



Comparing Engineering and Non-Engineering International Programs to Determine Value and Future Directions

Dr. Holt Zaugg, Brigham Young University

Holt Zaugg is the Assessment Librarian at the Harold B. Lee Library at Brigham Young University. His research interests focus on assessments and evaluations that improve student learning and integrate library services with other faculty courses.

Dr. Spencer P. Magleby, Brigham Young University

Dr. Magleby is a professor in Mechanical Engineering and is the associate dean of the College of Engineering and Technology at BYU where he oversees international program development.

Dr. Timothy L Elliott, Brigham Young University

Timothy Lynn Elliott directs Brigham Young University's office of International Study Programs which annually sends more than 1500 students abroad on study abroad, international internship, and international field study programs. Previous to this current position, he directed the study abroad programs at Utah Valley University, and managed international student programs at Brigham Young University and the University of Virginia. Lynn has a BA in Economics and an MA in International Relations from Brigham Young University and a Ph.D. in Foreign Affairs from the University of Virginia.

Dr. Alan R Parkinson, Brigham Young University

Dr. Gregg Morris Warnick, Brigham Young University

Gregg M. Warnick is the Director of the Weidman Center for Global Leadership and Associate Teaching Professor of Engineering Leadership within the Ira A. Fulton College of Engineering and Technology at Brigham Young University (BYU). The center provides oversight for leadership development and international activities within the college and he works actively with students, faculty and staff to promote and develop increased capabilities in global agility and leadership. His research and teaching interests include developing global agility, globalization, leadership, project management, ethics, and manufacturing processes. Gregg has lived in numerous locations within the USA and Europe and has worked in many places including North America, South America, Europe, Asia, and Africa. Prior to joining BYU, Gregg worked for Becton Dickinson, a Global Medical Technology fortune 500 Company. In this capacity he worked as a product development engineer, quality engineer, technical lead, business leader and program/project manager managing many different global projects. Gregg received his PhD in Educational Leadership and Higher Education from the University of Nebraska-Lincoln with a Master of Technology Management degree and a BS in Manufacturing Engineering Technology, from Brigham Young University. Gregg also does consulting in project management and leadership working with IPS Learning and Stanford University where he provides training for fortune 500 companies throughout the world.

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Introduction

International programs are a common approach to achieving a variety of global competency-related learning outcomes^[1]. Such programs are generally designed to meet lofty goals such as providing an in-depth understanding of people and their culture in such a way that discipline specific practices are compared and contrasted, personal student biases and misconceptions are exposed and a broader perspective is gained of the world in which we live and work^[2, 3, 4, 5]. In recent years there has been a significant increase in the number of engineering-specific international programs reflecting the increasing globalization of the engineering enterprise.

As engineering educators one might ask if engineering students learn differently on study abroad programs than do students in other majors? And, if so, what implication does this have in developing and conducting these programs? The field of international education has, for some time, sought to find ways to adequately assess international programs^[3]. There is a consensus in much of the literature that studying abroad can have a positive impact on a student's ability to deal with new cultures and on their intellectual development^[6, 7]. In these assessment efforts, it is important to understand what differences, if any, a student's major field of study might have on their approach to learning in an intercultural setting.

Each year Brigham Young University (BYU) sends over 1500 students abroad on international programs. Each of these students has the chance to evaluate the program they participated on through an on-line evaluation. The evaluation focuses on general learning outcomes for BYU international programs. The question that intrigued us was whether or not there was a significant difference in the way that engineering students on international engineering programs answered the questions on the evaluation when compared with non-engineering students on other programs. Each academic discipline approaches the world differently. Students in these varying disciplines are taught to see the world through the lens of the discipline's assumptions and guiding principles. It should not be surprising, then, that disciplines would develop students with differing response to international experiences.

On this paper we examine assessment data in the form of self-reported scale responses and open-ended comments in hopes of addressing the question of whether engineering students approach their international study experiences differently than do students from other majors.

