

# The Benefits of Short-Term Study Abroad Programs for Engineering Students\*

KERRY L. MEYERS and MARK J. MCCREADY

College of Engineering, University of Notre Dame, 257 Fitzpatrick Hall, Notre Dame, IN 46556, USA. E-mail kmeyers1@nd.edu, mjm@nd.edu

Engineering students are among the least likely to study abroad as undergraduate students despite the increasingly global nature of related work due to: (1) the high number of credits required for graduation, (2) challenging courses that build upon each other and are sequential, (3) students not typically having foreign language skills. While many universities are focused on trying to increase study abroad access and opportunities, there are little data to assess the tangible benefits for engineering students. Approximately 200 undergraduate engineering students at a selective private institution in the Midwest were part of the current study. The students that participated in a 6-week summer study abroad program during the summer of 2019 were surveyed before and after participating in the program. The results were analyzed statistically (primarily with paired t-tests) to better understand the programmatic benefits. Students were asked to evaluate themselves on measures of cultural self-assessment, and students pre vs. post responses showed growth in every category (statistically significant at 95% confidence level or above). Students participating in a summer study abroad program were more likely to graduate with a higher number of overall credits earned and more likely to have earned an additional credential such as a minor or second major.

**Keywords:** engineering; global learning; study abroad; short term Study abroad

## 1. Introduction

In the United States, only 1% of college students participate in a study abroad program, and increasing that number has gained national support [1]. The National Association for Study Abroad published a report detailing the US National Security concern over the lack of widespread knowledge about countries and cultures beyond the US despite widespread economic globalization. The report further indicated that the limitations on study abroad participation were both financial and a result of a lack of commitment to develop and maintain such programs by colleges and universities. The outcome of this was a governmental effort to dramatically increase study abroad participation. Specifically, educational institutions were successfully incentivized to develop study abroad programs through grant funding support [1].

## 2. Literature Review

### 2.1 Benefits

Study abroad programs are believed to have significant benefits for the development of students on a variety of measures; however, results are mixed and vary by program, institution, and duration. On measures of holistic student development, students who participate in study abroad programs showed gains in traits including knowledge, self-confidence, and relationships; however, other measures such as:

a more complex sense of self and more intense relationships with people that are unlike themselves did not show as much progress [2]. Study abroad programs have been reported to help students with vocational identity, self-knowledge, and metacognition. Students reported a better understanding of their values, interests, and skills following participation in a study abroad program [3]. Assessment of long term career and professional impacts for study abroad participants have also been reported [4]. Some of the reported assessment differences on the benefits of study abroad can be attributed to the duration of the experience, language difference, and program structures for cultural immersion. For example, a study by Allen reported that short term programs are often less immersive in that students are housed and taking classes with peers from their home institution rather than at their study location [5].

### 2.2 Short vs. Long Term Study Abroad

In a study comparing the program outcomes of short and longer term study abroad programs, researchers found that while short-term programs (defined as less than 8 weeks) have value, longer term programs show greater outcomes in terms of: synthesis of ideas, empathy, critical thinking, and working effectively with others [6]. Short term study abroad programs have gained recent popularity because they allow students in inflexible and sequential curriculums to participate [7, 8], and the tradi-

tional, longer duration study abroad programs have decreased in popularity [7]. The other benefits are the reduced cost and they are often led by faculty from a student's home institution so they can fit into semester breaks and count credits directly [8].

Short term programs (even as short as 4 weeks) have reported benefits for student participants including personal and intellectual development [7], students' self-perceived intercultural competence [9]. Students participating in a short-term study abroad program had statistically significant increase in global awareness (self-reported data) [10]. Participation in a study abroad program promotes global perspective [11]. Another study of a short term study abroad program reported that students that participated did not have statistically higher levels of self-identification as global citizens as compared to those that did not participate [12].

