AC 2012-3903: A COMPARATIVE ASSESSMENT OF GRADUATE VERSUS UNDERGRADUATE STUDENT OUTCOMES VIA INTERNATIONAL COMMUNITY ENGAGEMENT PROGRAMS

Kristine Louise Guzak, Michigan Technological University

Kristine Louise Guzak is a Ph.D. student of environmental engineering at Michigan Technological University. She is the lead graduate student on a larger project assessing the impacts of learning through service on undergraduate students. Her research interests include engineering education with some focuses on international programs.

Prof. Kurt Paterson P.E., Michigan Technological University

Kurt Paterson, Associate Professor of Civil and Environmental Engineering, is also Director of Michigan Tech's D80 Center. D80 has the mission to develop contribution-based learning, research, and service opportunities for all students and staff to partner with the poorest 80% of humanity, together creating solutions that matter. As Director of several international programs at the undergraduate and graduate levels, Paterson, his colleagues, and his students have conducted numerous community-inspired research and design projects. Paterson is an educational innovator, recently adding courses for first-year students, Great Ideas, and graduate students, Discover Design Delight. At the intersection of these two fields, Paterson leads several national initiatives for learning engineering through service, recently taking the reins for the American Society for Engineering Education's newest division startup, Community Engagement in Engineering Education. He is PI, or Co-PI, on several large projects assessing the impacts of learning through service on students, faculty, and communities around the world.

Alexandra Archer, Michigan Technological University

Alexandra Archer is an environmental engineering master's student in the Peace Corps Masters International program at Michigan Tech. She holds a master's in biological systems engineering from Kansas State University. Her research interests include sustainable engineering and international community engagement.

©American Society for Engineering Education, 2012

A Comparative Assessment of Graduate versus Undergraduate Student Outcomes via International Community Engagement Programs

1. Background

With the way the world is changing, the development of future engineers is going to require a mixture of technical expertise and communicative skills. It is becoming increasingly clear that universities lack the appropriate infrastructure to foster the necessary growth to promote successful engineering in the future.[1-5] In spite of this limitation, students are finding ways to gain these skills outside of the classroom through the development of extracurricular opportunities.[6] This movement has fueled the development of engineering courses and programs encompassing community engagement (CE) in institutions around the country. A narrow range of studies have shown that CE seems to be attracting a wide range of engineering students, while offering significant advantages to participants and the profession.[7-11] Michigan Technological University has acknowledged this trend and attempted to meet student demand by incorporating CE programs within their undergraduate and graduate curricula. Due to the quick growth of these programs, Michigan Tech has initiated a rigorous evaluation of their impacts for all stakeholders. This paper will examine methods and evidence concerning student participants.

This paper provides findings of a comparative study done on two of Michigan Tech's international community engagement programs: one at the graduate level, the other at the undergraduate level. In order to better understand the effectiveness of their engineering education in preparing students to engage in beneficial community fieldwork a three instrument assessment was used. These methods included: 1.) intercultural awareness, 2.) readiness for international experiences, 3.) and motivations for participation. Twenty-six undergraduates and twenty-three graduate students completed all instruments at the beginning and end of a two-semester experience (campus-based learning only for the graduate students, but including international fieldwork for the undergraduates). The collected information was analyzed utilizing three independent variables, gender (male or female), program (undergraduate or graduate student) and prior experience abroad (low, medium, high). Initial findings suggest a significant difference between programs with regards to participants' intercultural awareness and readiness. Additionally, preliminary results suggest gender differences with respect to motivations. This paper examines beneficial program design elements for student participants as well as the communities they serve.

2. Objectives

This paper presents findings evaluating programmatic design needs of two CE programs at Michigan Tech: (1) Undergraduate program, iDesign, an international senior-level capstone design program, and (2) Graduate program, Peace Corps Master's International (PCMI), an international graduate-level research program. Until recently, minimal assessment data existed for either program at Michigan Tech, but continued strong

demand over the past decade, plus resource allocation decision-making, encouraged a more formal approach to their evaluation.

While anecdotal evidence regarding participant and program outcomes is compelling, questions have surfaced on specific gains (and costs) to participants as a result of choosing these international sustainable development program options instead of other possibilities. In order to promote overall sustainability of these programs, the readiness of and potential challenges for, participants are crucial components to understand. Rigorous data collection and analysis can provide invaluable information that could shape these programs and lead to a better understanding of how to promote them to others, scale them effectively, or enhance their contributions for all stakeholders. In an effort to respond to these demands, a formal assessment program was designed and initial data was acquired in the 2010-2011 and 2011-2012 academic years; this paper examines findings from these datasets.

3. Study Participants

Both international programs at Michigan Tech partner with rural economically-developing communities in other countries, and both position the students as technical experts within a multi-stakeholder partnership for engineering infrastructure design, construction, or enhancement. Additionally, each of the programs has on-campus preparation prior to international fieldwork, and end with engineering analysis and communication. The programs are further described below.

3.1 iDesign Program

The undergraduate program cohort for the purposes of this study consists of 26 multi-disciplinary engineering students with a wide range in backgrounds (e.g. work experiences, travel experiences, language proficiency, etc.). As part of the program, students participate in one semester of prep work (Spring), two weeks of fieldwork in the host community (Summer), and one semester of analysis and communication (Fall). As a complementary component to the preparatory work, students completed an assessment before international travel (March-April, 2011) and completed it again after fieldwork (November, 2011).

3.2 Peace Corps Master's International Program

The graduate cohort consists of 23 masters students in civil or environmental engineering students from various backgrounds (e.g. undergraduate disciplines, travel experience, volunteer experience, etc.), although two students failed to complete the demographic information and two separate students failed to complete the intercultural inventory. As part of the program, students participate in two semesters of preparatory work (coursework and informally through their learning community), twenty-seven months of fieldwork (including three months of training), and one semester of communication (thesis defense) upon returning from fieldwork. Similar to the undergraduate students, the graduate students underwent an assessment at the start of the program (two cohorts in

August 2010 and 2011), but also at the conclusion of their on-campus preparation (one cohort in April 2011 and one in November 2011) before departing for their fieldwork. Upon return, they will undergo the same assessment (various points in Spring 2014 through Spring 2015). Our assessment protocol is a longitudinal one, following students from start to finish within their program; however, this paper focuses on the assessment program design and pre-fieldwork evaluation to date.

4. Assessment

This assessment program examines critical skills, attitudes, and identity using three instruments: i.) motivations, ii.) intercultural awareness, and iii.) readiness. Additional assessment components tracking alumni, host communities, and the university are not presented herein. As part of the student study the following instruments were used in an effort to qualitatively and quantitatively assess a better understanding of participants and their outcomes. Experiences on campus and the completion of the other instruments could have an impact on the narrative responses to instrument i. (Motivations), so that instrument is completed first by each student cohort as early as administratively possible during the on-campus preparation phase of each program, as well as after their fieldwork portion. The assessment program has been reviewed and approved for use by Michigan Tech's Institutional Review Board. The presented results should be interpreted with caution given the relatively low numbers in this quantitative study. While reflective of the programs presented herein, additional years of data are needed before conclusions can be transferred to such programs in general at other institutions.

A. Identity- Motivations

Comparable to many international service experiences in developing communities, both programs within this study are options, and demanding ones at that. Understanding motivations becomes especially important to the student, their team, and their host community. This paper focuses primarily on the connections between the instruments of the assessment protocol. Student motivations are captured through an essay describing interest in participation, and indirectly through parts of the other two tools. The essay is motivated by a handout at a cohort meeting early in the program (for pre-assessment) and near the end of participation (post); task directions are general to give students a completely blank canvas for response:

Task: write a narrative, no more than one page at 12 point font, describing your motivations for wanting to participate in this program. Print out, staple to this cover sheet, and drop off.

As standard protocol, no names are allowed on returned responses, rather student's use a six-digit codename (first 2 letters of first name + first 2 letters of last name + 2 numbers from birth**day**) across all three instruments.[12]

Each motivations narrative essay was transcribed, then coded using qualitative data analysis software (HyperRESEARCH 3.0) bearing in mind the question: *Why are students interested in participating in these programs?*[13] Appendix A includes the list of codes created, including further explanations of each. These codes were developed initially using the In Vivo followed up by pattern coding methods as outlined by Saldaña. Coding is an iterative process and it's only the initial step in analyzing and interpreting each motivational narrative. [14] Once the essays were coded they were then analyzed using a frequency reporting tool built into HyperRESEARCH. This dataset was examined using several filter options (all responses, by gender, class level, and international experience). The findings of these analyses are discussed in the Results section below.[15]

B. Attitude-Readiness

The Readiness Indicator is a shortened version of the 45-item instrument used to promote global competency, the Miville-Guzman University-Diversity Scale (M-GUDS).[16] The readiness assessment, developed for international programs at Purdue University, is comprised of 20 questions utilizing a six-point Likert scale ranging from strongly agree to strongly disagree and has been used to examine the awareness and potential acceptance of cultural similarities and differences among engineering students.[11] This instrument was utilized as additional perspective on the motivations of students participating in the international programs being assessed, as well as to understand preparation effectiveness, and potential team and project partnership issues. The resulting information provides essential background information and further perspective to analyze the students' motivations.

C. Skills- Intercultural Development Inventory (IDI)

Developed by the Intercultural Communication Institute, the IDI assesses intercultural competency and awareness.[17-18] The IDI is an online, 50-question instrument, which creates quantitative "scores" (perceived and actual intercultural development, among other information) based on participant responses to these Likert-scale questions. This information provides insight where the individual may lie on a development scale from ethnocentrism to ethnorelativism (stages: denial, defense, reversal, minimization, acceptance, and adaptation). The IDI suggests how well the participant might work with someone who has a different worldview, culture, and life experiences; while this is important for forecasting possible project partnership successes and challenges (and can inform preparation), it is also suggestive of the framework supporting a student's motivations for participation. Similar work is being done at Georgia Tech in an effort to develop and assess globally competent engineers.[19]

5. Results

A. Project Overview

Demographic information was collected from each of the participants prior to any of the instruments. Key characteristics of the data are presented in Table 1. Countering engineering enrollment patterns, these programs attract a large percentage of female students, over 50% in both programs, as commonly noted by faculty practitioners. Additionally, each individual was asked to note the languages they had experience in (ranging from knowing a few words to one they would feel comfortable taking engineering courses in). These languages were tabulated by giving each level a score (3-ability to take engineering courses, 2-basic conversation, 1-a few words) and the averages were calculated and are shown below.