Background

As assessment has become an integral part of higher education, it is no surprise that this stress on evaluating the effectiveness of educational programs has spilled over to international programs. A short discussion of this trend can be found in the essay by Darla Deardorff in *The Practice and Research in Study Abroad*^[8] or in the discussion of study abroad outcomes in *Study Abroad in a New Global Century*^[9]. Both of these summaries make clear that researchers have approached the assessment of international programs from a number of angles. These include looking at the impact participating on an international program can have on career selection, time to graduation, or on career earning potential^[10]. There have also been studies which look at more esoteric

topics such as the impact study abroad can have on one's creativity or on a person's later engagement in charitable activities^[7]. While there is a wide variety of topics addressed in this work, there is also a variety of data sets used. While almost all of the projects rely on some kind of survey or test of study abroad participants and their peers, some studies compare large numbers of student participants from a variety of universities attending programs over several years. Other studies only examine a smaller number of participants from only a few or even a single institution. Ultimately the goal of study abroad programs is to increase student understanding of and competence with global issues pertaining to their specific discipline of study.

In all of this, however, less attention has been paid to the role in which academic discipline can shape a student's response to an international learning experience. To be sure, there have been articles written which focus on international education for specific majors. For instance, *The Handbook of Practice and Research in Study Abroad*^[11] includes chapters which focus on study abroad for nurses and for education majors. But in cases like this, the focus is on the need for international education for these majors and the tactics that can be used to increase the number of international opportunities for nurses and teachers, and not on whether the actual international experience is viewed differently by these majors.

The question of whether students in various disciplines might view their international experiences differently needs further examination. This article is a first step in addressing this question.

Survey of Students

Each year more than 1500 students at BYU participate in some form of study abroad program. These students span a wide variety of majors from humanities to engineering. In this paper we focus on students from engineering, business and nursing.

The international program survey used in this study is administered to students as they completed their program. The survey questions address three outcomes that are desired of all students across the university:

1. Demonstrate an understanding of the people, worldview, culture (and language, where applicable) of the foreign setting in which they study.
2. Recognize one's cultural presuppositions and biases through sustained exposure to, and study of, foreign perspectives on one's own culture.
3. Articulate a deeper awareness of one's academic discipline by comparing and contrasting how it is understood and practiced in a foreign setting.

Seven survey questions are administered to assess the three outcomes. The first three questions relate directly to the competencies above. Question four refers to the cultural contacts and interactions students were able to gain by participating in activities with local church members that facilitated cultural interactions. Questions five through seven are more administrative types of questions that refer to the quality of experience students experienced as a direct result of participation in the program.

1. Through my experience abroad I gained an in-depth understanding of the culture in which I studied.

2. Through my experience abroad I recognized inaccurate assumptions or biases I held previously about the location in which I studied.
3. Through my experience abroad I was able to understand how my chosen field of study is practiced in a foreign setting.
4. Through my experience abroad I was able to understand the church teachings and practices in a global and cultural context.
5. The director of my study abroad program made good strategic use of the local setting to help me achieve the educational goals of the program.
6. The learning I gained on my program justified the investment in time and money.
7. Will you recommend this program to your family and friends?

The survey results include a Likert scale question followed by an open-ended response for each question. Questions 1, 2, 3, 4 and 5 each used a scale of 6. Question 5 used a scale of 8 and Question 6 used a scale of 5.

Framework of Assessment

Evaluating the similarities and differences between international programs requires a framework that indicates different levels of assessment for each international program. Figure 1 illustrates the framework used to evaluate the different programs in this study. At the bottom of the assessment triangle are the competencies that all international programs hope to achieve. The second level narrows this focus to international competencies found within each college. These competencies examine the specific influences of a global experience on the broad discipline each college offers. For example it illustrates the differences between engineering and nursing or business programs. While some commonalities will continue, this level focuses on specific differences at the college level.

The next level continues this narrowing of competencies to those specific to each study abroad program within specific college departments. The tasks of the global experience focus on the skills specific to each department within the college or school. For example, what specific global influences are unique to Mechanical Engineering as compared to Civil Engineering?

Finally, some departments may sponsor several international experiences, each with a unique global focus. In this way the specific competencies for a specific program are included. It should be noted that, if a department only sponsors a single international experience, this final step may be subsumed in the previous level of assessment.

