

## **Improving the Global Competency of Engineers through the Peace Corps Master's International Program**

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### **Abstract**

As society addresses the major challenges associated with food, water, energy and climate change there is an increasing need for engineers that are interdisciplinary and globally competent. The Master's International Program (MIP) at the University of South Florida (USF) is a graduate partnership with the U.S. Peace Corps that provides over two years of supervised professional service and international research experiences that include specialized training in language, culture, participatory planning, and sustainable development. The students gain a global perspective while performing research in an international context of economic, social, and environmental limitations. Using a survey tool with quantitative and qualitative metrics, this study assessed the effectiveness of global competency training for engineering students in the MIP at USF. Results show that students were able to identify the development of core global competencies, outlined by the National Research Council, throughout the MIP.

### **Keywords**

Global Competency, Sustainable Development, Engineering Education, Master's International Program, Peace Corps

### **Introduction**

The foundations and fundamentals of engineering are universal; however, the successful application of all engineering disciplines highly depends on the cultural context in which it is occurring, calling for the development of global competency skills for engineering students. Global competency is defined here as the ability for an engineering student to understand and work effectively with engineers and other co-workers from countries other than the student's own country, especially those who may solve and define problems differently than the student<sup>1</sup>. This paradigm is becoming increasingly evident as society addresses the major challenges associated with food, water, energy and climate change through multi-disciplinary strategies involving engineers, anthropologists, public health professionals and other related sciences in geographic or cultural settings that are unique from their training.

The National Research Council established the following four core competencies as a framework to develop globally competent engineers at the undergraduate and graduate levels: 1) development of language and cultural skills, 2) teamwork and group dynamics, 3) knowledge of international business and engineering cultures, and 4) knowledge of variations in international engineering education and practice<sup>2</sup>. Based upon this structure, several engineering programs have responded using various methods to address these global competencies. Georgia Institute

of Technology, for example, offers a Global Studies Certificate that focuses on international relations and the global economy through language training in addition to a capstone course and 26 weeks of study abroad. Other universities, such as Florida State University, Lehigh University, University of Texas–Tyler, University of Rhode Island, Michigan Technological University and University of Pittsburgh also have developed curriculums that cultivate core global competency skills through intensive coursework, projects and/or thesis work, and international study-abroad experiences. The main issue with some of these programs, however, is the duration of the international experience and the amount of training that the student receives before embarking abroad. For example, in 2012, 341,284 U.S. students participated in some form of international study abroad program (4% engineering discipline), however less than 1% of the total served or studied abroad for more than one academic year<sup>3</sup>. Comparative studies have demonstrated the importance of international experiences in developing global competency<sup>4</sup>, but this may be difficult to achieve with a short duration abroad and limited training.

The Master's International Program (MIP) at the University of South Florida (USF) is a university partnership with the U.S. Peace Corps that provides an opportunity for graduate engineering students to spend approximately two years in another country, while completing a thesis research requirement (see <http://cee.eng.usf.edu/peacecorps/>). Prior to their international training, service, and research, USF MIP students spend a year on campus and take courses in anthropology and public health in addition to traditional graduate engineering courses (e.g., physical and chemical principles, aquatic chemistry, green engineering for sustainability, etc.). Students enroll in or attend one-hour, graduate seminars such as the Environmental Research Interdisciplinary Colloquium (ERIC) in both semesters and the Environmental and Water Resources Engineering seminar (EWRE) in the spring that consist of on campus and guest lecturers on related topics each week. Outside the traditional engineering curriculum, they enroll in a specially-designed course, Sustainable Development Engineering, which includes topics based on the research of previous MIP students as well as a construction laboratory component. Through their coursework, most MIP students are able to obtain the graduate Water, Health, and Sustainability Certificate offered at USF. After completing this coursework on campus, the USF MIP students receive at least seven semesters of supervised professional service and international research experiences that includes specialized training in language, culture, participatory planning, and sustainable development practices through the Peace Corps partnership. This usually includes at least 8 weeks of intense language, cultural, and technical training and 27 months of service in a designated community. The students also gain a global perspective while performing graduate level research in an international context of economic, social, and environmental limitations<sup>5,6</sup>. There are over one hundred<sup>7</sup> MIPs currently operating at US universities; however, the specialization within engineering is currently limited to nine<sup>7</sup> campuses and typically includes mechanical, civil, and environmental engineering disciplines.