Table 1. Demographic data of student participants in the Michigan Tech's undergraduate and graduate international community engagement programs. Language proficiency is self-evaluated on a scale of 0=none, 1=a few words, 2=basic conversation, 3=ability to take an engineering course.

Descriptor	Undergraduate	Graduate
# Students	26	23
% Women	54%	52%
Average total time traveling abroad (weeks)	9.4	32.1
Average language proficiency	2.3	2.8

B. Identity-Motivations

a. General Findings

An overall frequency report of motivational codes was generated using HyperRESEARCH™ to better understand potential influences of independent variables (gender, program, and past international experience). Generally, the participation motivations seemed to be moderately influenced by past international experience, mildly by their class level, and not influenced by gender at all. The figures and tables below show the results of the code analyses of student motivation essays by experimental variable (gender, class, experience). See Appendix A for the list of all codes (motivations) and Appendix B for the raw pie charts depicting all codes within the groupings. While the top reason is idealistically focused ("helping others"), the rest are pragmatically focused professional and personal drivers.

The top five reasons students participate in these programs are shown in Table 2 and include: helping others, personal goal, a desire to work abroad, a career goal, a desire to solve problems and to gain hands on experience. A common statement was the desire to *make a difference and to use engineering to accomplish that goal* for their community

partners, but also for them as students. There was also a kind of camaraderie that came with belonging to a group of like-minded students motivated to accomplish goals for similar reasons, which goes above and beyond the required expectations for graduation. While these generalities provide an interesting first look, the remainder of the paper and presentation will provide more nuanced discoveries by gender, cultural experience, and academic level.

Additionally, a glance at the overall breakdown of students' motivations shows that there are three main motivations: helping others, personal goal, and desire to work abroad (see Appendix A for further code descriptions). A further examination of the entire list suggests that career goals, solving problems, and hands on experience are also high motivators for students to become involved with international programs (Table 1). A further breakdown of the results can be found in Appendix B. As discussed within the remainder of this paper, this information can be used to better design and market these programs to future students.

Table 2. Top motivation essay codes as response to reasons for participation in an international service program (n=300 code tags for 45 student essays across both programs at Michigan Tech)

Motivation (code)	Frequency
Helping others	15%
Personal Goal	10%
Desire to work abroad	10%
Career Goal	8%
Solving problems	6%
Hands on Experience	6%

b. Gender Influences

Despite decades of effort, the engineering field is still dominated by white men.[20,21-22] Intriguingly, CE programs, especially international ones, are disproportionately comprised of women, typically around 50%.[8-10,23] A better understanding of what is attracting females to (and retaining them in) these programs could create a pathway enabling universities to effectively create student bodies more representative of society. The evaluation of the gender-filtered code frequency reports effectively illuminate what attracts males and females to the two programs at Michigan Tech; these are likely a representation of what could be seen at other universities in other programs similar to these, but a greater study pool will elevate the confidence of generalized findings. Table 3 reveals motivations by gender. In this study, both gender cohorts are similarly sized, female participation in both the undergraduate and graduate programs is strong (54% and 52%, respectively, see Table 1). Analysis of the motivations suggests that the top three reasons are exactly the same (but in slightly different order), although the breakdown for the fourth and fifth reasons differs. Males and females alike agree that helping others, their desire to work abroad, and their own personal goals (e.g. Students claim they've

always wanted to pursue program X, from a young age they knew they wanted to be an engineer and this program helped fulfill that goal, or they've always wanted to travel and these programs enabled that, etc.) are the main three reasons that motivate them to participate in these programs. These top three reasons account for 37% of the motivation reasons mentioned by males and about 34% of those from females.

Due to the similarity of the responses for the top three reasons, the fourth and fifth ranked reasons (several reasons have tied for each place) were further examined. For the males these include alignment with career goals, the desire to solve problems, and getting hands-on experience. For the females this also includes alignment with career goals and their desire to help a community with their needs. Some similarities between males and females are evident in this second tier of reasons, but the few differences are noteworthy. Obtaining experience for career goals is a mutual interest of males and females; universities should work to attract students to these programs using career goals as an incentive. Additionally, females are drawn to the ability to help communities with their needs; universities could use this to further attract females to engineering (e.g. relating engineering practice to helping communities).

Table 3. Top five motivations expressed by men and women; rank (frequency), n=300 code tags within 45 student essays from both programs at Michigan Tech

Motivation (code)	Female	Male
Helping others	1 (14%)	1 (17%)
Personal goal	2 (11%)	3 (9%)
Desire to work abroad	3 (9%)	2 (11%)
Career goal	4 (8%)	4 (7%)
Community need	5 (7%)	
Solving problems		4 (7%)
Hands-on experience		5 (6%)

c. Academic Level Influences

Studies reveal that fewer American students are pursuing advanced engineering degrees.[24-25] As part of the graduate program within this study, students have the option to pursue a higher level degree while gaining international experience. Understanding what the motivations are of the two levels of students might help encourage students to explore these experiences and continue their education at the graduate level. The top three motivations were found to be similar for undergraduates and graduates; they are motivated by helping others, their desire to work abroad, their own personal goals, and additionally by solving problems.

Since the top reasons were insensitive to class level, the second tier reasons were further examined. Undergraduates were found to be equally motivated by their career aspirations (career goal, solving problems, and class influence) and personal interests (community need, and hands on experience. Graduates were motivated by more intrinsic factors (the influence of a class, their interest in helping communities with their needs, and their

desire to work abroad). Universities with such programs should ensure alumni of these programs are exposed to potential non-traditional careers (international, non-profit, etc.).

Table 4. Top three motivations expressed by undergraduate and graduate students; rank (frequency), n=300 code tags within 45 student essays

Motivation (code)	Undergraduate	Graduate
Helping others	1 (16%)	1 (15%)
Personal goal	3 (10%)	2 (11%)
Desire to work abroad	2 (11%)	4 (8%)
Career goal	4 (9%)	5 (6%)
Community need	6 (6%)	6 (5%)
Solving problems	7 (5%)	3 (9%)
Hands on experience	5 (7%)	7 (3%)
Class Influence	8 (4%)	5 (6%)

d. Past International Experience Influences

Once students become involved with international programs it is often difficult to go back to their daily lives without craving more. Students who have previously had international opportunities were also analyzed to determine what their motivations were for becoming involved with each of these two programs in hopes of better understanding the feedback cycle of past international experience begetting future experiences. Students were broken up into three categories for this category of analysis: low (0 to 10 weeks), medium (10 to 30 weeks) and high (above 30 weeks) international experience. The frequency results show these programs attract a fair amount from each level with the graduate program attracting more experienced students. Some students are interested in sampling such experiences for the first time, many others are returning for more. If the experiences are positive (and challenging based on motivations listed by graduate students in Table 4, for example), the biggest hurdle is crafting first experiences, then a virtuous cycle of involvement can be catalyzed.

Similarly to previous sections, top reasons for all international experience levels are helping others, desire to work abroad, and personal goal. Yet further examination reveals a few interesting differences. Desire to help others ("helping others") *decreases* with experience, this may be rooted in an appreciation of the realities of development work (partnership oriented vs. "helping"). The most experienced students ranked a desire to work abroad most highly. From these preliminary observations it seems that new (less experienced) students may connect more with an "engineering philanthropy" goal, whereas experienced students are looking for "engineering development." Regardless of their mindset, encouraging students to become involved with these programs because of the opportunity to gain valuable experience should be attractive.

Table 5. Top five motivations expressed by students with low, medium, and high international experience; rank (frequency), n=300 code tags within 45 student essays from two programs at Michigan Tech

Motivation (code)	High	Medium	Low
Helping others	1 (13%)	1 (16%)	1 (16%)
Personal goal	3 (9%)	3 (9%)	2 (12%)
Desire to work abroad	1 (13%)	4 (7%)	3 (10%)
Career goal	2 (11%)	2 (13%)	5 (5%)
Community need	4 (6%)	5 (6%)	5 (5%)
Solving problems	4 (6%)	5 (6%)	4 (6%)
Hands-on experience	4 (6%)	5 (6%)	4 (6%)
Class influence	5 (4%)	4 (7%)	6 (3%)

C. Attitude-Readiness

Students were asked to complete a readiness assessment in order to further evaluate their motivations for pursuing these programs as well as to look into preparation effectiveness, and potential team and project partnership issues. The motivations previously discussed in this paper serve as additional understanding to the readiness of participants in these programs. The Readiness assessment is comprised of 20 Likert-scale (Strongly disagree= -3 to Strongly agree=3). Included in the assessment were negatively phrased questions to eliminate bias in the data and ensure understanding of the questions being posed. These questions were tabulated and the results are displayed in Figure 1 below. It was found that the self-assessment of readiness for graduate students was lower than undergraduate students. This could imply that graduate students are more realistic about their upcoming CE experience. Additionally, undergraduate students were assessing themselves for a two week out-of-country program, whereas the graduate students were assessing for seven semesters (27months) abroad, which could provide further insight as to why graduate students scored lower than undergraduates.

D. Skills-Intercultural Competency

An overall frequency report of the percent change between the pre- and post-developmental Intercultural Development Inventory (IDI) scores was generated to better understand the distribution of scores amongst the graduate (pre n=23, post n=19) and undergraduate (pre n=26, post n=20) student groups. Actual and perceived competencies are reported, only the former are used herein. The hope of measuring the IDI pre- and post- fieldwork would be to see some improvement to show that the students engaged in these programs are gaining a better understanding of how to work with someone who has a different worldview, culture, or life experiences and to shed some light on their motivations for participating in the program. For the graduate students, the post scores represent their score at the time they are completing coursework prior to leaving for fieldwork, while the undergraduate post scores are upon the completion of their

community projects. Post-project scores for graduate students will be available following their Peace Corps service (more than two years from now).