As this is an initial step to understand similarities and differences between international programs across the university, two international programs at the college level were chosen to compare and contrast with engineering study abroad programs, namely, business and nursing. These programs were chosen because of a similar homogeneity within each program and a somewhat similar location of where the programs occurred in terms of geographical location, international experience and opportunities for cultural integration while on the international experience. It should be noted that, as an initial study comparing study abroad programs across campus, this study is housed in the bottom layer of our assessment framework that identifies

learning that all study abroad programs across campus should include. Future studies would include other layers in the assessment framework.

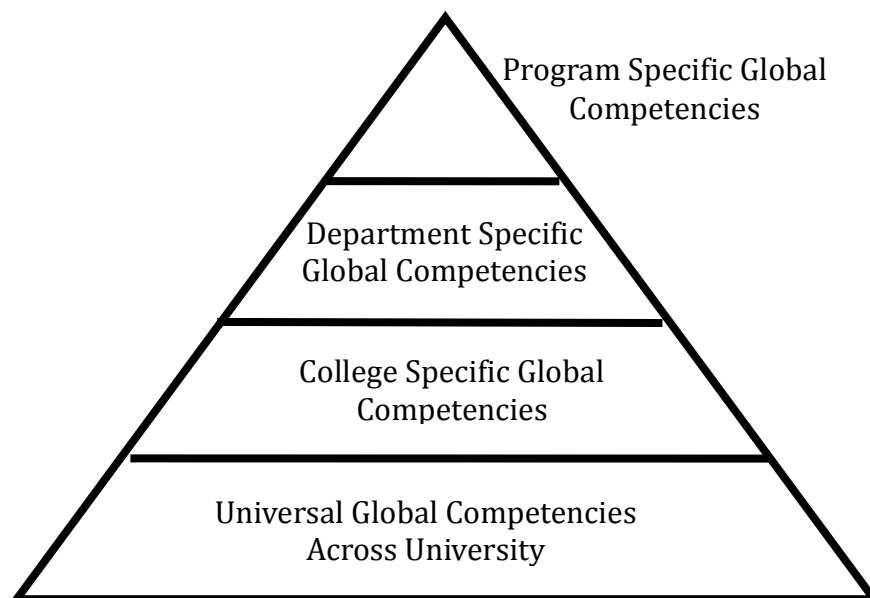


Figure 1. Assessment framework for international programs.

Results

To examine differences across students in the three colleges, each study abroad program sponsored by a single college was placed into a single group. The mean and standard deviation for each study abroad group (i.e. engineering, business, and nursing) were determined and are given in Table 1.

An ANOVA and a Levene's test of homogeneity of variances were conducted on the scale responses for each question. The ANOVA determined if there was a significant difference between the mean scores of the self-reported responses for each group. The Levene's test of homogeneity determined if the variance in the responses were significantly different from one another.

If there was a significant difference between the mean scores, a second analysis was conducted to determine between which groups the difference was significant. The Bonferroni or Games-Howell tests were used, depending on homogeneity between groups, to determine which means were significantly different. If the group variances were not significantly homogeneous a Bonferroni test was used. If there was a significant difference in the homogeneity between the group variances then the Games-Howell test was used. If no significant difference was reported on the ANOVA no further testing was conducted. The results of significant difference are reported in Table 2. It should be noted that, while significant differences may have occurred between the business and nursing groups, only differences between engineering study abroad groups and other study abroad groups will be discussed in this article.

Along with each scale question, study abroad participants were provided the opportunity to make open-ended comments related to the scale questions. These comments were used to further

clarify and explain patterns of significance and non-significance between groups. Following the report of significance, the results for each question are discussed.

Table 1. Number, mean, and standard deviation of each study abroad group by question.