Students who complete the engineering MIP program often find themselves working for public or private institutions after graduation that can be traced to their international service experiences and their research focus. In addition to jobs at engineering consulting firms, graduates have also been placed in positions that influence or implement science policy (e.g. Center for Disease Control and Prevention, Environmental Protection Agency, Mine Health and Safety Administration), directly implement global water, sanitation, and hygiene promotion (e.g. U.S. Agency for International Development, Oxfam, Action Against Hunger, CARE International, International Relief and Development, Relief International, IRC International Water and

Sanitation Centre), and academic teaching research (e.g. continuing graduate student, faculty member) are derived from globally competent skills that are developed during the MIP. The MIP is also a mechanism for peer-reviewed research to be conducted and scholarship generation, which further differentiates it from other undergraduate and graduate study abroad programs.

As the MIP at USF approaches its seventh year, the objective of this study is to assess the effectiveness of the USF MIP for training engineers to become more globally-competent, using a survey tool with quantitative and qualitative metrics to gather information from program alumni and students recently returned from their service. The qualitative metrics are framed within the core competencies outlined by the National Research Council, where students evaluate their entire experience based upon their perception of developing skills related to the core competencies. In addition, MIP graduates are assessed upon their current professional placements to better understand how they are utilizing the skills developed in the MIP to influence the global context. The quantitative portion of this assessment investigates the contribution of knowledge that was generated by the participants by evaluating the distribution of peer-reviewed publications.

## Methods

An online survey with seventeen questions was developed for the USF MIP alumni, students currently abroad, and students recently returned from Peace Corps that have not completed their Master's thesis requirement. This survey included two parts: 1) basic background information; and 2) a Likert-scale questionnaire to rank on how the MIP elements fulfilled each of the four NRC global competencies. Basic background questions included: where the student served or serves, what type of volunteer they were/are, their undergraduate education, which courses they took and extracurricular organizations they participated in at USF prior to service, if and where they published their research in an academic journal, and their current employment.

The second part of the survey had the alumni or student rank how each of the MIP elements satisfied the four global competencies on a scale of one to five (one being not at all, two being a little bit, three being somewhat, four being well, and five being very well). This part of the online survey was divided into three pages: pre-Peace Corps service (on campus), Peace Corps Service, and post Peace Corps service. This reflected the three stages of the USF MIP. The pre Peace Corps service had the alumni and students rank their anthropology, public health, seminar, engineering, and Sustainable Development Engineering courses as well as their extracurricular involvement and informal and formal language studies (if applicable). The Peace Corps service phase consisted of Peace Corps training and Peace Corps service. Finally, the post Peace Corps stage (if applicable) included the thesis process, academic journal publication, and their current/past employment since program completion.

Survey data was analyzed first with basic descriptive statistics, then by using non-parametric statistics. The Friedman test, a non-parametric version of the one-way analysis of variance (ANOVA)<sup>8</sup>, was used to test if the difference between the relative rankings of the different MIP elements was significant. Next, the paired-samples sign test was used to determine which of the 28 pairs of the differences in the matched program elements for each of the four global competencies were significant (if they had significantly higher positive or negative frequencies of median differences). The paired-samples sign test is used in place of the paired samples t-test

or Wilcoxon signed-rank test when the distribution of the median differences between elements is not normally distributed<sup>8</sup>. IBM SPSS version 21 software was used for all statistical analysis.

## Results and Discussion

Since the inception of the MIP at USF in 2008 (and through Fall 2014) 48 students have enrolled, with 42 of them having started or completed training and service in the Peace Corps by the start of 2015. Of these 42 students, 24 responded to the survey; but this does not include four of the study authors that have completed the program because they participated in the design of the survey. However, their basic demographic information (country served, major, etc.) was included in the results. Though most (88.5%) MIP students have an undergraduate degree in engineering, students from other majors (e.g., environmental science, ecology and evolutionary biology, geology, physics.) have also been able to participate in the program by taking supplementary engineering courses (see Figure 1).