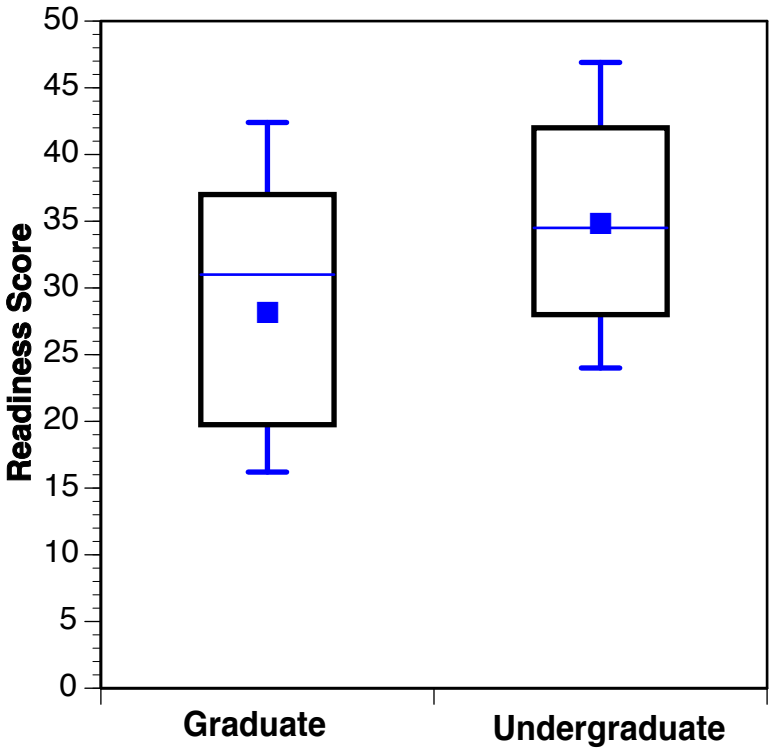


Figure 1. Graduate (n=21) and undergraduate (n=26) readiness scores

a. Program Influence

The IDI scores for program participants are presented in Figure 2. The boxplots depict the range in IDI score for both the grad and undergraduate groups increase from pre to post. The graduate students averages increase over the course of their time on campus, suggesting that that are becoming more culturally aware and are more prepared to work with people of different worldviews. However, the undergraduate average decreases from pre to post international experience. While the reasons for this are less than certain, preliminary findings from post experience interviews suggest many students have broadened their worldview and realize there is a lot they have to learn.

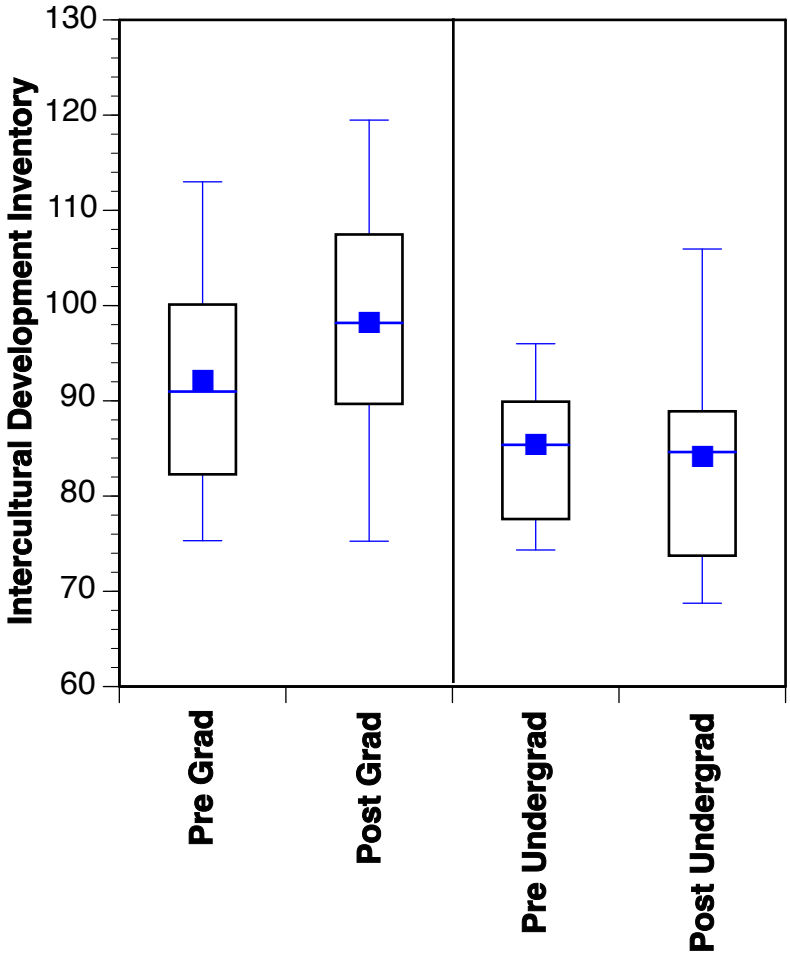


Figure 2. Pre and post IDI scores for graduate (pre n=23, post n=19) and undergraduate (pre n=26, post n=20).

b. Gender Influence

Gender influences were also evaluated to determine if there were differences between males and females in terms of intercultural awareness. Figures 3 and 4 depict the results found. From Figure 3 it is apparent that both groups of male students (undergraduate and graduate) showed little change in median scores from pre to post. In general, males exhibit no gains. The median for undergraduate males actually decreases (becoming more ethnocentric) post-international experience, although a few individuals did increase (become more ethnorelative). Additional work is examining potential causes of this intercultural regression. It is clear that the on-campus training have little impact on the intercultural competency of male graduate students; continued assessment will reveal whether their extended time abroad will have more impact. The opposite is true for females as depicted in Figure 4. Female graduate students seem to gain considerably from coursework, with female grad students displaying a strong increase in IDI scores. Although not as greatly as their male counterparts, undergraduate females were found to have lower post-experience scores too.

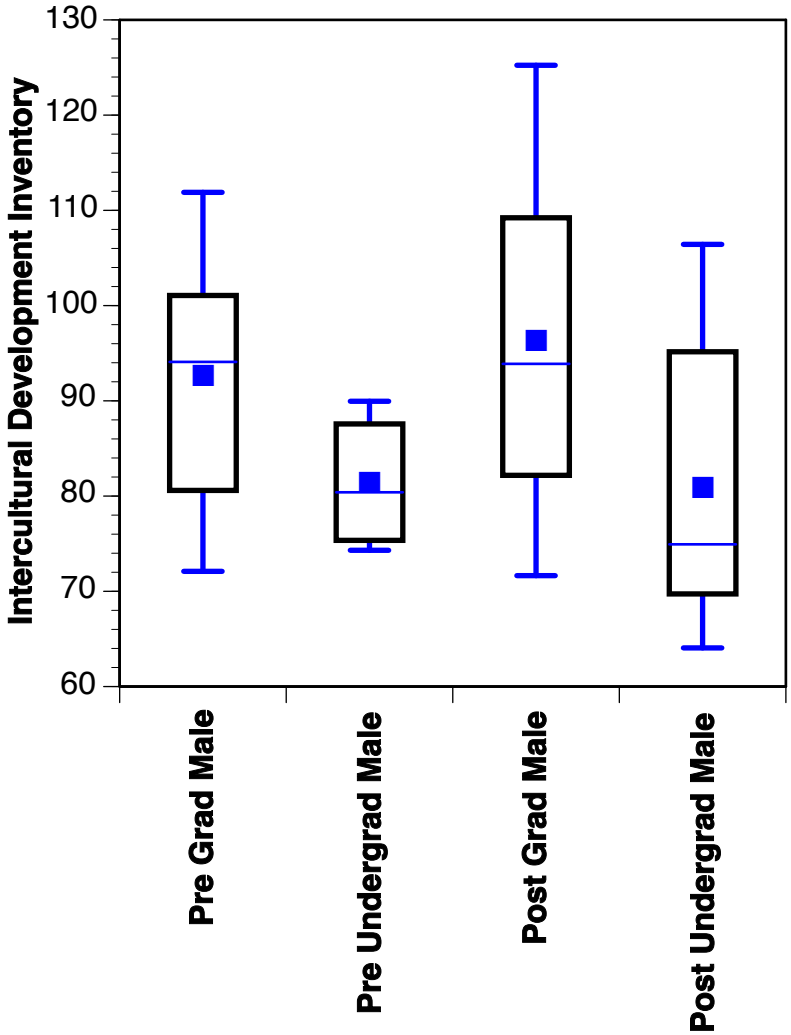


Figure 3. Pre and post IDI scores for male graduate (pre n=23, post n=19) and undergraduate (pre n=12, post n=10).

