

Exploring Global Skills Proficiency for Engineering Students Through a Short-Term Study Abroad Program

Robert O'Connell

Electrical and Computer Engineering Department
University of Missouri
Columbia, MO
oconnellr@missouri.edu

Miguel Ayllon

College of Engineering
University of Missouri
Columbia, MO
ayllonm@missouri.edu

Abstract—The purpose of this Work-in-Progress paper is to describe the continued improvement of a faculty-led, summer-based study abroad program in terms of its influence on the development of global competency skills in student participants. Improvements have been and continue to be made using the results of an on-going research study to determine students' expectations for global skills learned before going abroad and their perceptions of skills actually learned while abroad. The principal program assessment instrument is the information provided by students in the end-of-program surveys and interviews. In 2016 student participants reported via surveys that their expectations for experiencing a new culture generally were fulfilled to some extent; and that they developed independence and survival skills to a much greater degree than originally expected; however, their expectations for gaining experience related to international engineering and business practices were largely unmet. Based on that information, corrective modifications were made for the 2017 program, and a series of pre-departure and exit interviews were conducted to re-assess student expectations for global skills development and their perceptions of skills actually developed during the program.

Keywords—study abroad, global competency skills, retention.

I. INTRODUCTION

Because of the growing importance of global skills in engineering [1]-[4], computer science [5], and information technology [6], study abroad programs are proliferating [1], [5], [7]. Various formats for study abroad programs exist, e.g., semester-long, January intercession, and spring break, but the one of interest here is a popular faculty-led summer program that began as a four week, three-credit program in 2012 and expanded to a six-credit five-week program in 2015. This program enables students to become more aware of and develop some global competency skills, and it helps to motivate them to be more engaged in their education, which results in greater retention, i.e., graduation rates [9].

While the program in question has been reasonably successful, it is not yet optimal in terms of facilitating the learning of global skills. Furthermore, it has been asserted that many global skills cannot be learned very well in a five-week program [8]. Thus, in 2016 we began a study to determine the

extent to which students can and do learn and develop global skills during the program. In Phase I of the project, described at the 2016 FIE Conference [9], we conducted questionnaire-based pre-departure and exit surveys of students participating in the study abroad program that year. The purpose of the two surveys was to determine, respectively, which global skills the students hoped to develop during the program and which skills they felt they actually did learn.

While Phase I produced significant useful information, it also revealed several items that require further probing. For example, many students complained of significant "culture shock" experienced in dealing with the local populace in the host country. Also, for many of them, their expectations for international engineering and business practice experience were largely unsatisfied.

Based on the results of the exit surveys from 2016, several changes to the pre-departure classes were implemented for 2017, including more intensive introductory language (German) training, and more intensive study of the social and cultural customs and behaviors of the German people. At the same time, a second phase of the study 2016 was recently conducted to probe deeper into some of the issues raised in the exit surveys from 2016. This is being done with qualitative inquiry using in-depth in-person interviews of a small number of students, rather than with questionnaires. Both pre-departure and exit interviews were conducted.

The following sections of the paper include a brief description of the history of the study abroad program in question; a brief summary of Phase I of the research project [9] aimed at improving student learning of global competency skills; and a description of the recently completed Phase II of the project, including results from the pre-departure and exit interviews.

II. PROGRAM HISTORY

The program began in 2012 as a faculty-led and -taught month-long study abroad program to the Republic of Ireland. Using facilities at a local university, students from freshmen through senior levels and from all departments in the College

of Engineering take an introductory three-credit course in electric circuit theory. The course differs from the similar course required of electrical and computer engineering (ECE) majors only in the lack of a laboratory component. So ECE majors participating in the program simply take the laboratory component separately during the subsequent Fall semester.

The course is taught by one of the authors using an adapted version of a strategy known as team-based learning (TBL) [10], in which the students are required to study new conceptual material outside of class before it is formally addressed; and they then spend significant classroom time working in instructor-formed groups on assigned problems and exercises. During group work, students are required to help each other (peer instruct) within their groups, and the instructor and teaching assistant observe the group work and provide appropriate assistance when needed. This teaching and learning approach has been found to work very well with such a diverse mix of years and majors [9].