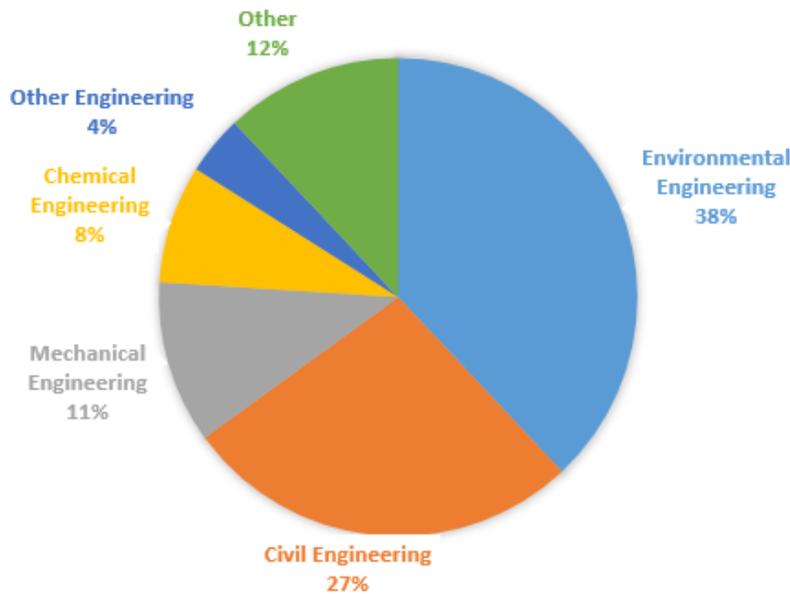


Figure 1: University of South Florida Master's International Program undergraduate degree background (n = 24)

Figure 2 presents two descriptions of the graduate students who participated in the MIP at USF. The bar chart summarizes which areas of service that the MIP students went into during their study abroad collaboration with the US Peace Corps with water and sanitation being the dominant placement for students (over 50%). This was followed by similar placement levels in both health and education (20% and 15% respectively). This primary placement trend mirrors the skill sets of the MIP students as they develop core engineering fundamental competencies during their undergraduate and graduate coursework before their international service and research experience. In some cases, placements in health, education or agriculture actually lead to work in the Water, Sanitation, Hygiene (WASH) sector, still allowing students to build their thesis research around an engineering topic. Other, less prevalent, placements occurred in areas of natural resource management, agriculture and technology transfer. Many responses indicated that most MIP students had secondary assignments that incorporated the other areas into their

work. For example, one MIP in Mexico was assigned to natural resource management but spent a significant amount of time working in water and sanitation. Additionally, water and sanitation placements were often closely connected to health activities. The information in Figure 2 depicts the diverse experience that MIP students at USF undertake during their 27 month Peace Corps service (including three months of immersion training) and field research.

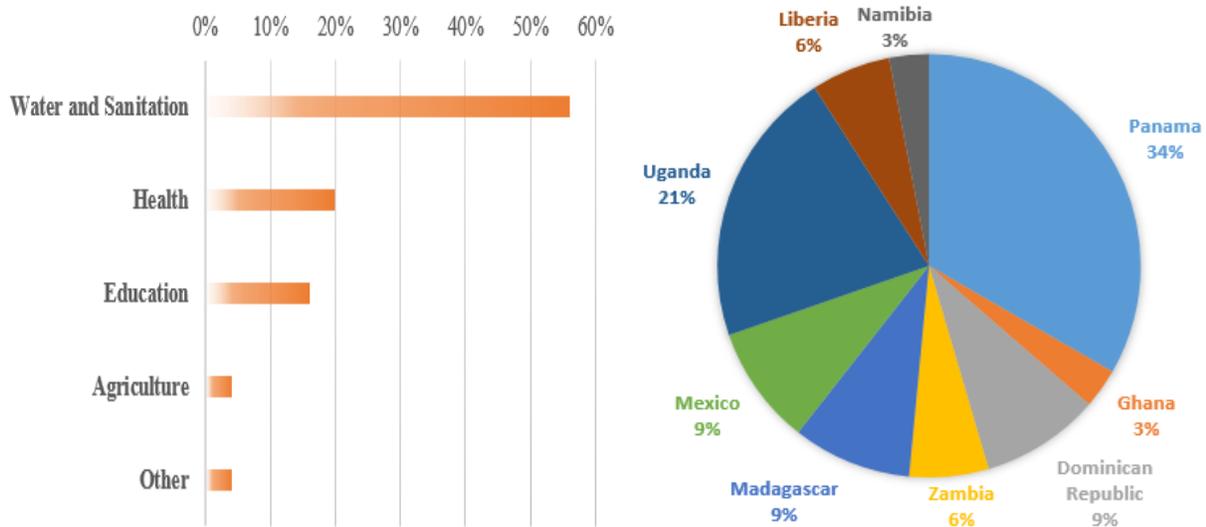


Figure 2: The primary assignments (n=26) and locations (n=42) of past University of South Florida Masters International Program students.

The survey had former and current MIP students rank each portion of the MIP (on campus courses, Peace Corps training and service, and the thesis process) on a scale from one to five (one being not at all and five being very well) in terms of how well these elements satisfied the four global competencies. Median values of the self-reported rankings of the four global competency for each element are shown in Figure 3.