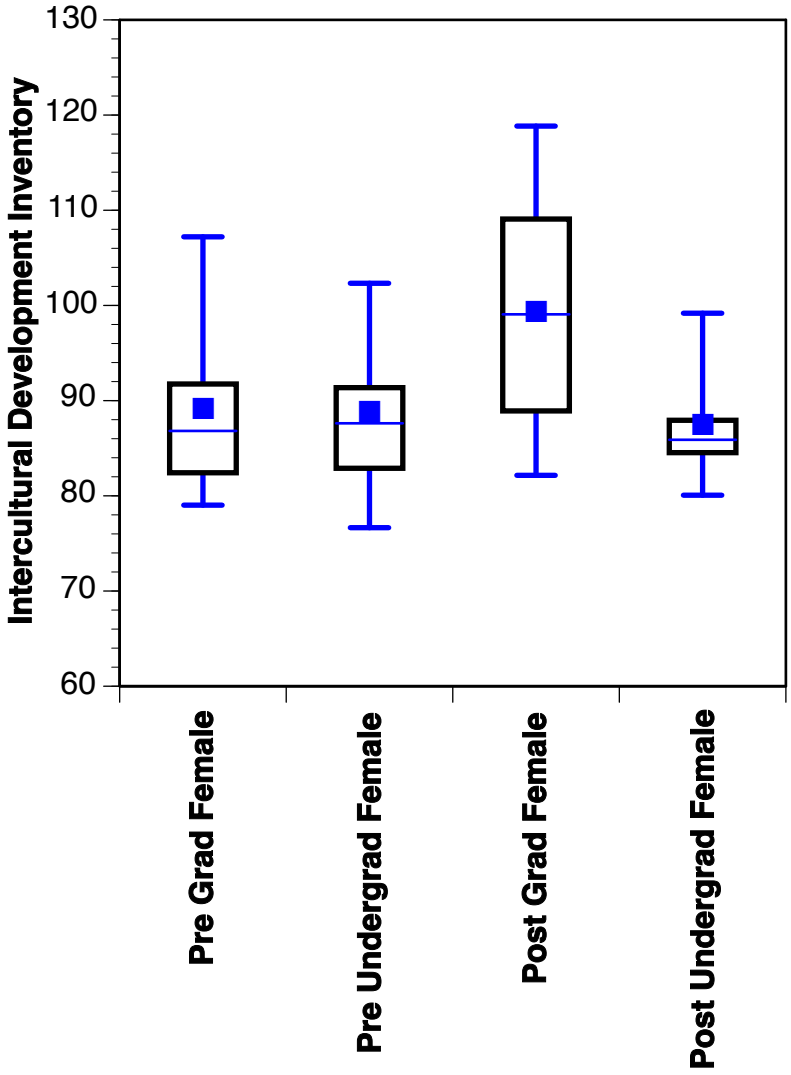


Figure 4. Pre and post IDI scores for female graduate (pre n=23, post n=19) and undergraduate (pre n=14, post n=10).

c. International Experience Influence

The three categories for international experience were also evaluated to determine if there were significant differences between the two programs and gender within low, medium, and high international experience categories. Figure 5 depicts the students from both programs delineated by international experience. It is apparent the IDI increased from pre to post for those with lowest experience, with little change for the medium and high experience groups. Figures 6 through 8 further break down the categories for graduate and undergraduate students. In all three categories the graduate students increase from pre to post, however, this is not the case for the undergraduates. With the exception of the Low category, the undergraduates decrease their scores from pre to post. Additionally, the undergraduates narrow the range between the 25th and 75th percentiles. These observations may suggest that undergraduate students of medium and higher levels (or any with decreasing scores) may have had an unsettling international experience during

their fieldwork, or their past international experiences had little merit for the type of experience within these programs, despite their duration. It is possible that all of their international experience was from other varieties of travel (e.g. tourism with family, study abroad, etc.) which may be ineffective, or counterproductive, preparation for international community engagement. Finally, Figures 9 and 10 depict the breakdown of females and males within Low, Medium, and High experience. Figure 8 shows, with the exception of Medium, females' pre to post average scores increase. The largest average increase occurred within the high international experience group. Males depicted a similar pattern in Figure 10, the Low and Medium categories increased from pre to post, while the High average decreased from pre to post. However, the range for Low, Medium, and High all increased from pre to post.

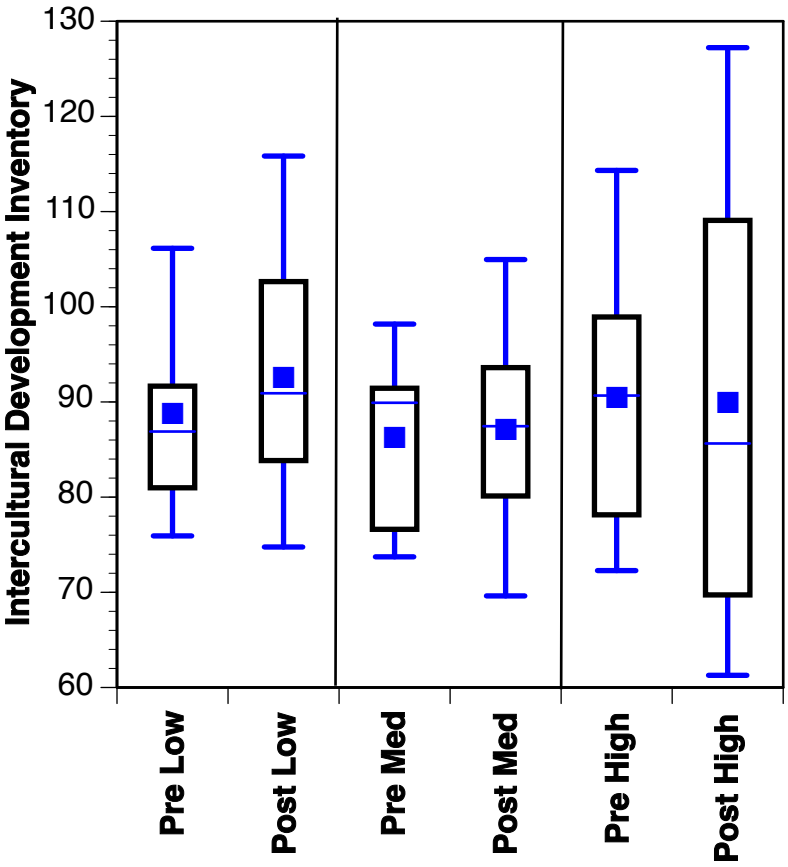


Figure 5. Pre and post IDI scores for students with low (pre n=29, post n=22), medium (pre n=11, post n=22), and high (pre n=7, post n=6) international experience.

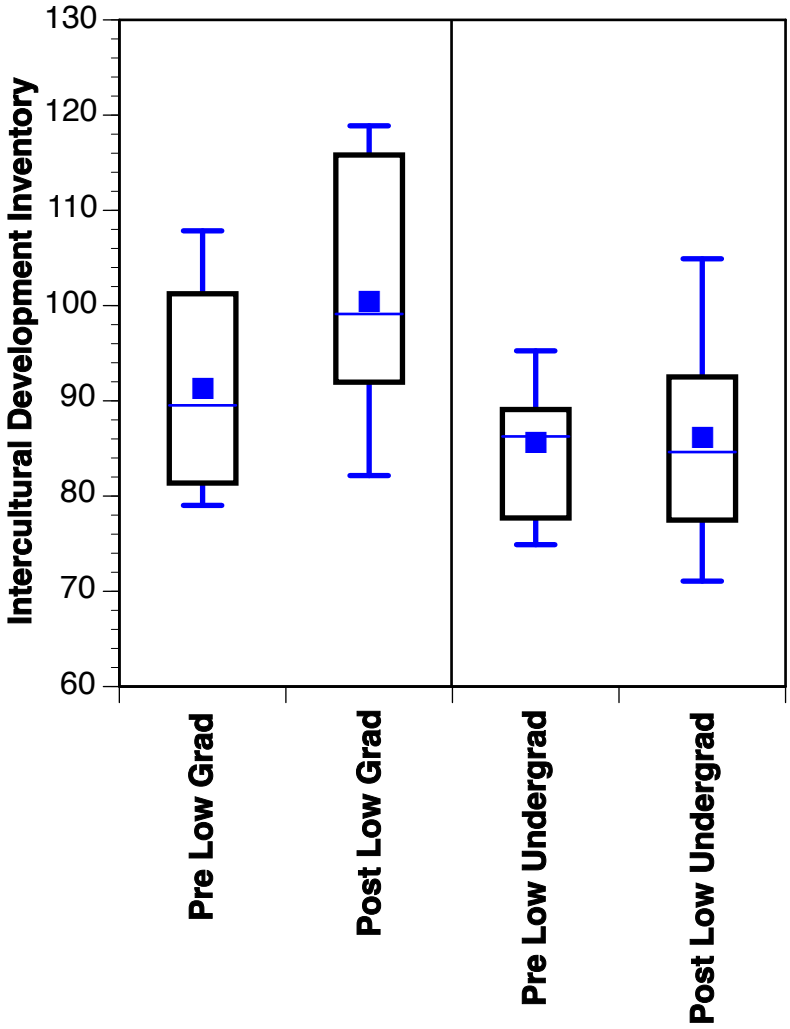


Figure 6. Pre and post IDI scores graduate (pre n=12, post n=10) and undergraduate students (pre n=17, post n=12) with low international experience.

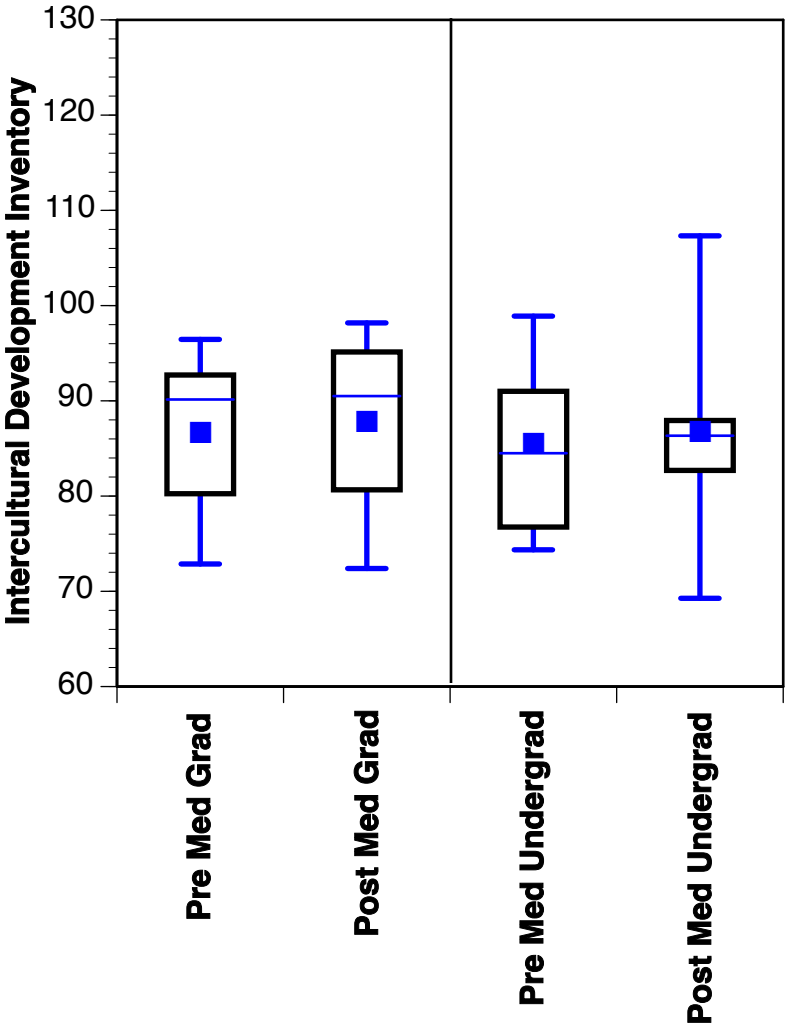


Figure 7. Pre and post IDI scores for graduate (pre n=5, post n=4) and undergraduate students (pre n=6, post n=5) with medium international experience.

