills he had learned, another participant explained, “I think reading body language will be one. Just learning how Chinese students, and Chinese in general, don't say exactly what they feel or mean right at that moment, but you're supposed to be able to still understand what they mean.”

Participants also developed, or improved, what they called “people skills.” One participant explained:

A lot of people say that I’m a people person, so I guess I’ve utilized that skill a lot—just being able to talk to the non-native English speakers; I just have the patience for that. Some people just get fed up with it. They’re like, “You can’t carry a conversation.” People always tell me that I’m a people person, so that’s helped; so that’s improved maybe.

When it came to *communication skills*, many participants enjoyed learning how to *bargain*. One participant explained, “Haggling is also a lot of fun. I think I mentioned that at the first interview. That certainly hasn’t been a disappointment.”

Participants in the GEARE Junior Year program developed a particularly rich pallet of outcomes in the *attitudes domain*, exhibiting a more diverse array of outcomes in this domain than participants in the GEARE program. The most common outcomes in the attitudes domain related to openness, particularly *openness to new experiences*. When one participant was asked to describe the most important thing he had learned in China, he replied, “Just to be open to new experiences. Of course, never say ‘no,’ and, I mean, if you’re unsure about something, don’t let that hold you back from taking the chance.” Another participant echoed this sentiment, adding, “The most important thing I’ve learned? Be open. Be open to the experiences because it will be a lot more fun than you may think.” The previous international experiences of most participants in the GEARE Junior Year program were quite limited. Participants in this program did an amazing amount of traveling during their semester in China. Participants traveled to Northeastern China for the ice carving festival in the city of Harbin. Many participants visited Beijing—some more than once. A large group took a weekend trip to both the eastern port city of Qingdao as well as the ancient city of Xian in the center of the country. Others took a cruise through the Three Gorges region of the Yangtze River, while still others took a tour of Tibet and visited the base camp of Mount Everest. At the end of the program, several participants went on to visit other Asian countries. Participants encouraged each other to be adventurous. With each trip participants’ enthusiasm for travel seemed to grow.

Participants also learned to be more *open to other cultures*. When listing the things he had learned, one participant explained, “One would be like my knowledge and maybe acceptance of the Chinese culture.” Another participant expressed both enthusiasm and respect when talking about the things she had learned about Chinese culture, explaining “I have loved learning that everything they [the Chinese] do has a reason. Like, they put out their quilts to sunbathe—to get UV radiation, like cleansing, or whatever.”

Other attitudinal outcomes were more specific to individual participants. Prior to participation in the GEARE Junior Year program only two participants knew each other. Several

students found that their experiences in China helped them to become more *outgoing*. One participant explained how she changed in this way:

Like I said earlier, I was really shy. I wouldn't talk in first grade, but I've gotten better since then, progressively. And I mean this has really helped me a lot. I can just come out of my shell and talk to people. When I first got on the plane, I had like 18 people to meet [the other participants in the GEARE and GEARE Junior Year programs]. I had to make friends with them. Well, I didn't have to make friends with them. If I wanted to have an enjoyable time, I probably should make friends with them! So I talked to them, and when we got here [to China] I wanted to learn and explore, so I met other people. Now I will just go up and talk to people...[Another participant] has actually helped a lot. She's really outgoing. She'll talk to anyone. I watched her and thought, "Well, she seems to be having a lot of fun. I want to meet people too."

For this participant, this change persisted beyond the end of the program. She explained, "I've noticed myself talking in class more. Like, I took a class this summer [after the end of the program], and every time I had a question I'd raise my hand, and I was like, 'I never did this before!' I'm more sure of myself and more confident."

Although another participant described himself as quite outgoing, he felt that he became more outgoing too, explaining:

I'm really more outgoing...I can usually talk to people about nothing for a good while, but usually they're people I know and it's kind of just standing around and talking. Now, I can make small talk. I was never really that great with small talk before. I've worked on that quite a bit.

Several participants' expressed an increased *interest in China* as a result of participation in the program. One participant explained:

Definitely anytime I see anything about China I'm interested in what's going on. Just an example, my [co-op] boss sent me an email last week about some building that fell over in Shanghai. It was under construction. I was immediately interested. I'm like, "What happened? Where's it at?"