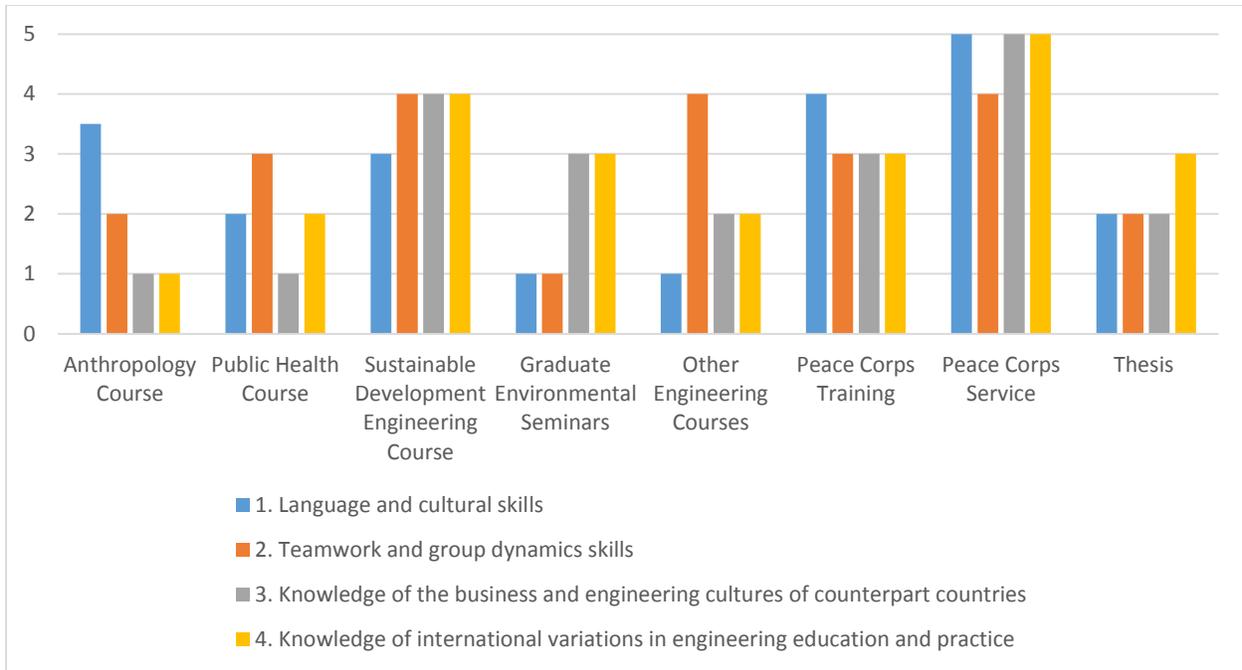


Figure 3: Median rankings by former and current University of South Florida Master's International Program students on how they perceived the elements of the Master's International Program influenced their core global competency skills (n = 17-23).

It is evident from Figure 3 that there are distinct differences between how students perceived each element of the Master's International curriculum satisfied the global competencies. Overall, the Sustainable Development Engineering course was ranked high for all four global competencies while other engineering courses are strong only in the second global competency (teamwork and group dynamic skills). The anthropology course was ranked high in satisfying the global competency of language and cultural skills, but was ranked low in the other three global competencies. Peace Corps training ranked relatively high in all the global competencies, though Peace Corps service ranked the highest in all four compared to the other elements of the MIP except for teamwork and group dynamics which it tied with engineering courses and the Sustainable Development Engineering courses. Moreover, the thesis process ranked relatively low (2-3) in all the global competencies though this is understandable given that most often the thesis is completed on campus in the United States (based on research conducted in the international field setting).

Nevertheless, these differences need to be analyzed statistically to confirm that they are significant. First, the Friedman test was applied for all four global competencies to see if the differences between each of the MIP element rankings were significant. For each global competency there was a significant difference in the relative rankings between the MIP elements ( $\chi^2(7) = 55.6, p < 0.01, \chi^2(7) = 39.2, p < 0.01, \chi^2(7) = 48.6, p < 0.01, \chi^2(7) = 43.15, p < 0.01$  for each of the four global competencies in increasing order). Even when the pre-campus courses and Peace Corps experience (training and service) were compared separately, there were significant differences between the elements in each of these phases ( $p < 0.01$ ).