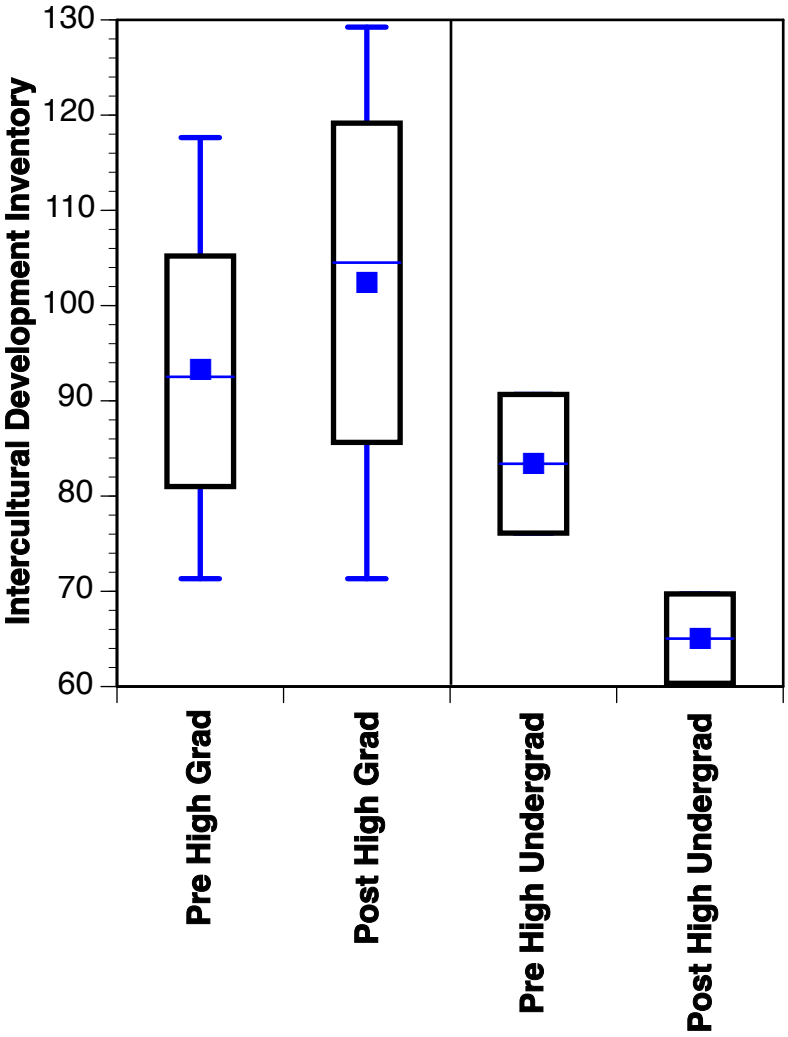


Figure 8. Pre and post IDI scores for graduate (pre n=5, post n=4) and undergraduate students (pre n=2, post n=2) with high international experience.

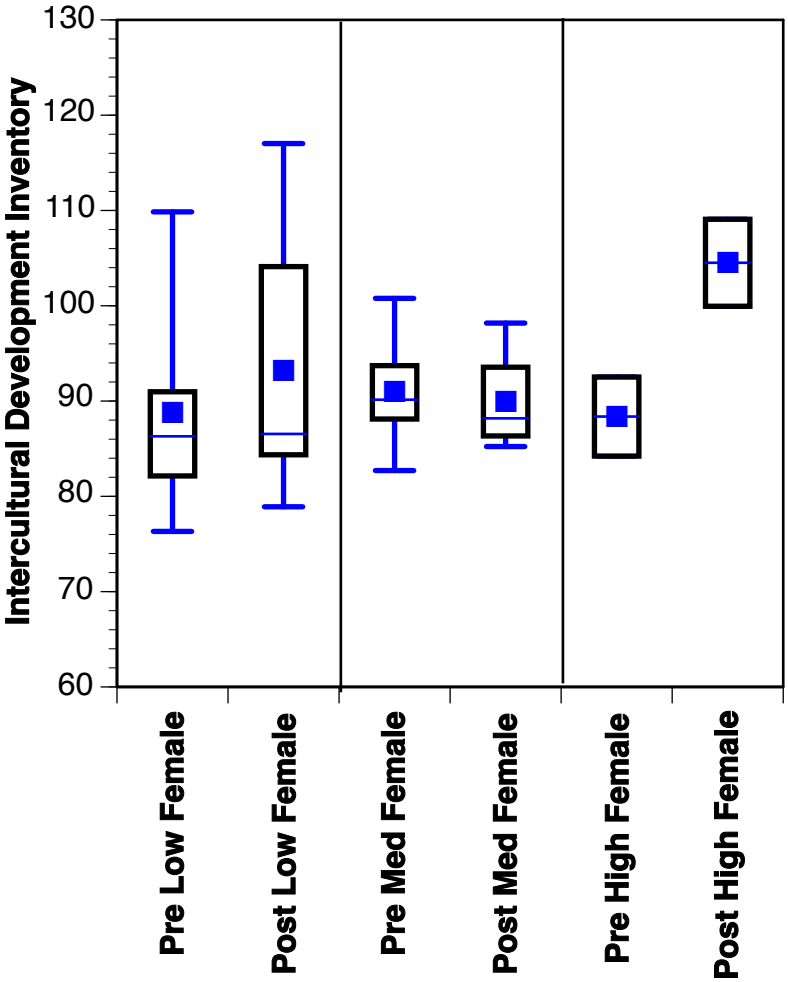


Figure 9. Pre and post IDI scores for female students with low (pre n=17, post n=12), medium (pre n=5, post n=4), and high (pre n=2, post n=2) international experience.

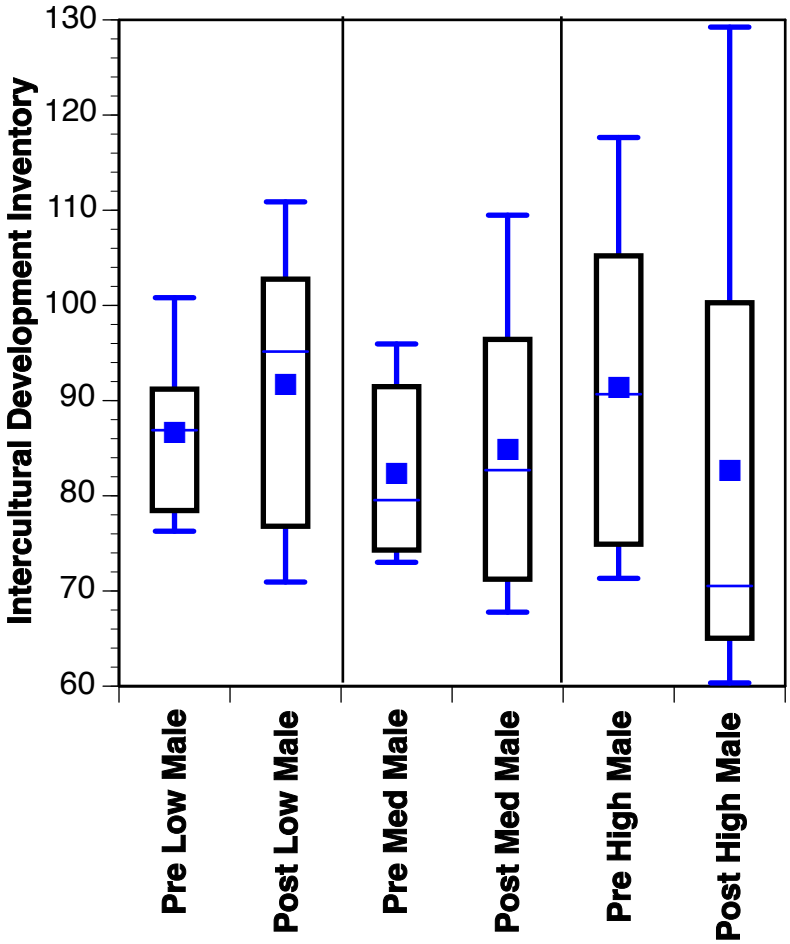


Figure 10. Pre and post IDI scores for male students with low (pre n=11, post n=9), medium (pre n=6, post n=5), and high (pre n=5, post n=4) international experience.