Question	Group	N	Mean	Standard Deviation
1	Engineering	42	4.81	1.153
	Business	61	5.30	.863
	Nursing	40	5.23	.733
2	Engineering	42	3.90	1.322
	Business	60	4.30	1.357
	Nursing	40	4.13	1.244
3	Engineering	41	4.88	1.229
	Business	51	5.45	.673
	Nursing	39	5.38	.747
4	Engineering	42	4.64	1.100
	Business	60	5.08	1.062
	Nursing	39	5.33	.869
5	Engineering	43	5.44	.700
	Business	60	5.48	.748
	Nursing	33	4.76	1.119
6	Engineering	41	7.20	1.005
	Business	60	7.40	.867
	Nursing	39	7.00	1.000
7	Engineering	42	4.57	.859
	Business	60	4.83	.493
	Nursing	39	4.67	.621

Note: Questions 1, 2, 3, 4, and 5 use scales of 6. Question 6 uses a scale of 8. Question 7 uses a scale of 5.

Table 2. ANOVA between and among group significance by question.

Question	Between Groups		Homogeneity of Variances	Among Groups	
	f	Sig.		Group	Sig.
1	3.692	.027	.081	Business	.030
				Nursing	.133
2	1.116	.330	.388	Business	-
				Nursing	-
3	5.181	.007	.004	Business	.025
				Nursing	.072
4	4.783	.010	.286	Business	.103
				Nursing	.009
5	8.938	<.001	.001	Business	.955
				Nursing	.009
6	2.145	.121	.639	Business	-
				Nursing	-
7	2.086	.128	.003	Business	-
				Nursing	-

Boldface and italics indicate significant findings.

Note: When no significant difference is reported between groups, no further analysis is done to determine significant difference among groups.

Also, when there is no significant difference in homogeneity of variances between groups, Bonferroni is used to determine among groups significant difference. When there is a significant difference in homogeneity of variances between groups, Games-Howell is used.

1. Through my experience abroad I gained an in-depth understanding of the culture in which I studied.

The business study abroad group reported significantly higher scores ($p = 0.30$) than the engineering group. While not significant, the nursing study abroad group mean scores were higher than the engineering mean scores. The bulk of comments from all three groups focused on students' visits to sites unique to the study abroad experience and the interactions study abroad students encountered. Engineering students focused on visits to historical or cultural sites on their trips. Interactions were largely focused on group members, when working on a specific project, or the interactions when one would visit a historical site. Typical comments of engineering students were:

- *We went to a lot of museums, traditional restaurants, and other cultural events that helped us understand the history of each place and how it affects people living there.*
- *Going to markets was one of the ways that I was able to learn more about the local people.*

Business and nursing students had a broader and deeper experience of visits and interactions. Business study abroad groups visited a wider variety of businesses and often had specific discussions about their discipline and the effects of culture on that discipline. Nursing students worked in a variety of settings that also had close contact with a wider variety of people in health related settings. Comments typical of these groups included:

- **Business:** *We interacted with people in each area that we visited and learned from them about what it would be like to work in their countries – which not only helped us with our business aspirations, but helped us understand the culture as well.*
- **Nursing:** *During my clinicals in Finland, I was able to work with multiple Finnish nurses. On multiple occasions I was able to go with them to do home visits to many patients. I was able to interact with these patients and see the homes they live in. This gave me insight into their daily life and the things they hold most important.*

Discipline-specific interactions with the local population in extensive specific settings appears to be one of the key differences as engineering study abroad students typically focused on a specific project or focus of study with more restricted interactions. While each program encouraged broad cultural interactions through activities such as visiting museums, historical sites, or restaurants, each discipline also required different levels of personal contact. Business and nursing require more interpersonal contact with local people. Engineering focuses on the study of structures or building things, which may not require as much contact with local people. The additional contact required by business and nursing increases the opportunities for cultural understanding.

2. Through my experience abroad I recognized inaccurate assumptions or biases I held previously about the location in which I studied.