However, the Friedman test does not demonstrate how these elements are different. Thus, the paired-samples sign test<sup>8</sup> was used to compare the median difference between each combination of matched pairs of how survey respondents ranked the MIP elements in each of the four global competencies. This statistical test determines if there is a significantly higher frequency of positive or negative differences between the matched pairs. The results for each of the 28 pairs of comparisons between the MIP elements for the four global competencies are show in Tables 1-4. From Table 1, students ranked the anthropology course significantly higher more times in the global competency of language and cultural skills than public health, seminars, engineering courses and thesis. Only Peace Corps service was ranked significantly higher at greater frequencies than anthropology for this first competency. Additionally the public health course was ranked significantly higher at greater frequencies in language and cultural skills than engineering courses.

Table 1: Significance results (p-values) of paired samples-sign test for the first global competency of language and cultural skills between the different elements of the University of South Florida Master’s International Program (n = 15-22).

	Public Health Course	Sustainable Development Engineering Course	Graduate Environmental Seminars	Other Engineering Courses	Peace Corps Training	Peace Corps Service	Thesis
Anthropology Course	<0.01 <sup>+</sup>	0.08	p<0.01 <sup>+</sup>	p<0.01 <sup>+</sup>	0.45	<0.01 <sup>-</sup>	<0.01 <sup>+</sup>
Public Health Course		0.18	0.15	0.01 <sup>+</sup>	<0.01 <sup>-</sup>	<0.01 <sup>-</sup>	0.29
Sustainable Development Engineering			p<0.01 <sup>+</sup>	p<0.01 <sup>+</sup>	0.06	<0.01 <sup>-</sup>	0.04 <sup>+</sup>
Graduate Environmental Seminars				0.04 <sup>+</sup>	<0.01 <sup>-</sup>	<0.01 <sup>-</sup>	1.00
Other Engineering Courses					<0.01 <sup>-</sup>	<0.01 <sup>-</sup>	0.04 <sup>-</sup>
Peace Corps Training						<0.01 <sup>-</sup>	0.01 <sup>+</sup>
Peace Corps Service							<0.01 <sup>+</sup>

<sup>+</sup> Indicates significantly greater frequencies of positive differences between the left row rankings to the top column rankings

<sup>-</sup> Indicates significantly greater frequencies of negative differences between the left row rankings to the top column rankings

In general, the other MIP elements were ranked significantly higher more times for the first global competency than engineering courses (Table 1). Notably, the Peace Corps service ranked significantly higher more times in this competency than all the other MIP elements, even Peace Corps training. However, Peace Corps training is only 8-12 weeks while service is 27 months. Peace Corps training ranked significantly higher at greater frequencies in language and cultural skills over most elements, but this difference was not significant compared to the anthropology and Sustainable Development Engineering courses. Thus, the pre-Peace Corps preparatory courses offered through anthropology and the Sustainable Development Engineering course

significantly fulfill the self-reported global competency of language and cultural skills, which are then reinforced during the Peace Corps. These results reinforce the usefulness and importance of pre-service MIP courses in preparing program participants for their Peace Corps service and future careers that may otherwise not be included in a standard engineering curriculum.

Regarding the second global competency of teamwork and dynamic skills, engineering courses have a high ranking median value (4), as shown in Figure 3. However, there is no statistically significant higher frequency of differences on how students ranked other MIP elements in comparison. The Sustainable Development Engineering course and the Peace Corps training and service had statistically significant greater frequencies of higher rankings from students compared to other MIP elements (including engineering courses). Therefore, these results demonstrate that the Sustainable Development Engineering course and the Peace Corps service perform well at satisfying the second global competency of teamwork and group dynamic skills.

Table 2: Significance results (p-values) of the paired-samples sign test for the second global competency of teamwork and group dynamic skills between the different elements of the University of South Florida Master’s International Program (n = 16-23).

	Public Health Course	Sustainable Development Engineering Course	Graduate Environmental Seminars	Other Engineering Courses	Peace Corps Training	Peace Corps Service	Thesis
Anthropology Course	1.00	<0.01 <sup>-</sup>	0.02 <sup>+</sup>	0.14	0.14	<0.01 <sup>-</sup>	0.51
Public Health Course		<0.01 <sup>-</sup>	0.04 <sup>+</sup>	0.15	0.21	<0.01 <sup>-</sup>	0.39
Sustainable Development Engineering			<0.01 <sup>+</sup>	<0.01 <sup>+</sup>	0.24	0.45	<0.01 <sup>+</sup>
Graduate Environmental Seminars				1.00	<0.01 <sup>-</sup>	<0.01 <sup>-</sup>	0.18
Other Engineering Courses					0.01	<0.01 <sup>-</sup>	0.77
Peace Corps Training						<0.01 <sup>-</sup>	0.15
Peace Corps Service							<0.01 <sup>+</sup>