Some of the differences in the reported benefits may relate to the faculty and students participating. In a study exploring cultural mentoring it was found that while there are a rising number of STEM students studying abroad, STEM faculty members were less likely to engage in cultural mentoring [13]. Instructor influence was cited in another study which reported "the instructor needs to be viewed as a prime source of intercultural mentoring" in order to maximize intercultural learning opportunities [14].

### 2.3 Who Studies Abroad

Prior studies have looked at how open minded a student is to study abroad upon arrival in college and if those are the students who actually participate [15, 16]. An analysis by BaileyShea likened the decision to study abroad to the selection of a college which relates to personal background, involvement at the university, and institutional factors. Caucasian women were most likely to study abroad and have come from families in which their parents had completed a bachelor's degree or more [17]. "For a wide variety of physical, social, economic, cultural, and academic reasons, certain populations in the US higher education tend to be underrepresented in education abroad programs" [18]. Desssoff cites tradition as an explanation of the gender imbalance in study abroad participation, specifically international education began in finishing schools and women's colleges, but indicates that today it represents a consistent pattern wherein women are "making the most" of their collegiate experience and higher academic performance. Students of color are less likely to participate in study abroad programs, with barriers of financial aid and concerns for bias indicated as explanations [18].

Private universities have a higher percentage of students participating in study abroad. Student

participants were also most likely to be living away from home during college. Students participating in one or more extracurricular activities were most likely to study abroad [17]. Although another study by Luo and Jamieson-Drake found that certain extracurricular activities such as student government, theater, club sports, and living off campus negatively impacted study abroad participation [15]. Peer influence has been reported to influence study abroad participation, although peers did not significantly influence intent to study abroad [19].

Other reports detail the majors that US students study while they are abroad, only 26% are STEM [20], and further 67% of the US students that study abroad are women [20]. These are interesting factors to consider since women are underrepresented in engineering and STEM fields but over represented in the US students that study abroad [21]. A study by Niehaus and Inkelas of STEM Majors found that there is complexity in intent to study abroad between major, gender, and academic progress as predictive factors for participation, and indicate that within STEM majors there are likely many different barriers to participation [22]. The rigid structure, sequential courses, few electives, limitations on credits from other institutions, and lack of faculty encouragement were cited as barriers to participation for Engineering students [15, 23]. Engineering students are among the least likely to participate in study abroad programs [15, 22, 24], it is interesting to note that as mathematical ability increases the likelihood of participation in a study abroad program decreases. In a study of program structures and best practices, a few challenges related to recruiting engineering students and obstacles to participation including time to graduation, expense, leaving community of family and friends, difficulty transferring credits back, timing of semesters, and length of internships [25].

## 3. Methods

### 3.1 Study Location

The current study was conducted at a medium sized, Midwestern, selective private institution. This institution has rapidly grown its engineering summer study abroad program which is short term (6 week) experiences are offered in: London, Dublin, Berlin, Alcoy (Spain), and Rome. The students that participate in these programs do so at an additional cost but are able to take 2 technical engineering courses taught by faculty from their home university at the study abroad site. Most participants complete the summer study abroad programs after their first or second year of school. In total, among the summer and the school year study abroad programs ~60%

of undergraduate engineering students study abroad, with over 200 students going on short term programs each summer.

### 3.2 Data Sources/Analysis

The two primary sources of data were: (1) Surveys (pre and post) and (2) GPA and Course Credit Data. A series of questions were asked related to: which study abroad program, locations in the world they would consider living after graduation, motivations for studying abroad, cultural awareness, and demographics. The pre and post surveys were distributed on-line using Qualtrics where the pre and post responses could be paired for analysis to evaluate growth (in particular for the cultural awareness questions). Table 1 is a summary of the respondents; there was a higher response rate for the pre survey than the post. In using only complete paired surveys for analysis there were 175 responses (for paired t-tests). The answers to the survey free response questions were used by researchers to help interpret the data and sample student responses are offered to help explain the results.