Immediately after the end of the program, another participant flew to Germany to participate in another study abroad program for the summer. Not only did this participant become more interested in China, but his *interest in current events* around the world also increased. He explained:

I'm actually more interested in world politics and world...what's going on in the world. I still have the Shanghai news blog on my computer every day, and I read

through that still interested in what's going on in Shanghai and interested in going back eventually.

From their experiences in China, several of the participants developed an *interest in living abroad* at some point in the future. Some were clearly charmed by the comfortable lives of the expatriates that they encountered in Shanghai. One participant explained:

I think I got the mentality to go towards global instead of just being like American. I want to be an open person who'll work around. I think that's going to help me a lot in engineering...So, now I can say, "Oh, you know, I've been to China." I'd go there for six months, live a little expat life and...I think before this I probably wouldn't have ever wanted to work outside the United States.

Some participants developed complex and conflicted *views of globalization* and its effect on local and global labor markets. When asked if he thought his experience in China had changed his values, one participant explained:

I think maybe a little bit, but not a whole lot. When I was on co-op this last semester [after the end of GEARE Junior Year program], we had like 60% of the employees that were previously there, like the co-op before [the GEARE Junior Year program] ...so, I came back from China and it was almost empty...Yeah, they cut like 40%, like almost half. And I think like [there were] a lot of problems with suppliers, and stuff with outsourcing; "Maybe we'll build this in China, or in India." ...I just don't view outsourcing the same because...in India, in China, and other places, they really need to build an economy over there...I think getting rid of jobs here [in the U.S.] is a terrible thing...Seeing a ton of my coworkers gone and hearing their stories, and they're trying to make ends meet over here. It's hard to see that. But I think overall I still disagree with most people because you're helping people [overseas] that need help the most first, I think.

Discussion and Conclusions

A very wide variety of learning outcomes were identified by participants in both programs in this study. The most common learning outcomes reported by participants in the GEARE program related to various kinds of *cultural knowledge* and *foreign language skills*. Within the domain of cultural knowledge participants learned about how Chinese people interact with each other, nationalism in China, engineering practice in China, and some of the engineering achievements of China. The program's internship experiences gave participants a firsthand opportunity to learn about engineering in China as did the research experiences that some participants sought out. Foreign language training was a requirement of the program and so it was not surprising that participants were able to improve their language skills while abroad. Participants in the GEARE program expressed achievement of relatively few attitudinal

outcomes when compared with participants in the GEARE Junior Year program. However, some participants felt that they learned to be more flexible and adaptable, and some also expressed interest in pursuing an international career at some point in the future. One participant felt that his experiences abroad helped him to become less shy.

Participants in the GEARE program were already international students before enrolling in the program, and so the experience of studying abroad was not entirely new for them. As a result, the impact on attitudes may not have been as great for this group of participants. The cultural and environmental contexts of the GEARE program were new, however, so participants simply needed to acquire knowledge about a new culture and develop new language skills.

The most common learning outcomes reported by participants in the GEARE Junior Year program included various kinds of *cultural knowledge*, *foreign language skills*, and *openness to new experiences and other cultures*. Within the knowledge domain, social cultural knowledge was the most common learning outcome. Although the development of foreign language skills was not a formal part of the program, all participants learned at least a few words and phrases in Chinese. In addition, participants felt that they developed valuable non-verbal communication skills. Participants in the GEARE Junior Year program developed a particularly rich pallet of outcomes in the *attitudes domain*, exhibiting a more diverse array than participants in the GEARE program. In addition to the attitudinal outcomes expressed by the participants in the GEARE program, GEARE Junior Year participants felt that they became more open to new experiences and developed greater openness to other cultures as well. This was exhibited by an increased interest in China as well as world events. Some participants also developed new views of globalization. A few participants also felt that they had become more outgoing as a result of their experiences abroad.

Participants in the GEARE Junior Year program were particularly enthusiastic about seeking adventure, especially with regard to traveling. Participants organized trips to destinations across China and even to other Asian countries. With each subsequent adventure, participants became more confident and adventurous. In addition, participants bolstered each other's enthusiasm for adventure.