<sup>+</sup> Indicates significantly greater frequencies of positive differences between the left row rankings to the top column rankings

<sup>-</sup> Indicates significantly greater frequencies of negative differences between the left row rankings to the top column rankings

Next, the third global competency concerns the knowledge of the business and engineering cultures of counterpart countries. The statistical analysis results in Table 3 show that the interdisciplinary courses in anthropology and public health are ranked lower significantly more times than the Sustainable Development Engineering course, seminars, and Peace Corps service. Overall, the Sustainable Development Engineering course and Peace Corps service elements have greater frequencies of higher rankings than the other MIP elements. Furthermore, seminars are ranked higher at significantly greater frequencies than engineering courses in addition to the

interdisciplinary courses. Thus, as with the previous two global competencies, the Sustainable Development Engineering course and the Peace Corps service are ranked high in satisfying the third global competency of knowledge of the business and engineering cultures though seminars are also significant in this area.

Table 3: Significance results (p-values) of the paired-samples sign test for the third global competency of knowledge of the business and engineering cultures of counterpart countries between the different elements of the University of South Florida Master’s International Program (n = 16-23).

	Public Health Course	Sustainable Development Engineering Course	Graduate Environmental Seminars	Other Engineering Courses	Peace Corps Training	Peace Corps Service	Thesis
Anthropology Course	0.38	<0.01 <sup>-</sup>	0.01 <sup>-</sup>	0.12	0.03 <sup>-</sup>	<0.01 <sup>-</sup>	0.15
Public Health Course		<0.01 <sup>-</sup>	0.02 <sup>-</sup>	0.30	0.10	<0.01 <sup>-</sup>	0.15
Sustainable Development Engineering			<0.01 <sup>+</sup>	0.00 <sup>+</sup>	0.05 <sup>+</sup>	0.61	<0.01 <sup>+</sup>
Graduate Environmental Seminars				0.00 <sup>+</sup>	0.30	<0.01 <sup>-</sup>	0.61
Other Engineering Courses					0.77	<0.01 <sup>-</sup>	0.77
Peace Corps Training						<0.01 <sup>-</sup>	0.12
Peace Corps Service							<0.01 <sup>+</sup>

+ Indicates significantly greater frequencies of positive differences between the left row rankings to the top column rankings

- Indicates significantly greater frequencies of negative differences between the left row rankings to the top column rankings

Lastly, the statistical analysis results of the fourth global competency, knowledge of international variations in engineering education and practice, shown in Table 4 are similar to those of the third global competency in knowledge of the business and engineering cultures of counterpart countries. The interdisciplinary courses of anthropology and public health have higher frequencies of lower rankings compared to the other MIP elements, which would be expected since global competencies three and four concern engineering education and business and these courses are outside of engineering. Again, the Sustainable Development Engineering course and the Peace Corps service have the significantly highest occurrence of higher median rankings compared to other MIP elements. Though both the third and fourth global competencies concern engineering education, engineering courses were not ranked higher at significantly greater frequencies than even the interdisciplinary courses. In fact, the Sustainable Development Engineering course and Peace Corps service were ranked higher at significantly greater frequencies than the engineering courses.

Table 4: Significance results (p-values) of the paired-samples sign test for the fourth global competency of knowledge of international variations in engineering education and practice between the different elements of the University of South Florida Master’s International Program (n = 16-23).

	Public Health Course	Sustainable Development Engineering Course	Graduate Environmental Seminars	Other Engineering Courses	Peace Corps Training	Peace Corps Service	Thesis
Anthropology Course	0.02 <sup>-</sup>	<0.01 <sup>-</sup>	0.01 <sup>-</sup>	0.55	0.02 <sup>-</sup>	<0.01 <sup>-</sup>	0.01 <sup>-</sup>
Public Health Course		<0.01 <sup>-</sup>	0.33	1.00	0.21	<0.01 <sup>-</sup>	<0.01 <sup>-</sup>
Sustainable Development Engineering			<0.01 <sup>+</sup>	<0.01 <sup>+</sup>	0.01 <sup>+</sup>	0.55	<0.01 <sup>+</sup>
Graduate Environmental Seminars				0.34	0.61	<0.01 <sup>-</sup>	1.00
Other Engineering Courses					0.79	<0.01 <sup>-</sup>	0.39
Peace Corps Training						<0.01 <sup>-</sup>	0.79
Peace Corps Service							<0.01 <sup>+</sup>