Deidentified GPA and Course Credit Data were provided by the institution's Office of the Registrar. These data were used to understand how students performed academically during study abroad compared to the prior semester and also to determine if participating in a study abroad program increased the number credits a student earned prior to graduation. The comparison group for the number of students who earned an additional credential is not the same as the survey population as this was data at graduation.

There were two other secondary sources of data: (1) focus group discussions and (2) senior surveys. The researchers conducted focus group discussions with all of the participants in the London Chemical Engineering Study Abroad Program (30 students in 8 groups). The discussions were in groups of 3–4 students in which the faculty researcher led discussions on the following topical areas: motivations for participating, priority of internship vs. study abroad, preparation for the program, program

flexibility, priority school vs. cultural experience, and the influence of the program on long term goals. Notes were taken during all sessions but used to guide interpretation of the primary pre/post survey results, the responses were not qualitatively coded for analysis.

The senior survey data were from all 2018 College of Engineering Graduates and allowed for comparison of the satisfaction with a student's engineering major and program flexibility. The survey is administered by Institutional Research, but the aggregated results were used for comparison to students who did not participate in a study abroad program to those who had.

### 3.3 Program Participants

The students that participated in the summer study abroad program are summarized in Table 2. There were 41% female participants, wherein the College of Engineering as a whole is ~33% women. This overrepresentation of women in study abroad programs was also indicated in the literature. The majority of students participate in these engineering study abroad programs after their First-Year, a time when they are least likely to have a summer internship.

Fig. 1a shows the engineering department percentages of program participants. The percentages of study abroad participants by major is approximately representative of the proportion of students in each program, the notable exception is Computer Science and Engineering. Computer Science and Engineering students were underrepresented in study abroad participation and it is attributed to two factors: (1) the employability rate of Computer Science and Engineering students and (2) the other options available to those students for study abroad. Although it is beyond the scope of the current study, internal data shows that Computer Science and Engineering students get internships earlier in their educational progression than other engineering disciplines. Additionally, the university has other opportunities for Computer Science and Engineering Students to participate in such as a

**Table 1.** Summary of Survey Respondents

Survey	# of Respondents	# of Potential Respondents	Response Rate	Final Paired Results
Pre-Survey (May 2019)	220	225	98%	175
Post-Survey (August 2019)	189		84%	

**Table 2.** Summary of Program Participants

Program Participants	Gender		Summer Following		
	Male	Female	First-Year	Sophomore	Junior
	59%	41%	62%	35%	4%