The course includes several co-curricular activities, including group field trips to culturally enriching sites and to facilities where engineering is either practiced or taught. Between the two types of outings, students learn some history and culture as well as various aspects of engineering education and practice in the host country. During their free time, students observe the customs of, and interact with, people from the host country. On weekends, many of them travel to other European countries. These activities enable them to develop the independence and personal growth needed to live in a foreign country [1], [2], as well as what is known among global studies experts as cross-cultural awareness and appreciation [2], which includes items such as etiquette and interpersonal skills, appropriate dress, and awareness of religious customs and political issues. All these features of the program provide the students with a certain amount of global competency that will serve them as practicing engineers in the increasingly global engineering workplace of the 21st century.

In 2015, the program was expanded to its current format, which includes a three-credit engineering humanities course option. Students may take either or both of the two courses. The humanities course begins on campus in March with weekly classes to study the culture and history of the host country. Then, for the first ten days in the host country, the group tours several cities and locations that are of cultural and/or engineering technical interest. At the completion of the humanities course, the above-described month-long electric circuit theory course, including several cultural and engineering co-curricular visits of its own, is conducted on the campus of a local host-country university or center of higher education. Since 2016, the program has been held in countries whose first language is not English (Italy and Germany), to provide students with the addition survival skills challenges related thereto.

Enrollment data on the numbers of students in the electric circuit theory component of the program since its inception are shown in Table I. The jump in enrollment in 2015 was

attributed to the addition of the three-credit humanities course option. The decline from 44 students in 2016 to 27 in 2017 was attributed to an increase in summer study abroad options. Enrollments don't appear to be affected by language differences because students believe that English is spoken as a second language by many Europeans.

III. GLOBAL SKILLS LEARNING: PHASE I SUMMARY

In order to initiate improvements to the program from the perspective of global competency skills learning, in 2016 a pair of IRB-approved questionnaires were administered to the 44 participating students, one before departing for the host country, and the other a few days before returning. The purposes of the surveys were to determine students'

TABLE I. Program Enrollment Data

Year	Location	Number of Participants
2012	Dublin, Ireland	13
2013	Dublin, Ireland	16
2014	Dublin, Ireland	16
2015	Dublin, Ireland	32
2016	Rome, Italy	44
2017	Heidelberg, Germany	27

expectations and perceived accomplishments, respectively, concerning global skills learning. Details of the surveys are described in [9], but in brief, results of the initial, pre-departure, survey suggested that, in general, the students had a reasonably good idea of the skills needed for global competency, and they looked forward to developing some of those skills. Their definitions of global skills could be grouped thematically into four broad categories: experience a new culture, be able communicate across language and cultural barriers, develop independence and survival skills for living abroad, and observe engineering and business practices and working environments.

Results of the end-of-the-program survey suggested three principal themes. First, students' expectations for experiencing a new culture generally were realized, particularly in regard to observing the local people, their lifestyles, shopping, customs, traditions, and cuisine. Second, they developed significant independence and survival skills, especially the abilities to manage time and money, and to navigate transportation and travel modes, both within the host city and country, and all over Europe. And third, they were somewhat disappointed in their lack of opportunities to meet and interact with host-country engineers, and observe their workplace environments and facilities.

The end-of-program surveys also asked the students to suggest ways to improve the global skills learning aspects of the program. Two suggestions were predominant. First, while they had ample experience observing the local people and their customs, many students had difficulty interacting and communicating with them, due to both their lack of language

(Italian) skills, and insufficient knowledge of local customs and etiquette. Some referred to this as “significant culture shock.” The suggestion was for the pre-departure component of the program to include more intensive instruction in the foreign language, customs, and etiquette of the host country. And second, in connection with students’ disappointment in interactions with engineers and their work environments, the suggestion was for the program to provide more and better opportunities for doing so. The first suggestion was acted upon in the 2017 pre-departure classes by having more sessions on local customs and language than in 2016, and the second one was used in planning the co-curricular engineering site visits in the host country (Germany) for 2017. The effectiveness of these actions were the subject of the Phase II exit interviews conducted in late June 2017 and discussed below.

IV. GLOBAL SKILLS LEARNING: PHASE II

The purposes of the current phase of the study were to probe deeper into students’ expectations and perceived accomplishments concerning global skills learning during the five-week study abroad program, and to assess the impact of the above-mentioned changes that were implemented for the 2017 program.