+ Indicates significantly greater frequencies of positive differences between the left row rankings to the top column rankings

- Indicates significantly greater frequencies of negative differences between the left row rankings to the top column rankings

While these results highlight the importance of the Sustainable Development engineering course, the other USF engineering courses are important to the USF MIP curriculum. The Peace Corps service component of the MIP is the longest (over two years) which may have created a perception bias, potentially resulting in higher relative rankings. Nevertheless, perhaps the core engineering courses could be adapted to better incorporate the global competencies, like the Sustainable Development Engineering course has done. This analysis does show that the thesis process ranks relatively low on the global competencies and this element could be improved by: adding a community dissemination component (whether it is a report, video, education intervention, etc.) and/or have the students develop a lesson plan or module for the Sustainable Development Engineering course based on their research. Some students who have transitioned to the PhD program have already done this. In general, the results of this analysis do not simply determine which MIP elements are best at satisfying the global competencies (which are the Sustainable Development Engineering course and Peace Corps service), but they demonstrate how each of the MIP elements complement each other to fulfill all four global competencies. For example, the anthropology course is strong in the first global competency of culture and language skills but weak in the third and fourth global competencies that concern engineering specifically. However, the Sustainable Development Engineering course and even the seminars are strong in the third and fourth competencies which leads to an overall program and preparation that satisfies all four of the global competencies. Further qualitative data (e.g.

interviews) could be collected from students returning from Peace Corps service to gain a deeper understanding of how students ranked the different MIP elements.

MIP elements such as informal and formal language training, extracurricular involvement, and post-Peace Corps employment were not included in Figure 3 or the statistical analysis with their comparatively smaller sample sizes (4-16) though they are important components in the MIP and do reflect the core competencies outlined earlier. Of the 19 alumni and students that responded to the survey question about which extra-curricular activity they participate on campus, 52.6% (10) said they were involved in Engineers without Borders, 31.6% (6) said they were members of professional engineering societies such as American Water Works Association and 63.2% (12) were involved in other activities as well such as sports teams, service and religious organizations. MIP survey respondents ranked their extracurricular involvement high at fulfilling the global competency of teamwork and group dynamic skills (median score of 4) while the first, third, and fourth global competencies received rankings of 2, 1, and 1.5 respectively. This demonstrates the importance of extracurricular involvement even in engineering education. Though only one person surveyed reported taking formal language training (such as a course), seven out of 25 respondents (28%) indicated that they participated in informal language training, specifically Rosetta Stone (six out of the seven). Furthermore, three students indicated that they were already fluent in Spanish prior to enrollment in the MIP.

Notably, the analysis shows that engineering courses and the thesis process alone with their lower median rankings, as is done for a traditional Master's education, may not completely satisfy the four global competencies that are crucial skills for engineers today. Of the 16 survey respondents who ranked their current employment for the global competencies, the median scores were 2.5, 5, 3.5, and 3 for each of the global competences in increasing order. These higher rankings indicate that global competencies are essential in engineering careers. Courses like the Sustainable Development Engineering course and longer term, international service and research such as through the Peace Corps that are rated higher in the global competencies are needed to prepare today's engineers for their future career paths.

Often, engineering graduates have opportunities to continue their professional development in industry, academics, governmental and non-governmental organizations—many of these organizations desire the skill sets that graduates of the MIP possess<sup>9-11</sup>. It can be argued that a career path or employment position best displays the global aptitude of a graduate because some positions require the core competencies outlined by the National Research Council as prerequisites for the job. For example, students that continue on an academic path must have shown the ability to apply the fundamentals of engineering to solve problems that are unique to their own context, and they communicate the results to very diverse stakeholders in a meaningful way. Or, students pursuing governmental or non-governmental organization work must be multidisciplinary and possess integration skills that allow them to function in different cultures.

Figure 4 presents data related to the post-MIP activities of the graduates in terms of chosen career path. Here, most of the MIP graduates have taken professional placements in engineering (42%), often working for industry or engineering consulting firms; however, a large percentage (21%) of the graduates have continued to pursue advanced graduate degrees. Other current career paths included choices such as government agency jobs, non-governmental development groups, or undecided. It should be noted that some students have touched many different career

paths resulting from their involvement with the MIP at USF, however, this survey did not inquire about the complete employment history of the participants. An example of this would be a student who works outside of academia after graduating from the MIP, but then returns to graduate school for a doctoral degree. The option to pursue an advanced degree is an important career path in terms of measuring global competency because these people must have shown some level of global aptitude to be successful and reach this milestone, while at the same time they are often working with younger students and mentoring junior engineers to become more globally skilled. This mentoring relationship is fostered at USF by graduates of the MIP who provide support and advice to current MIP students before and during their international experience.