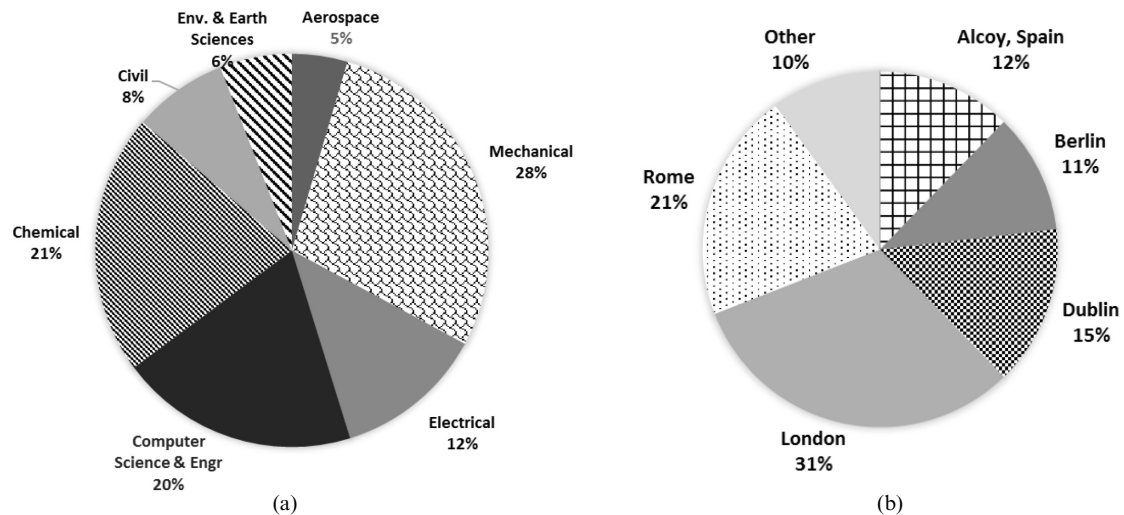


Fig. 1. (a) Engineering Departments. (b) Study Abroad Locations.

semester in Silicon Valley, so the summer general engineering study abroad programs may simply be less appealing to those students. Fig. 1b shows the percentage of students at each study abroad location, London is the largest as there are 2 programs (a standard program and a program limited to Chemical Engineering Sophomores). There are a few students that go to Japan, China, and New Zealand as part of research programs that were not central to this study.

### 3.4 Research Questions/Hypotheses

This study is the first formal assessment of summer experiences of engineering students for study abroad at the institution studied which took place in the summer of 2019. The following are the research questions are addressed in the current study:

1. **GPA Boost:** *Do students have a higher GPA's during the summer they study abroad?*
2. **Additional Credentials:** *Does taking classes over the summer reduce the number of courses a student has to take during the school year (or leaves room for minors, concentrations, or graduate level courses)?*
3. **Cultural Awareness:** *Do students assess themselves as having a higher level of cultural awareness after participating in a study abroad program?*
4. **Professional Development:** *Do students find positive benefits towards professional development after participating in an engineering study abroad program?*

There is much that has been written about the benefits of study abroad in general, however; this paper offers the unique contribution of reporting

the tangible benefits for engineering students who are among the least likely to study abroad.

## 4. Results

### 4.1 GPA Boost

The grade point averages (GPA) for students who studied abroad were compared: (1) the student's cumulative GPA in the semester before they studied abroad in the spring of 2019 to (2) the student's GPA in the courses taken during the summer of 2019 while abroad. The results show a statistically significant improvement in grade point average. Table 3 is a summary of the shifts in GPA's for the 218 students who studied abroad. It is important to note that these GPA's are not self-reported, rather they come from a student's institutional academic record.

A statistical comparison, using a paired t-test, shows that the mean GPA's for students before studying abroad and the semester they study abroad is statistically significant. Table 4 shows the mean GPA comparison in which students had a 0.37 increase in GPA during their summer abroad.

Given that this was an engineering study abroad program, the courses taken were technical engineering courses; however, for students they only had to focus on 1–2 courses as compared to 5 in a typical semester on campus. Another explanation could be

Table 3. Summary of GPA Shifts for Study Abroad Students

GPA Shifts	Number of Students
GPA Increase	174
GPA Same	12
GPA Decrease	32
Total	218

**Table 4.** Mean GPA t-test Results Summary

	Spring 2019 (Before Studying Abroad)	Summer 2019 (Studying Abroad)	Difference	t value
Grade Point Average	3.39	3.76	0.3683	12.93***

\*\*\* Denotes  $\alpha < 0.00001$ .

**Table 5.** Summary of Credits and Credentials

	Students who studied abroad (244)	Students that did not study abroad (209)	Difference	t-test
Number of Extra Credits at Graduation	19.76	14.05	5.71	4.82***
Extra Credential (Major or Minor)	34.02%	13.88%	20.14%	5.08***

\*\*\* p value < 0.001.

that a course could be “easier” during the summer than during the school year, and while maybe that could be a partial contributor, in the focus group discussions with engineering students it was reported that students also felt they were not constantly trying to balance which courses to spend time on, they had ready access to teaching assistants and professors who also had a singular focus. The free response comments from First-Year students show that in some cases there are lower expectations for engineering classes abroad, there were also students indicating significant challenge in the courses they took:

