# ELCIR – Engineering Learning Community Introduction to Research: A research and global experience program supporting first generation low incoming underrepresented minority students

**Dr. Sonia Jacqueline Garcia, Texas A&M University**

Dr. Sonia Garcia is the Senior Director for the Access and Inclusion Program in the College of Engineering at Texas A&M University. She joined the college in 2014. In this role, Garcia is responsible for the initiation, development, management, evaluation, and promotion of research informed and strategic comprehensive activities and programs for the recruitment and success of historically underrepresented minority students and under-served communities in engineering at the undergraduate and graduate levels.

Through pre-college efforts such as summer camps, visitation days, Garcia has directed programs that offer hands-on engineering experiences to high school students who may not have had the opportunity otherwise. Many of these students have since decided to pursue a degree in engineering at Texas A&M, and Garcia continues to work with them to ensure their success.

Garcia also directs community-building and peer-mentorship programs for undergraduate and graduate students, giving underrepresented students the opportunity to build confidence and camaraderie. These programs include the Engineering Success Program, established to provide academic support to first-generation underrepresented college students, and the Engineering Learning Community Introduction to Research Program, a high impact learning and research opportunity that offers freshmen underrepresented engineering students a chance to partake in a one-credit class and research project while gaining global experience with a research trip to Merida, Yucatan, Mexico. Garcia also leads efforts directing and coordinating the Engineering Summer Bridge Program, which gives first-generation students a head start on engineering and math courses before their first semester begins.

Before joining the College of Engineering, Garcia served as program coordinator then promoted to assistant director of outreach and diversity at Mays Business School at Texas A&M. She later served as director of recruitment in the College of Geosciences at Texas A&M. In both capacities, she created, managed and developed projects and programs to enhance the presence of underserved underrepresented students in science and in business to enhance their academic experiences.

She has received many awards throughout her professional career, including an Outstanding Staff award from the Mays Business School in 2005, the 2008 President's Award for Academic Advising, the 2011 Latino American Who's Who for her achievements in advancing the culture of the Latino American business community, and the 2012 Dean's Distinguished Achievement Award in the College of Geosciences for her work on increasing diversity in STEM.

Garcia received her B.S. in Political Science from the University of Massachusetts at Boston, her M.S. in Human Development from the University of Rhode Island, and her Ph.D. in Higher, Adult, and Lifelong Education from Michigan State University. She speaks Spanish, English and Italian fluently, and is well-versed in French.

**Dr. Maria Claudia Alves , Texas A&M University**

Maria Claudia Alves Director for the Halliburton Engineering Global Programs at Texas A&M University

Dr. Maria C. Alves is the Director for the Halliburton Engineering Global Programs at Texas A&M University . She has been in this position since July 2012. In this position she is responsible for internationalizing the research and education activities of the Dwight Look College of Engineering. Under her leadership the college has significantly increased the number of students studying abroad, established new models of study abroad including co-op and research abroad and established meaningful connection for research and attraction of funded international graduate students. Maria started working at Texas A&M in 2005 as Assistant Director for Latin American Programs and in 2009 she was promoted to Program Manager for South America in the same office. During her time at the Office for Latin America Programs she created, managed and developed projects to enhance the presence of Texas A&M University in Latin

American and to support in the internationalization of the education, research, and outreach projects of the university. She was charged with the development and implementation of a strategic plan for Texas A&M in South America. While at the Office for Latin America Programs, Maria was also responsible for the opening of the Soltis Center in Costa Rica. Maria speaks three languages fluently (Spanish, Portuguese and English) as well as intermediate French. Maria is originally from Brazil and completed her undergraduate studies at Lynn University in Florida, where she graduated with honors in Business Administration in 2002. She was part of the tennis team and was the team captain for two years, including the year the team was NCAA National Champion in 2001. She is a December 2003 graduate of the MS-Marketing program at Texas A&M University. And in March 2017, Maria defended and passed her PhD in Higher Education Administration with focus on Global Engineering Education

**Mr. Matthew Pariyothorn, University of Houston**

Matthew Pariyothorn is currently Director of Academic Programs in the Department of Computer Science at the University of Houston (UH). He manages undergraduate and graduate academic operations encompassing outreach, recruitment, admissions, advising, curriculum development, student success and enrichment, as well as alumni and industry partnerships.

Prior to joining UH, Matthew was Acting Director and Senior Program Specialist for Graduate Programs in the College of Engineering at Texas A&M University (TAMU) from 2009-2016. In his role he encouraged undergraduates to pursue graduate education and promoted engineering graduate degree programs at local, state, and national recruiting events. He also managed summer research experiences for high-achieving undergraduates (USRG and NSF-REU) and high school math and science teachers (NSF-RET). While at TAMU, Matthew also managed graduate academic affairs and advising in the college. In addition to recruitment, academic affairs, and program coordination, Matthew was involved with student affairs. He served as university adviser to the Philippine Student Association (PhilSA), Beta Tau Omega (BTO), an Asian-interest fraternity, and the Society for Asian Scientists and Engineers (SASE).

Matthew completed a B.S. in psychology (industrial/organizational emphasis), M.S. in management (human resource management emphasis) from the Mays Business School, and has completed some doctoral coursework in Human Resource Development, all from Texas A&M University. His research and professional interests include mentoring relationships, career development, graduate school recruitment, undergraduate research experiences, and higher education and employment law.

**Ms. Ahmarlay Myint M.S., Access and Inclusion**

Ahmarlay Myint is a doctoral student in school psychology whose research interests include English learners and first generation college students.

**Ms. Alexandra K. Hardman, Texas A&M University Access and Inclusion**

Alexandra Hardman is a school psychology doctoral student with research interests in teacher multicultural competence.