Downey et al. (2006) argue that engineering graduates must learn to work with individuals from other cultures. Participants in both programs in this study exhibited outcomes that align with the specific learning objectives put forward by Downey et al. (2006). These include: developing knowledge of other cultures, improving communication skills (both verbal and non-verbal), and developing attitudes such as openness toward other cultures. Administrators of various global programs for engineering students have been searching for ways to assess the outcomes of their programs, particularly in the domain of attitudinal outcomes. Some methods that have been used to assess achievement of program objectives include surveys (Adams, 2006; Allert et al., 2007), journals (Evans, Jablonski, K. Buffinton, & R. Buffinton, 2010), portfolios

(Nasr et al., 2002), and various measures of intercultural sensitivity (Bielefeldt & High, 2007; Mayhew, Eljamal, Dey, & Pang, 2005).

The Intercultural Development Inventory (IDI) (Hammer, Bennett, & Wiseman, 2003) is one instrument that has been widely used to assess changes in intercultural sensitivity. At the University of Michigan the IDI was administered to participants in a number of global programs for engineering as well as a control group of non-participants (Mayhew et al., 2005). Mayhew et al. (2005) did not find significant differences in intercultural development between members of the various global programs, nor did they find differences between participants in the global programs and a control group of non-participants. Within the broader context of study abroad programs, the IDI has also been used with mixed results. An example is Patterson's (2006) study of the effect of study abroad on intercultural sensitivity using both the IDI and qualitative data collected through interviews and questionnaires. This study included both alumni of various study abroad programs and a control group of students who had not studied abroad. Each group consisted of about 40 participants. Although the qualitative data revealed changes in intercultural sensitivity, the IDI did not measure any significant changes.

The participants in both the GEARE and GEARE Junior Year program identified a variety of attitudinal outcomes. However, many of the outcomes described by participants may not directly result in measurable changes in intercultural sensitivity on instruments such as the IDI. For example, participants described increases in openness to new experiences and becoming more outgoing. These outcomes may be desirable in a global context; however, they may not necessarily have an impact on an individual's *intercultural* disposition.

Participants in the two programs that were the focus of this study described a wide range of learning outcomes. Many were context specific, suggesting that characteristics of participants and their environments significantly impact learning outcomes. In addition, several participants had their own personal objectives for the programs in which they were enrolled, such as the participants who sought out research experiences while abroad. Although it is important for global programs to set and assess program-level learning objectives, participants might also benefit from setting and assessing achievement of personal, contextually situated objectives. For program administrators this would mean supporting a diverse array of outcomes. Participants might then benefit from recognition of outcomes on a personal level.

Participants in this study were universally enthusiastic about their experiences abroad and were able to articulate a wide range of learning outcomes during interviews. However, it often seemed as if participants were reflecting on their experiences for the first time. During the interviews, several participants acknowledged the value of personal reflections but admitted that they had failed to find motivation to actually engage in reflection while in the midst of their experiences abroad. One participant explained, "I kept considering writing something about my life, some day. But, I kept saying later, and later, and later and never did it." At the end of the GEARE Junior Year program, another participant went straight to Germany to participate in a

study abroad program over the summer. When asked how his view of himself might have changed as a result of his participation in the GEARE Junior Year program, he replied:

I don't know. I haven't really had much time to reflect on that. I've been moving around and kind of trying to soak everything in so much that I haven't had a lot of time to sit back and think of all that other stuff, or notice it either.

Participants in programs such as those in this study could benefit from engaging in regular structured reflection. Many study abroad programs encourage, or even require, participants to document their experiences and learning outcomes, often in the form of journals (Santanello & Wolff, 2008). In some cases participants are required to set their own learning objectives and reflect on the achievement of those objectives in their journals (Evans et al., 2010). In programs of significant duration, participants could be requested to engage in an iterative process of formative self-assessment, setting personal goals and assessing the attainment of those goals through regular reflections. When participants in the GEARE and GEARE Junior Year programs were visited by the researcher at the mid-point of their stay in China, they were eager to share their experiences and learning outcomes with an interested party. Program participants might also benefit from engaging in active reflection while abroad mediated by mentors (perhaps program alumni). Mentors could review participants' reflections and suggest ways for participants to engage in experiences that would help them to develop outcomes that would be beneficial to their future careers. In such a way, participants could be supported in achieving a diverse array of personal outcomes.

Acknowledgements

The authors wish to thank the GEARE and GEARE Junior Year program administrators for their enthusiastic support of this work and participants for their willing participation. We also acknowledge support for this work from the National Science Foundation as well as the Motorola Foundation.

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