A. Predeparture Interview Results

Using a purposeful sampling approach, five students, three women and two men, agreed to participate in the two-interview program. The number of participants was limited to five because of time constraints at the end of the Spring semester and at the end of the study abroad program in June. All five participants were high achieving students, with GPAs of 3.0 or above. They were pursuing undergraduate degrees in civil engineering (2), mechanical engineering (2), and bio-engineering, and their academic standings consist of one sophomore, two juniors, and two seniors. Each was interviewed by the authors in a confidential, informal, and conversational setting, with the following questions guiding the interview:

- Why have you decided to participate in this particular study abroad program?
- Besides earning academic credit, what else do you hope to achieve during this program?
- Please describe your understanding of what global competency skills are.
- What global skills, if any, do you hope to develop during this program?

No significant gender differences were evident as students defined global skills and their expectations for achieving them. However, there were several recurring themes that emerged during the interviews.

1) Survival Skills and Global Engineering

The students generally agreed that participating in cultural excursions and visits to engineering companies in a different

country while earning academic credit in a core engineering course are the principal reasons in their decisions to study abroad, and the specific country and course (Germany and Electric Circuit Theory for Engineers) are the main reasons behind their choice of this particular study abroad program.

When asked to articulate their understanding of global competency and what global skills they expected to gain and develop during the program, the students’ responses essentially echoed those from the pre-departure survey administered in Phase I in 2016. That is, they expected to learn basic survival skills, such as time and money management, navigating transportation modes, and enough German language to communicate with locals in various settings. They expected to observe and experience everyday German customs, etiquette, and traditions. Finally, they expected to meet some German engineers and observe their work place settings and practices.

One particular participant, a civil engineering major, who has already travelled to more than 30 countries and participated in two prior short-term engineering study abroad programs, and is clearly interested in global engineering and business, offered a more advanced and mature response. He discussed the importance of becoming aware of the myriad factors that affect a country’s culture, which then influence its engineering and business practices. Among the many factors he discussed were the political relations among nations, the effects of geography and natural resources on a country’s culture, international trade agreements, internal corruption, and religious customs.

2) The Program Location

Offering our study abroad program in Germany provided a strong incentive for our study participants. Another participant, a mechanical engineering major, said that he was looking forward to learning about the German automotive industry and their latest engineering developments. The bio-engineering student stated that she wanted to go to Germany because they have a global reputation for state-of-the-art biomechanics in the health sector. The female civil engineering student stated, “Germany leads the world in renewable energy and recycling...I want to learn about how they do that.”

All these comments reflect a desire by study abroad students for significant engineering work place experiences, and they underscore the importance of carefully planning the co-curricular engineering site visits.

3) The Family Influence

Although none of the guiding questions specifically asked participants to discuss the role of their parents and families in their study abroad decisions, three of the five student participants reflected upon the role played by their parents in the study abroad decision process. The female mechanical engineering student stated, “My dad travels a lot out of the country for work, and he told me to never pass up an opportunity to travel overseas.” The male civil engineering

student commented, “My family has always appreciated traveling. Before we became teenagers we had traveled all over the U.S. When we became older, our parents began to take us overseas.” Finally, the female bio-engineering student commented, “My mother and I were visiting the College of Engineering for Summer Welcome, and when my mom saw the Germany study abroad banner, she said, ‘I studied abroad in Germany when I was in college. I will pay for this if you want to do it.’”

Thus, it is important to acknowledge the key role that parents’ relevant experiences play in students recognizing the importance of study abroad and global skills acquisition. As faculty and study abroad professionals work at recruiting students for study abroad programs, they should engage students’ families in the process.

B. End-of-the-Program Interview Results

As was done with surveys in Phase I of the program in 2016, those students who participated in the pre-departure interviews were interviewed again, just before the end of the five-week study abroad program. The purpose of the second (exit) interviews was to inform two broad areas: first, to what extent the students’ expectations for global competency skills were realized, and second, to what extent the above-discussed changes to the pre-departure sessions and the engineering site visits in Germany were successful at helping students develop those skills. To assist the five students in this, they were asked to keep a diary of their experiences while in Germany. As in the first interviews, the exit interviews were conducted in a confidential, informal, and conversational setting. The following principal guiding questions were used:

- Did you develop any global competency skills? If so, which ones, and to what extent?
- Are there any global skills or experiences that you had hoped to develop, but did not? If so, which ones?
- To what extent did the pre-departure component of the program provide you with knowledge of German customs, etiquette, and language?
- How successful were the engineering site visits at providing you with opportunities to interact with German engineers in their workplace environments?

As in 2016, students’ expectations for experiencing a new culture were generally realized, i.e., concerning the local German people, their lifestyles, customs, traditions, language, and food. Also, they developed significant independence and survival skills, i.e., time and money management, and transportation and travel mode navigation. The English language is so predominant as a second language in Germany that students had very little difficulty dealing with local merchants, etc.