While no significant differences were reported between any of these study abroad groups, a comparison of comments between groups is of interest. First, more engineering study abroad students commented that they did not have any biases or inaccurate assumptions prior to going. The only specific reason given was prior experience abroad. However, this was a small subgroup compared to the other students. Overwhelmingly the biases and inaccurate assumptions corrected by a study abroad experience were as different as the cultures that were visited. Common themes

among all groups included the political atmosphere (basic freedoms and socioeconomic status); food; the disposition of indigenous people (they were happier, friendlier, and more helpful than previously thought); language skills (they thought everyone spoke English); and the scope of seeing something in person that had only been viewed in pictures. Similar comments could be found in each study abroad group specific to their experience. While the comments below mention specific cultures, similar comments were found in each program. Comments typical of student experience include:

- **Engineering:** *I thought the Chinese felt oppressed by the government, but found that they are actually a very happy people.*
- **Business:** *I assumed people in China would all speak English and it was very difficult to find anyone that spoke English.*
- **Nursing:** *I held biases against the Russians for being hard hearted and uncaring for their children. However, through working with the harbor I was able to see mothers who were very concerned for their children's health and willing to learn from complete strangers.*

3. Through my experience abroad I was able to understand how my chosen field of study is practiced in a foreign setting.

The business study abroad group mean scores were significantly higher ($p = 0.025$) than the engineering group. While not significant, the nursing study abroad group mean scores were higher than the engineering group and approached significance ($p = 0.072$).

Student comments in each group revealed similarities and key differences among the groups. All groups reported the importance of examining their discipline practices in a real-life world setting. In each group this examination was viewed as a positive influence in the development of discipline specific skills.

Differences in comments were manifest in four areas; interactions with local people, cultural applications, site visits and comparing and contrasting discipline practices.

Interactions. Both engineering and business students had more comments regarding the importance of discipline specific interactions among cultures. These interviews typically involved local and ex-patriot individuals directly related to the discipline in the work force. The interactions offered insights on how it would be to live and work in a foreign setting. A comment typical of this experience was:

- *I was able to meet and see MBA graduates and BYU MBA alumni working abroad, ask questions, and see them apply the skills I'm learning within different foreign countries. It was an invaluable educational experience.*

Cultural Applications. Both business and nursing study abroad students had more comments (over 10 to 1) on how the culture of local people affected the practice of their discipline. Typical comments were:

- **Business:** *I saw how various businesses had to adapt their business practices to be successful in their given markets.*
- **Nursing:** *It helped me to understand that I must be aware of cultural differences in order to be an effective nurse.*

Site Visits. Business students had double the comments on site visits as either engineering or nursing students. As mentioned before, these comments focused on specific interactions with local or ex-patriot individuals who were working in a business setting. In these interactions focused strongly on how culture affected specific business practices. A comment typical of students included:

- *We visited the American Chamber of Commerce in Greece and were able to hear a lot about the economic, political, and cultural situations. The economic and political helped us understand many of the cultural phenomena that happen from a business perspective. It also provided a first-hand account of the culture and showed me that not everything you hear from the news about culture and economics is correct.*

Compare and Contrast. Nursing students had three to four times the number of comments indicating that they were comparing and contrasting nursing practices between countries that were visited or, more commonly, between the United States and the host country. In every instance these comments indicated that such a comparison in practices strengthened student understandings of nursing practices. It often resulted in nurses commenting on how the comparing and contrast would change the way they practiced nursing. A comment typical of nursing students was:

- *We were a lot more similar than I realized, but I feel like the nurses in Taiwan, in general, were much more aware of religious practices and needs of their patients and families were much more central to the care. I appreciated seeing such respect and patience and want to become more like that in my nursing career.*

4. Through my experience abroad I was able to understand the church teachings and practices in a global and cultural context.

The nursing study abroad group mean scores were significantly higher ($p = 0.009$) than the engineering group. While not significant, the business study abroad group mean scores were higher than the engineering group. Participation with the local church members facilitated deeper cultural interactions and understandings among all study abroad students.

Of interest were the commonalities in the comments made by all study abroad students. Students in all groups commented that much of their interaction was by attending local church meetings and acknowledging that church practices were uniform throughout the world, but there may be some minor cultural accommodations (although no specific ones were mentioned).