“The professors understood that while class was important we all wanted to explore the new world around us.” – First-Year, Civil, Male, London

“The classes were somewhat demanding but not too demanding, and the schedule allowed for lots of travel and leisure.” – First-Year, Computer Science, Male, London

“One class was very easy, one was very hard, huge gap in between time spent on each.” – First-Year, Electrical, Male, London

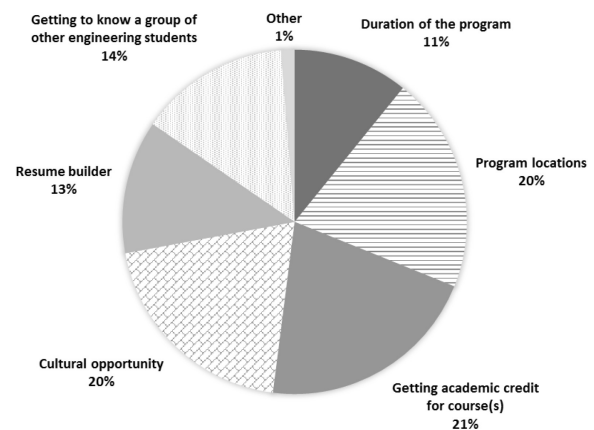
“I think the quantum physics class offered was a great class, but more appropriate for sophomores.” – First-Year, Electrical, Female, Rome

#### 4.2 Additional Credentials

A t-test was used to compare the number of credits upon graduation for students that did study abroad (244) and those that did not study abroad (209) in 2019. The results show that on average students that studied abroad graduate with ~5.7 more credits than those students who did not. This number is reasonable, as most of the study abroad programs offer two – 3 credit hour courses. Further this is an indication that students participate in study abroad to gain flexibility to take courses they wish to take beyond the restrictive engineering requirements (and not just reduce their course load when they are back on campus). The same students were compared to see if those that studied

abroad earned an additional credential (second major or a minor) and the difference was statistically significant. Table 5 shows a summary of those differences.

During the pre-survey students were asked to indicate their motivations for studying abroad, and getting academic credit is among the strongest motivators as shown in Fig. 2. Additionally, students appreciate the program locations and recognize this as a valuable the cultural opportunity which will be discussed in the Cultural Self-Assessment section that follows.

**Fig. 2.** Summary of Motivations for Studying Abroad.

The student free response comments as to their motivations for studying abroad helped to understand their perspective for gaining more credits to complete an additional credential (the first 2 quotes), and also a desire to reduce the credit load in future semesters (the second 2 quotes).

“I wanted to participate in this study abroad experience because it will allow to get an international experience in college when studying abroad during the year may not be an option, and also frees up spots for courses to complete my Bioengineering minor.” – First-Year, Mechanical, Male, Berlin

“Allows me to peruse my minor because this study abroad frees up my schedule.” – Sophomore, Chemical, Female, London

“Not only do I really want to lighten my load to take classes I’m interested in, it seems like a great opportunity culturally and professionally since I’ll be working at a pilot plant in London.” – Sophomore, Chemical, Male, London

“I wanted to add some flexibility to my schedule.” – First-Year, Mechanical, Male, Rome

To contextualize the responses from the surveys in this study, the researchers evaluated the University Senior Exit Survey Data that was collected in 2018 which asked students how satisfied they were with program flexibility. These data were broken down by students who participated in a study abroad program and those who did not and there seems to be a nuance to the flexibility gained by participating in an engineering study abroad program. Table 6 shows a summary of responses and those who studied abroad indicated that they had lower satisfaction in program flexibility – this was unexpected; but this may be explained by the extra credential. Many students applied these credits to a minor or secondary major and in doing so limit program flexibility in order to complete the additional requirements.