6. Conclusions

The students in two international community engagement programs were assessed to better understand their motivation, readiness and intercultural competency. Motivations analyzed within this study can indicate where efforts should be focused to meet the needs of students to encourage their participation, as well as better prepare students to make meaningful community contributions, all while benefitting professionally and personally. Additionally, understanding student motivations can be used to attract more students in future years, while personalizing the program to meet the motivations of the incoming students. The intercultural competency assessment can provide further insight into the readiness of engineering students to work effectively in international communities; while there are some exceptionally ethnorelative students, most engineering students could benefit from targeted training in this arena. Michigan Tech has debuted a new course called Cultural Dimensions of International Immersion to address this (for our graduate students only, so far). Michigan Tech is using its evaluation program to allow program administrators and designers to improve existing, and create future, experiences. Future studies will expand the student participant pool (new cohorts), look at post fieldwork outcomes for the graduate program, and incorporate other assessment media (design

reports, theses, presentations, field journals, photographs, etc.). This preliminary assessment completed at Michigan Tech will be continued to assess post-program attitudes and lives of alumni, expanding it to other similar international programs within the university, and offered to other universities, all with a desire to share best practices in international community engagement, enhance the sustainability of such programs, and most importantly, make meaningful contributions to communities around the world.[26]

References

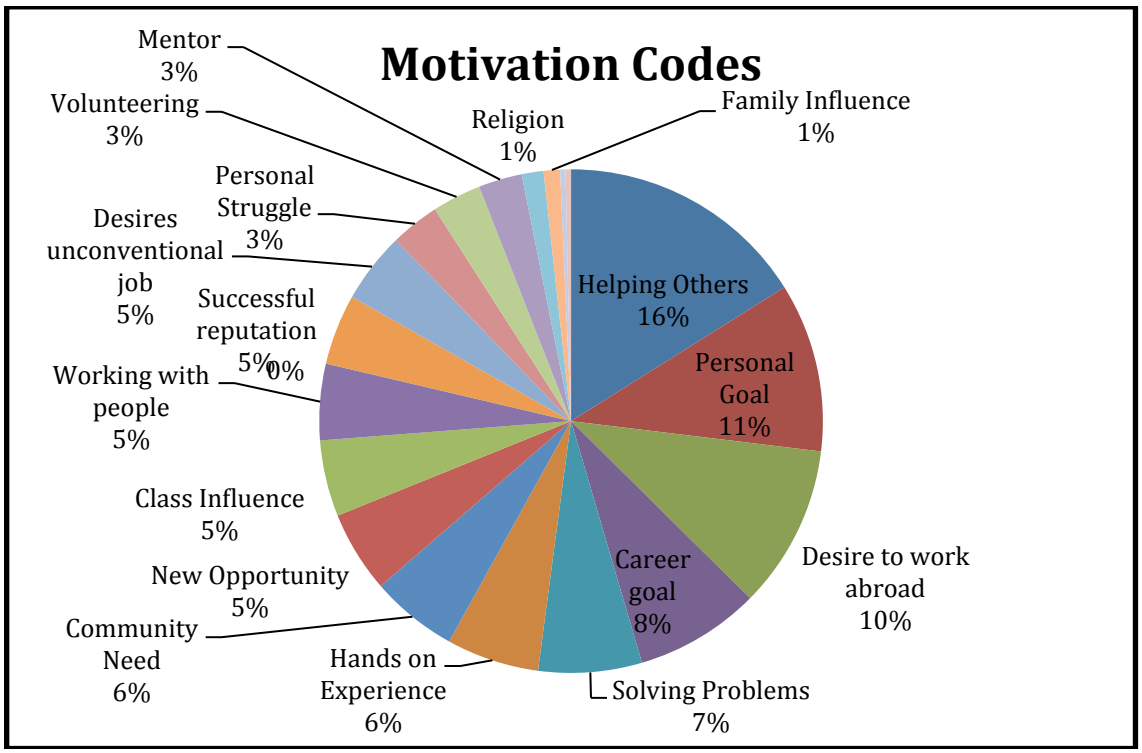
1. Boyer, E. L. (1996). The Scholarship of Engagement. *Bulletin of the American Academy of Arts and Sciences*, 49(7):18-33.
2. Grandin, J. M., and E.D. Hirleman. (2009). Educating Engineers as Global Citizens: A Call for Action / A Report of the National Summit Meeting on the Globalization of Engineering Education. *Online Journal of Global Engineering Education*. 4(1): 10-25. Available at http://digitalcommons.uri.edu/ojgee/vol4/iss1/1/ (Accessed August 9, 2011)
3. Katehi, L. The Global Engineer (2005). In *Educating the Engineer of 2020: Adapting Engineering Education to the New Century* (151-155). The National Academies Press, Washington, DC.
4. Sigma Xi. *Embracing Globalization: Assuring a Globally Engaged Science and Engineering Workforce* (Workshop Report). Sigma Xi, Washington, DC. 2007.
5. Vest, C.M. (2006). Educating Engineers for 2020 and Beyond. *The Bridge: Linking Engineering and Society.* National Academy of Engineering. 36(2):38-44
6. Paterson, K., C. O'Holleran, and C. Leslie (2010). *Faculty Impressions of Service Learning in Engineering Education*. Proceedings of the American Society for Engineering Education Annual Conference. Louisville, KY. AC2010-2033, 8 pp.
7. Silliman, S., R.Mohtar, K.G. Paterson, and W. Ball (2010). *Engineering Academic Programs for Hydrophilanthropy: Commonalities and Challenges.* Journal of Contemporary Water Research and Education. 145:5-29. (I)
8. Bielefeldt, A.R., K.G. Paterson, and C.W. Swan (2010). *Measuring the Value Added from Service Learning in Project-Based Engineering Education*. International Journal of Engineering Education. In Special Issue on Problem-Based Learning, 26(3):1-12. (I)
9. Paterson, K.G. and V.J. Fuchs (2008). *Development for the Other 80%: Engineering Hope*, Australasian Journal of Engineering Education. 14(1):1-12.
10. Parkinson, A. Engineering Study Abroad Programs: Formats, Challenges, Best Practices. *Global Journal of Engineering Education*, 2(2): 1-15.
11. Jesiek, B.K., Chang, Y., Shen, Y., Lin, J.J.J., Hirlemann, E.D., and E.A. Groll (2011). International Research and Education in Engineering (IREE) 2010 China: Developing Globally Competent Engineering Researchers. *Proceedings of the American Society for Engineering Education Annual Conference*. Vancouver, BC. AC2011-1975. 14 pp.
12. Paterson, K. and C. Swan (2011). ISES-A Longitudinal Study to Measure the Impacts of Service on Engineering Students. *Proceedings of the American Society for Engineering Education Annual Conference*. Vancouver, BC. AC2011-1328.
13. ResearchWare, Inc. (2010). *HyperRESEARCH User Guide*, *ver.3*. Randolph, MA. 171 pp.
14. Saldaña, Johnny. *The Coding Manual for Qualitative Researchers*. London: Sage, 2009. Print.
15. Guzak, K. and K.G. Paterson (2011).*Learning Through Service Student Motivations*, ASEE North Midwest Conference
16. Miville, M. L., Gelso, C. J., Pannu, R., Liu, W., Touradji, P., Holloway, P., et al. (1999). Appreciating similarities and valuing differences: The Miville-Guzman Universality-diversity Scale. *Journal of Counseling Psychology*, 46 (3), 291-307.
17. Bennett, M. J. (1993). Towards ethnorelativism: A developmental model of intercultural sensitivity, in R. M. Paige (Ed.), *Education for the intercultural experience*, Intercultural Press, Yarmouth, ME, pp. 21-71.
18. Hammer, M.R., M.J. Bennett and R. Wiseman (2003). Measuring intercultural sensitivity: The

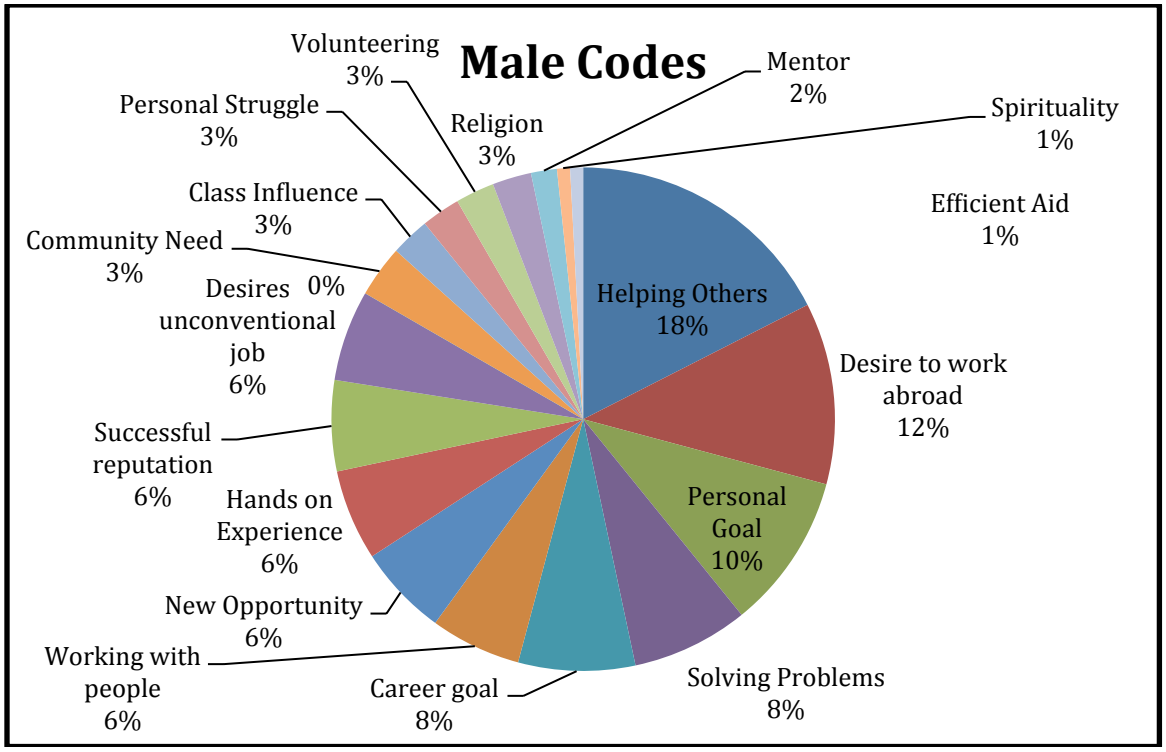
intercultural development inventory. *International Journal of Intercultural Relations*. 27(4): 421-443.
19. Lohmann, Jack R., Howard A. Rollins, Jr., and Joseph Hoey (2006). Defining, developing and assessing global competence in engineers. *European Journal of Engineering Education*. 31(1): 119-131.
20. Jordan, K.L., Amato-Henderson, S., Sorby, S.A. and T.L. Haut Donahue (2011). Are there differences in self-efficacy between minority and majority students across academic levels? *Proceedings of the American Society for Engineering Education Annual Conference*. Vancouver, BC. AC2011-659. 13 pp.
21. National Academy of Engineering (2008). *Changing the Conversation: Messages for Improving Public Understanding of Engineering*, Committee on the Public Understanding of Engineering Messages. National Academies Press, Washington, DC. 149 pp.
22. Besterfield-Scare, M., Moreno, M., Shuman, L., and C. Atman (2001). Gender and ethnicity differences in freshmen engineering student attitudes: a cross-institutional study. *Journal of Engineering Education*. 90(4):477-489.
23. Busch-Vishniac, I. J. and J. P. Jarosz (2004). Can Diversity in the Undergraduate Engineering Population Be Enhanced Through Curricular Change? *Journal of Women and Minorities in Science and Engineering*, 10(3):50-77.
24. National Science Board (2008). *Science and Engineering Indicators 2008*. Volumes 1 and 2. National Science Foundation, Arlington, VA. 1164 pp.
25. National Science Foundation (2011). *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2011*, National Science Foundation, Arlington, VA. 16 pp.
26. National Academy of Engineering (2009). *Developing Metrics for Assessing Engineering Instruction: What gets measured is what gets improved*. National Academy Press, Washington, DC. 52 pp.