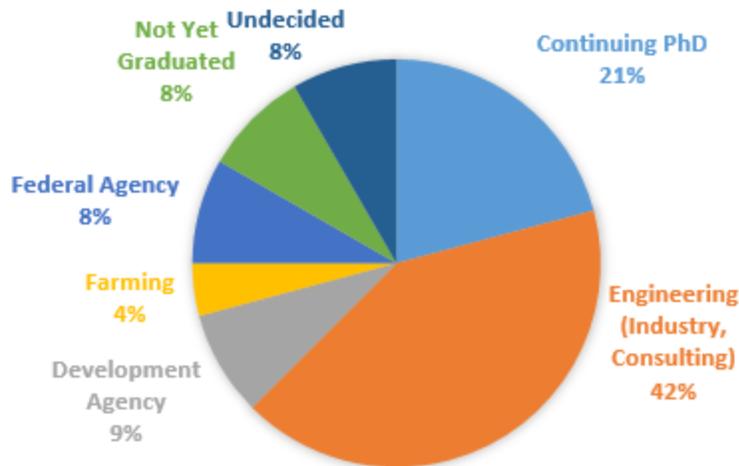


Figure 4 – Where the University of South Florida Master’s International Program students are employed as of November 2014 (n=26).

Finally, peer-reviewed research is another metric to assess the global impact, or global competency, of the students in the program since the peer-review process challenges the researcher to conduct a study that is important, meaningful and well designed. The USF MIP students are working in a unique context, culturally and geographically, and then their publications must satisfy the challenges presented by the review process, and in turn demonstrate aptitude on the global level. Table 5 summarizes some of the journals and books that have been published based on research of the MIP since 2008. Many of the target journals involve water, health, and development which is reflective of the primary placements described in Figure 2. The MIP at USF has provided opportunities for students to conduct and publish research in areas of global need, including research that: assesses resource recovery from sanitation systems<sup>12,13</sup>, determines embodied material and human energy in provision of water<sup>14</sup>, examines for lead contamination of self-supply groundwater systems<sup>15</sup>, assesses the usage of appropriate hand-washing technologies<sup>16</sup>, uses solar distillation for water provision<sup>17</sup>, assesses sustainability of infrastructure that includes life cycle thinking and principles of sustainable development<sup>18,19</sup>, measures the feasibility of domestic rainwater harvesting<sup>20</sup>, investigates the potential of the EMAS pump for water supply<sup>21</sup>, and applies material balances to solid waste management in small island developing states<sup>22</sup>.

Table 5 – Peer reviewed publication destinations as of 2014 from the University of South Florida Masters International Program graduates.<sup>12-22</sup>

Journal of Sustainable Development	Environmental Science & Technology
Journal of Water and Health	Journal of Water, Sanitation and Hygiene for Development
Alternative Water Supply Systems (book chapter)	Journal of Water Resources Planning and Management
Chemosphere	Journal of Cleaner Production
Journal of Environmental Engineering	Environmental Engineering Science

## Conclusions

Defining, developing and assessing global competence for engineers is an emerging field of inquiry. This paper presents the MIP at USF as an example of a curriculum that achieves these goals using intensive multi-disciplinary graduate level coursework and long-term study abroad research experiences by means of collaboration with the US Peace Corps. Program outcomes that focus on interpersonal evaluation, career path choices and peer-reviewed publications are used to demonstrate the efficacy of the MIP at USF as a means to improve the global aptitude of engineers graduating from the program, and also differentiate it from other study abroad experiences where students are rarely evaluated beyond their own experiential viewpoints.

Statistical analysis confirmed that MIP elements such as the Sustainable Development Engineering course and Peace Corps Service were ranked significantly higher than traditional engineering curriculum (engineering courses and master’s thesis) at satisfying the global competencies. Overall, the study results demonstrated how each of the MIP elements, such as the interdisciplinary courses in anthropology and public health, engineering courses, seminars, and international research and service, complement each other to fulfill all four global competencies that MIP alumni utilize in their careers. Globally competent engineers are needed now more than ever to help solve the major challenges in food, water, energy and climate and the USF MIP is one program helping to train these types of engineers. Since MIPs are limited by the number of students that the Peace Corps can support, it is realistic to use this example as a template for other engineering curriculums to follow with help of other funding sources.

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