#### 4.3 Cultural Awareness

In all measures of pre vs. post understanding of cultural self-assessment showed statistically significant improvement (paired t-tests). Table 7 outlines the pre and post responses for respondents.

Looking closer at these questions, there were no difference by gender nor race/ethnicity. The only reported difference between white and non-white students was in where they would consider living after completing their bachelor of science in engineering degree, where white students were more likely to indicate more places they would be willing to live in the US and abroad than non-white students.

While the cultural assessment showed improvement in each area, it’s notable that “ability to work cooperatively with diverse people” had the smallest reported gains. The nature of the short term program assessed is not as culturally immersive as other programs as the students live with and take classes with students from their home institution [5].

“I feel as if I have been exposed to a whole new world around me. I now recognize plenty of opportunities I have as a person and as an engineer.” – First-Year, Civil Engineering, Female, Spain

“It has helped to give me a more diverse view of the world and how interconnected it is.” – First-Year, Electrical Engineering, Male, Germany

“It has made me more confident in my ability to live in a wide range of places.” – Sophomore, Electrical Engineering, Male, London

“The program exposed me to many different cultures around the world, and allowed me to learn about many global issues.” – First-Year, Computer Science and Engineering, Female, Rome

#### 4.4 Professional Development

Overall students who participated in a study abroad program had higher satisfaction levels of: (1) their

**Table 6.** Student Satisfaction with Engineering Major Flexibility

Senior Survey Question: Satisfaction with Flexibility for Major (e.g. time for electives)					
Studied Abroad?	Very Dissatisfied	Generally Dissatisfied	Generally Satisfied	Very Satisfied	Mean (4pt scale)
Participated in Study Abroad	19%	41%	27%	14%	2.36
Did not Participate in Study Abroad	17%	24%	40%	19%	2.62

**Table 7.** Change in Cultural Self-Assessment

Cultural Self-Assessment Responses (183)	Paired t-tests		
	Pre Study Abroad	Post Study Abroad	t value
<b>Based on your current life experiences, how would you rate your awareness level:</b>			
Understanding of other countries and cultures	3.454	3.672	-3.653***
Understanding global issues	3.203	3.407	-3.170**
Ability to see the world from someone else’s perspective	3.588	3.896	-4.847***
Ability to work cooperatively with diverse people	4.000	4.137	-2.360*
Understanding of how my intended profession/career fits into a global environment	3.454	3.863	-5.666***
People and places that are different from me	3.760	4.044	-4.274***
Personal biases	3.628	3.858	-3.511***

\* p value < 0.05, \*\* p value < 0.01, \*\*\* p value < 0.001.

undergraduate experience overall, (2) opportunities for personal development, and (3) knowledge, skills, and personal development than students who did not participate in a study abroad program (as measured by a senior exit survey).

In several measures there were gains reported that relate to professional development. First, 85% of all engineering study abroad participants indicated that the program positively influenced their career interests/plans. Second, students reported the number of faculty that they knew well enough to write a professional recommendation increased after participating in this program from 1.60 to 2.03 (statistically significant  $\alpha < 0.0001$ ). Students got to know both their peers and faculty very well through this program which has been reported to improve student academic performance [26]. Students were able to leverage this experience in putting it on their resume and as a professional interview talking point. The following are quotes from the free response survey items relating to personal and professional development:

“The classes themselves really helped me think about my path moving forward, I also made friendships with many other students and professors.” – First-Year, Male, Civil Engineering, Ireland

“I had an awesome time, and the people involved (professors, program heads, RAs, etc.) were amazing.” – First-Year, Male, Mechanical Engineering, Rome

Reassurance of major: “The mechanics course reassured me that I was in the right major.” – First-Year, Female, Mechanical Engineering, London

“It has helped me to realize that I made the right choice for engineering and that I definitely want to do CS. As a person, I feel more aware of global issues that are present.” – First-Year, Male, Computer Science, Rome