The key difference between engineering students and other students was the ability to meet with local church members. The majority of engineering study abroad programs were centered in Mainland China. In this location ex-patriot and local church members were not allowed to meet together. This prevented engineering students from experiencing cultural uniqueness of local members in a close and personal way. Those in other programs were able to have this close personal contact that enabled entrance to the local culture through a common bond.

It should be noted that the final three questions were more of an administrative nature that indicate the importance of study abroad directors and the satisfaction with the program overall. Since questions six and seven are similar in nature as agents of satisfaction, they are discussed as a single component.

5. The director of my study abroad program made good strategic use of the local setting to help me achieve the educational goals of the program.

This is the one area where engineering study abroad students reported significantly higher mean scores ($p = 0.009$) than nursing students. Mean scores and variance for business students was virtually identical to that of engineering students.

Comments in this area were considerably confounded. For example, in one program one student had considerable complaints about the program director, whereas, another student in the same program with the same director described him in positive, warm and glowing terms. Such opposed comments were not unique to the disposition of the director, but also continued in other areas.

Some interesting differences did appear. When logistical problems arose (e.g., flight or hotel bookings), business students tended to lay the blame for the problems on BYU's Study Abroad office or Travel Office instead of the director. In the case of both engineering and business students, praise was given for the study abroad director's connections to local people and businesses and the advantages that these connections provided. Engineering study abroad preparations courses were also viewed more favorably in terms of helping student know what to expect when traveling abroad. Business and nursing comments were primarily negative.

The diversity of comments about the program directors among the three study abroad programs did not allow for a comment typical of any one group or any one area of the director's responsibility. However, engineering study abroad programs typically involved students working on a specific project with local people, guided by their tour director. While the nursing study abroad program also had tour directors, comments indicate broader interactions with local people through service in local clinics and hospitals. These broader impacts may have resulted in the difference in the importance of a tour director. It should be noted that engineering and business responses were almost identical ($p = 0.955$). This may indicate the importance of local connections that business directors had and the collaboration partnerships that engineering directors had.

6. The learning I gained on my program justified the investment in time and money.

7. Will you recommend this program to your family and friends?

There were no significant differences between any of the groups on either of these questions. All comments were overwhelmingly positive and supportive of the learning and study abroad experience. All ratings were extremely high (7.00 to 7.40 out of 8 on question six and 4.57 to 4.83 out of 5 on question seven). Comments focused on the personal growth gained on the experience; the opportunity to travel, and the interactions with people of other cultures. Many felt that the cost/benefit for traveling was reasonable and affordable.

Future Directions

Next steps for the assessment of study abroad programs will include a refinement of the university wide assessments for all programs. In addition to this engineering, and other disciplines who wish, will begin to identify competencies that all engineering study abroad programs should achieve. This would include competency evaluations that are unique to

engineering. Ultimately these evaluations will move up the framework to specific programs of study.

In addition to the refinement and development of the study abroad program competency evaluation, will be an examination of evaluation tool. While a survey, including Likert responses and open-ended questions, was used for broad university based evaluation, other evaluation tools may be better suited for higher levels. For example, interviews or focus groups may work better at the college, department, or program levels of the framework. Students may also be asked to submit journals, blog posts, or other forms of self-evaluation that may provide evidence of learning and the satisfactory completion of identified competencies.

Conclusions

While the results of the comparisons outlined above provide some interesting insights, they seem to raise more questions than provide answers. Many of the results lead to speculation as to why some of the differences exist. For example, why would business or nursing students feel the study abroad experience helped them understand better how their discipline is practiced in a foreign setting than engineering students? Is it that the study abroad experience is better or the discipline is different? For example, nursing is much more "homogenous" than engineering. Would that play a part? With this data we feel even more motivation to better understand the interplay of program objectives, academic norms in various disciplines and program culture common to specific colleges.

The study presented in this paper can serve as an initial step in understanding and defining the value of engineering international programs in the context of the traditional, wide-ranging study abroad experience. While this study focused on a few college-based programs that had relatively high levels of common outcomes, more is to be learned by expanding the study to programs in the liberal arts that have a long history of international experiences. Further comparisons between engineering and non-engineering programs could assist in better understanding common strengths and challenges, and unique issues and opportunities.

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