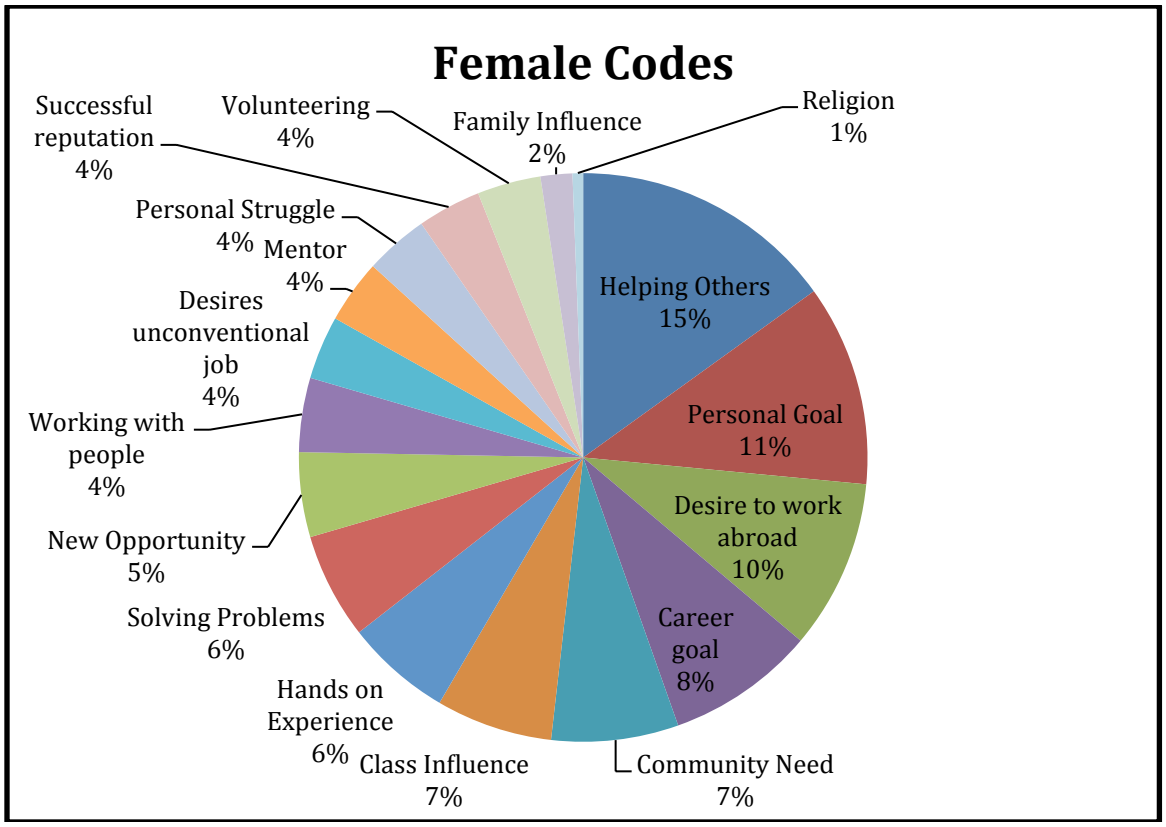
Appendix A: Code Descriptions

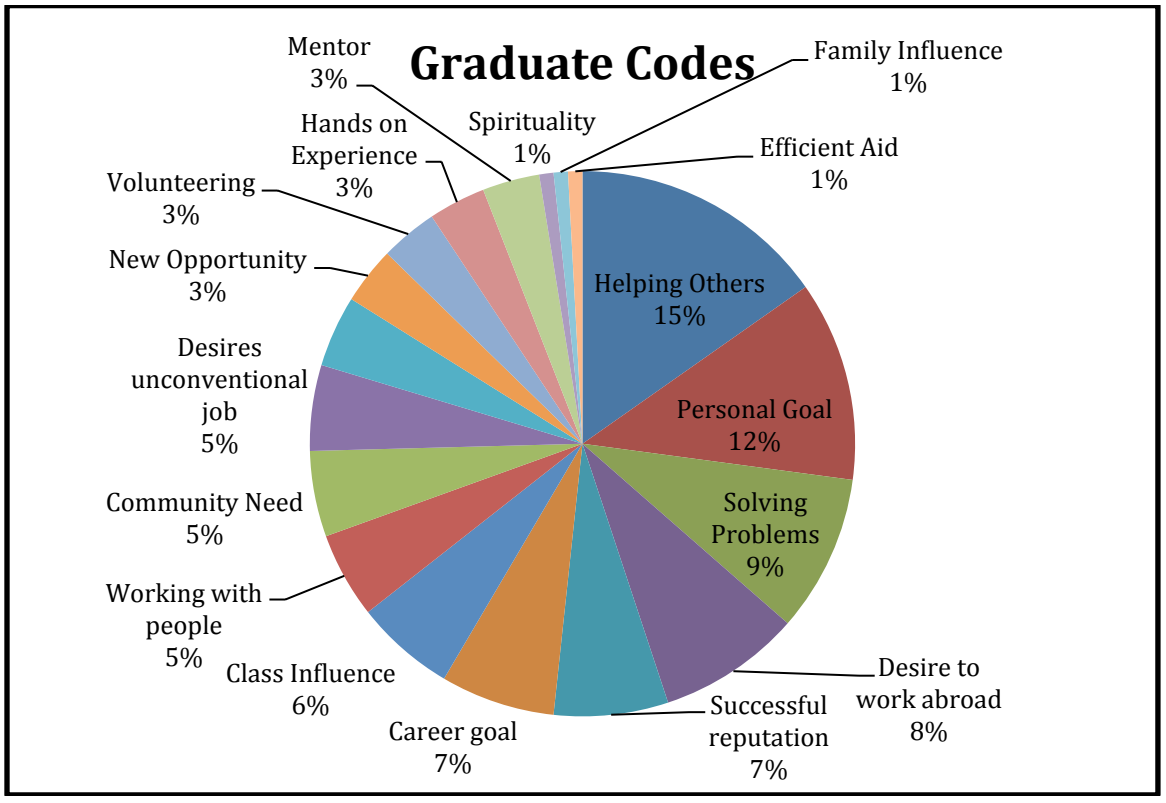
Career goal	Personal ambition, international experience will help with resume or other forms of career aspirations
Class influence	Within a class it was suggested that international experiences are beneficial
Community need	A desire to work with people to get them what they need as opposed to giving them what is thought they need
Desire to work abroad	Personal ambition to work outside of the United States
Desires unconventional job	Personal ambition to work in a setting that is atypical of the engineering 9 to 5 job
Efficient aid	A desire to work with the people to get them what they need even if this means not personally traveling
Family influence	Family members suggest the importance of international experiences
Hands on experience	A desire to use the material learned in class out in the field to solve real problems
Helping others	A desire to assist people other than oneself
Mentor	An outside source like a professor or advisor suggests that international experiences are useful
New opportunity	The prospect of experiencing something outside the ordinary
Personal goal	Individual ambition to do something internationally
Personal struggle	Individual problems one must overcome while working internationally
Religion	A religious belief impacts the desire to work abroad through the desire to help, teach, learn, etc.
Solving problems	A desire to work with circumstances to overcome obstacles others face
Spirituality	Trying to find some sense of purpose, meaning and structure to life
Successful reputation	The reputation of the international program precedes itself, encouraging students to participate
Volunteering	The desire to give one's time
Working with people	The desire to work with others to reach a common goal and learn from each other