“It completes the junior lab requirement and gave us experience. It will certainly be a talking point in interviews. Lastly it gave me the chance to explore a lot of Europe.” – Sophomore, Male, Chemical Engineering, London

“It made me think of professional opportunities outside of the United States.” – First-Year, Female, Chemical Engineering, London

The final quote regarding living outside of the United States is encouraging as study abroad programs more generally aim to help support our global awareness and engagement. Interestingly, the researchers in this study tracked where students were from (what they consider to be “home”) and all the places they would consider living after graduation. This was asked in both the pre and post survey, but the differences were not statistically significant. While the researchers do think an international experience gives students confidence to think more broadly about where they might live/work someday it did not show a measurable difference based on the questions asked. A future study would look further

at this; the question could be reframed to not just be a list of geographic locations with check boxes but a free response question or qualitative interviews with students.

## 5. Discussion

The results of this study show the many positive benefits of study abroad for engineering students, even short-term, 6 week programs. On average, students did earn a higher GPA the semester they studied abroad as compared to the semester prior, this is thought to be due to: (1) focused attention on 1–2 courses and (2) lower/more realistic expectations of faculty of students doing work in a cultural setting. Participating in a program over the summer that offers multiple technical engineering courses and is taught by engineering faculty from the home institution directly supports student’s degree completion. There is no concern of credits not transferring nor not counting towards requirements; however, students perceive getting ahead on 2 engineering classes as beneficial to either offer a future semester with fewer credits required or flexibility to earn additional credentials – which overwhelmingly students that studied abroad did. One factor that is concerning is that when students reflected on their entire engineering experience upon graduation they felt they had less flexibility than students that did not study abroad. This could be due to self-imposed pressure to gain another credential, or a byproduct of taking courses that count in many cases as “technical electives” rather than requirements which diminishes some of the already quite limited “choice” that engineering students from ABET accredited programs feel.

In terms of a cultural experience, certainly a program that allows students to live with a host family, is longer in duration, or has a language requirement may experience larger gains. However, for engineering students who are among the least likely to study abroad, a 6-week cohort based program still yielded significant personal growth. Students indicated gains in every cultural factor considered between the pre/post analysis which is to say that there is student development occurring through this experience. They also frequently cited the opportunity to really get to know faculty members and their peers with whom they would be working during future classes as both a motivation for participation in a study abroad program and one of the things they enjoyed most about participating. Finally, students also reported growth in professional development in terms of reassuring them of an academic pathway in engineering, their engineering major, and made them consider living outside of the US in their future career paths.

## 6. Conclusions

There are significant positive benefits to short term study abroad programs for engineering students including: (1) a boost to the students GPA, (2) higher number of credits at graduation and many had earned an additional credential such as a concentration or a minor, (3) students self-assess-

ment of their cultural awareness showed improvement, and (4) students indicated positive benefits for professional development. The only concern that was found during this analysis was the decreased academic flexibility reported by students. This concern should be evaluated in a future study at another dissimilar institution.

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**Kerry L. Meyers** holds a PhD in Engineering Education (BS & MS Mechanical Engineering) and is specifically focused on programs that influence student's experience, retention rates, and the factors that determine the overall long term success of students entering an engineering program. Her current research interest is in Engineering Major Discernment and



professional development. She is the Assistant Dean for Student Development in the College of Engineering at the University of Notre Dame and also the Director for Women in Engineering. She is committed to the betterment of the undergraduate curriculum and is still actively involved in the classroom and works to administer programmatic activities that support student learning and development.

**Mark J. McCready** has been a faculty member at the University of Notre Dame since 1984. His degrees are in chemical engineering from the University of Delaware (BChE) and the University of Illinois (MS, PhD). His research activities and teaching interests are in multiphase fluid mechanics and transport processes with applications to chemical process technologies and physiological flow and transport processes. He is currently the Senior Associate Dean of Engineering for Research and Graduate Studies.