Concerning the above-mentioned changes to the pre-departure sessions, for Spring 2017 those sessions included two-hour class discussions of a novel based on contemporary German history (The Wall Jumper by Peter Schneider) and of

a film entitled “The Rise and Fall of the Berlin Wall,” produced by the History Channel. The pre-departure sessions also included guest lectures on German customs, etiquette, and traditions; and a crash course on the German language. Finally, in other pre-departure sessions the students, in teams, made presentations on various aspects of German culture, such as contemporary history, government, important cities, food, music, and German engineering companies and universities.

The five interviewed students generally agreed that, except for the language lessons, the pre-departure sessions prepared them well for the program. Useful practical (survival skill) knowledge gained in the pre-departure sessions according to all of the interviewed students and referred to several times in the five interviews included information on recycling, water and tipping in restaurants, and the need to pay to use public lavatories. Concerning the language lessons, the consensus was that without a full semester course, very little useful German could be learned in two sessions. Better use could have been made of the time spent on the German lessons. Besides, English is so widely spoken by the German people that it was rarely needed during the program.

For 2017, technical site visits included guided tours of the Deutsches Museum in Munich, the Franziskaner Brau Brewery in Munich, the Audi manufacturing facility outside Heidelberg, and an extended visit to The School of Engineering and Architecture at SRH University in Heidelberg, among others. The interviewed students generally agreed that these visits were interesting and educational, and they permitted a significant amount of interaction between the students and the technical experts leading the tours. The bio-engineering student noted the connection between the lesson on cavitation given by the tour guide at the Deutsches Museum, and an SRH University graduate student’s research project on the same subject. She also noted the similarity between the development of robotic instruments for the manufacture of automobiles (the Audi visit) and prosthetic devices for human use. All five students spoke favorably of the energy-based conversation they had with the two faculty members (the tour guides) from SRH University. The bioengineering student mentioned the probable connection between German politics and the national goal to power Germany solely with renewable energy sources in just a few years.

V. CONCLUSIONS

The Phase II exit interviews suggest that the efforts made in the pre-departure sessions and the choices of technical site visits for the 2017 program helped to improve student global skills development, and similar efforts need to be made in the future to ensure a rich study abroad experience during our summer-based, faculty-led study abroad programs. One global skills area we have not addressed thus far in the program is that pertaining to international business and finance. We are currently working to include some development of that skill area in 2018.

REFERENCES

- [1] S. C. Klahr and U. Ratti, "Increasing engineering student participation in study abroad: a study of U.S. and European programs," *Journal of Studies in International Education*, 4, 1, 2000.
- [2] C. Del Vito, "Cross-cultural soft skills and the global engineer: corporate best practices and trainer methodologies," *Online Journal for Global Engineering Education*, 3, 2, 2008.
- [3] A. Parkinson, "The rationale for developing global competence," *Online Journal for Global Engineering Education*, 4, 2, 2009.
- [4] D. Bremer, "Engineering the world," *Online Journal for Global Engineering Education*, 3, 2, 2008.
- [5] S. Beecham, T. Clear, J. Barr, M. Daniels, M. Oudshoorn, and J. Noll, "Preparing tomorrow's software engineers for work in a global environment," *IEEE Software*, January/February 2017.
- [6] S. Kulturel-Konak, A. Konak, I. Esparragoza, and G. Kramer, "Measuring global awareness interest development of engineering and information technology students," *Proceedings, 46th Frontiers in Education Conference*, Erie, PA, October 12-15, 2016.
- [7] A. Parkinson, "Engineering study abroad programs," *Online Journal for Global Engineering Education*, 2, 2, 2007.
- [8] M. M. Dwyer, "More is better: the impact of study abroad education," *The Interdisciplinary Journal of Study Abroad*, 10, 2004.
- [9] R. O'Connell and M. Ayllon, "Student perceptions of global knowledge and skills acquired during a five-week study abroad program," *Proceedings, 46th Frontiers in Education Conference*, Erie, PA, October 12-15, 2016.
- [10] R. M. O'Connell, "Adapting team-based learning for application in the basic circuit theory sequence," *IEEE Trans. on Education*, 58, 2, 2015.
- [11] T. F. Schubert and F. G. Jacobitz, "Compact engineering experiences: expanding student international awareness through short-term study abroad courses with substantial engineering technical content," *Online Journal for Global Engineering Education*, 7, 1, 2013.