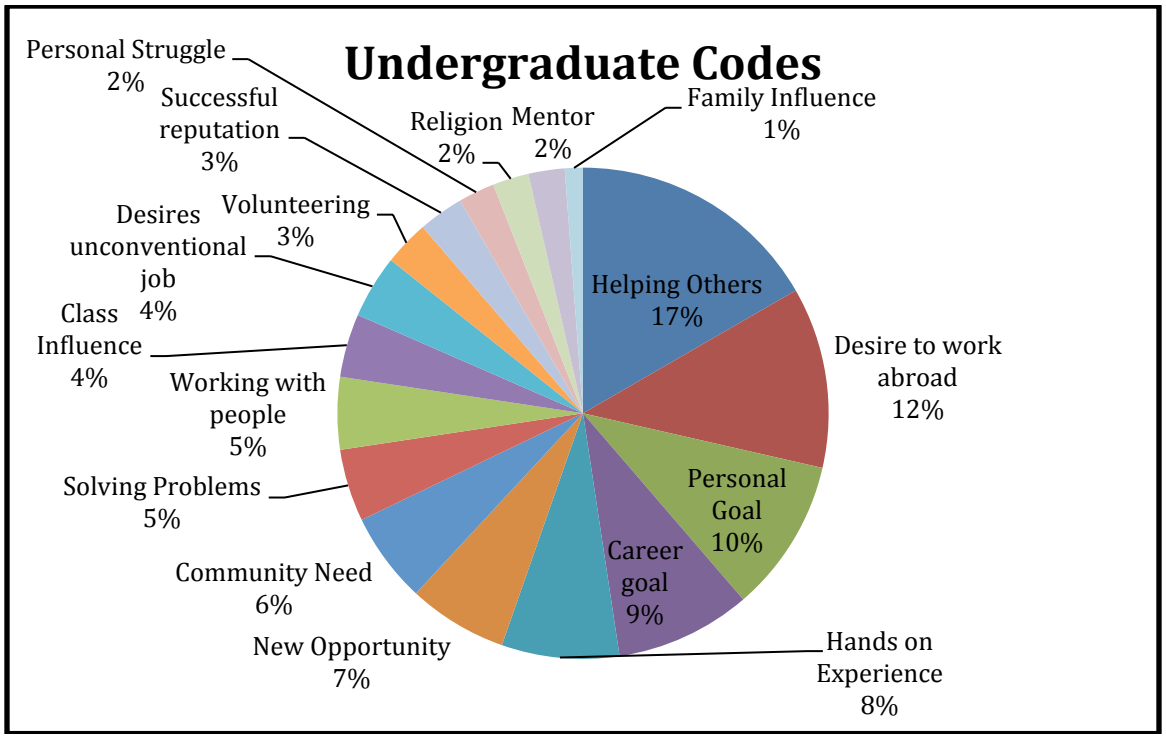
Appendix B: Detailed Charts



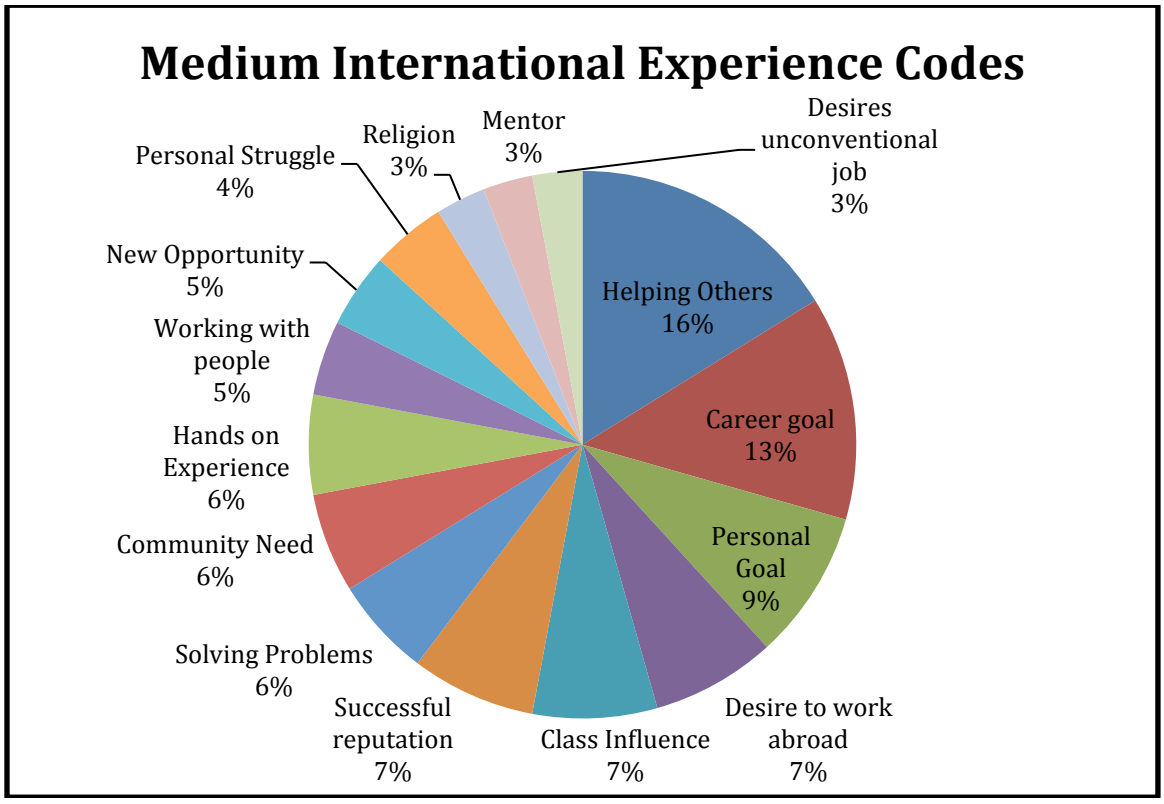


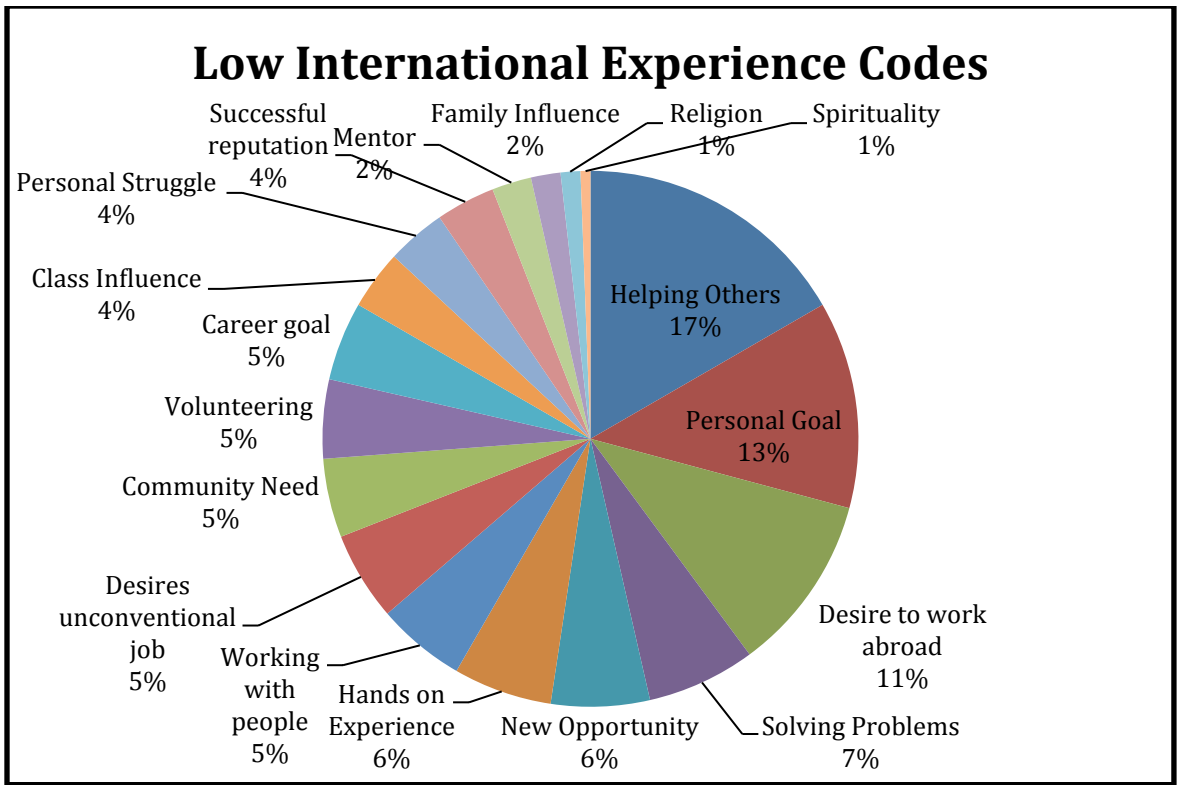

Female Codes
Helping Others 15%
Personal Goal 11%
Desire to work abroad 10%
Career goal 8%
Community Need 7%
Class Influence 7%
Hands on Experience 6%
Solving Problems 6%
New Opportunity 5%
Working with people 4%
Desires unconventional job 4%
Mentor 4%
Personal Struggle 4%
Successful reputation 4%
Volunteering 4%
Family Influence 2%
Religion 1%


Graduate Codes
Helping Others 15%
Personal Goal 12%
Solving Problems 9%
Desire to work abroad 8%
Successful reputation 7%
Career goal 7%
Class Influence 6%
Working with people 5%
Community Need 5%
Desires unconventional job 5%
New Opportunity 3%
Volunteering 3%
Hands on Experience 3%
Mentor 3%
Spirituality 1%
Efficient Aid 1%
Family Influence 1%


Undergraduate Codes
Personal Struggle 2%
Successful reputation 3%
Religion 2%
Mentor 2%
Family Influence 1%
Desires unconventional job 4%
Volunteering 3%
Class Influence 4%
Working with people 5%
Solving Problems 5%
Community Need 6%
New Opportunity 7%
Helping Others 17%
Desire to work abroad 12%
Personal Goal 10%
Career goal 9%
Hands on Experience 8%

High International Experience Codes
New Opportunity 3%
Volunteering 2%
Mentor 2%
Efficient Aid 2%
Desires unconventional job 5%
Successful reputation 5%
Working with people 5%
Class Influence 5%
Community Need 7%
Hands on Experience 7%
Solving Problems 7%
Helping Others 14%
Desire to work abroad 14%
Career goal 12%
Personal Goal 10%


Medium International Experience Codes
Desires unconventional job 3%
Mentor 3%
Religion 3%
Personal Struggle 4%
New Opportunity 5%
Working with people 5%
Hands on Experience 6%
Community Need 6%
Solving Problems 6%
Successful reputation 7%
Class Influence 7%
Desire to work abroad 7%
Personal Goal 9%
Career goal 13%
Helping Others 16%


Low International Experience Codes
Spirituality 1%
Religion 1%
Family Influence 2%
Mentor 2%
Successful reputation 4%
Personal Struggle 4%
Class Influence 4%
Career goal 5%
Volunteering 5%
Community Need 5%
Desires unconventional job 5%
Working with people 5%
Hands on Experience 6%
New Opportunity 6%
Solving Problems 7%
Desire to work abroad 11%
Personal Goal 13%
Helping Others 17%