ELCIR Program – Engineering Learning Community Introduction to Research: A research and global experience program supporting first generation, low-income, and underrepresented minority students.

INTRODUCTION:

The College of Engineering at Texas A&M University has set some ambitious goals: to increase diversity in engineering and to better prepare the engineers who are joining today's global and dynamic workforce. Some of the issues that need to be addressed at our college are: 1) increase the retention of underrepresented minority (URM) and first generation students in engineering, 2) enhance the participation of those students in engineering research and study abroad programs, and 3) pave the way for those students to enroll in graduate programs in STEM areas. To help address these issues, the Access and Inclusion Program and the Global Engineering Programs joined forces to create what is today the ELCIR Program - Engineering Learning Community Introduction to Research Program.

The ELCIR Program is unique in that it engages freshman students from the very onset of their engineering careers in four rich experiences: 1) a hands-on research class, allowing students to identify their own research problem with the support of faculty and researchers, 2) a high impact global experience, 3) engagement with first-class researchers and research centers, and 4) a poster presentation of their research results at the end of the course to peers, faculty, and administrators. As part of the ELCIR program, students register/enroll in a research course, travel to Mexico to become immersed in binational research projects in major research labs, and write a research proposal. In addition, another unique aspect of this program is the synergy with the Yucatan Initiative, a collaboration effort between researchers from the College of Engineering at Texas A&M University in College Station, Texas and researchers from SIIDETEY, the Yucatan Research Consortium sponsored by the Yucatan government.

In the next sections, we will present the rationale for developing the ELCIR Program as well as the literature review, followed by the description of the 2015 and 2016 programs, methodology, and data analyses. To close the paper, we will present the results and draw conclusions based on the data that emerged from the study.

**Rationale and Literature Review:**

A study conducted by three researchers with the Center for International Business Education and Research found that almost 40% of U.S. companies surveyed missed international business opportunities because of a lack of internationally competent personnel. Given that 95% of consumers live outside of the United States, it is important for students to gain international experience (Daniel, Xie, & Kedia, 2014). With those numbers in mind, the National Academy of Engineering states that a core need for engineers is to be able to work with a diverse, multinational, and multidisciplinary workforce. Therefore, engineering colleges must develop strategies that provide global perspectives and international experiences to help their graduates excel in this new world order (Borri, Guberti, & Melsa, 2007).

Research abroad, internship abroad, and study abroad are some of the ways universities have found to provide a global perspective to students. However, not all of the students can afford to

have a study/research abroad experience, especially first generation, low income, minority students. The College of Engineering at Texas A&M University is slightly above the national average with about 6% of the students studying abroad in a single academic year, and 25% by the time they graduate. Even though the offers of study abroad programs have grown in most colleges of engineering in the United States, they cannot reach all students mainly due to financial reasons.

The rationale behind this proposal was to create a program for underrepresented first generation ethnic minority students to be engaged in a research course during the spring and summer semesters of their freshman year. This course, led by an engineering faculty member, includes a research field trip to Mexico where students not only take an introduction to research course, but they also have the opportunity to get immersed in research labs and interact with researchers from Mexico and from their home university.

*The 2015 Pilot Program*

In 2015, with LSAMP's – the Louis Stokes Alliance for Minority Programs – $25K seed funding and additional funding from the College of Engineering at Texas A&M Univeristy, we were able to launch the first of its kind: the *Engineering Learning Community Introduction to Research* (ELCIR) Program. The pilot program had the participation of 17 freshman first generation underrepresented students. However, the demand and the interest proved to be higher, as we had 55 students apply for only 17 spots covered by the seed grant.

The program took place during the Spring and Summer 2015 semesters. Once the 17 first generation underrepresented students were chosen, we started meeting with them as a group regularly during the Spring semester 2015, preparing them for the research class and the research field trip that was done in collaboration with the Yucatan Government and University of ANAHUAC in Yucatan, Mexico. Our first meeting with the students consisted of a general overview of the ELCIR Program, the Louis Stokes Alliance for Minority Programs (LSAMP) support, as well as a general study abroad orientation. Students were also introduced to the various research topics under the Yucatan Initiative – a research effort between this large southern university and the Yucatan government. Under this initiative there were researchers from the southern university and from Yucatan working jointly on 5 areas: energy, coastal dynamics, logistics, aquifers and early warning systems. Students selected which area they would like to join and contribute to. During our second meeting, the students had an opportunity to observe a presentation and ask questions directly to the faculty member leading a research project; students were able to choose their research topic and faculty mentor. The third meeting consisted of a panel discussion of students from Merida, Yucatan, with topics including: studying at the College of Engineering at Texas A&M University, cultural differences, transitional issues, and adjustments in Merida. The last two meetings before the ELCIR students' departure on Sunday, May 17, involved discussing their class, cultural activities and research site visit schedule. From May 17-30, 2015 the students traveled to Merida, Yucatan where they took the introduction to research course at ANAHUAC MAYAB, had technical visits to the sites related to their research, and visited cultural sites such as Chichen-Itza. While in Merida, we

communicated with the students (peer group meetings), the host faculty members, and our graduate student (chaperone) via skype.

Once the ELCIR students returned to their home institution in the United States, Texas A&M University, we met with them individually; meetings took place on campus face-to-face and also via skype, and the purpose of these meetings was to hear and record their experiences as well as to explain to them the next steps of the program. The one-on-one meetings were revelatory in that, every single ELCIR student, with the exception of one or two, expressed a genuine interest in continuing research, their career at their present institution, applying for an internship research experience abroad, and most importantly, solidified their commitment to engineering (i.e., retention). After their return, the ELCIR students continued to work on their research proposal, met with their faculty mentors, and participated in the ELCIR Online Learning Community; this learning community allowed them to share/post their thoughts, ask questions, and submit drafts of their work. To conclude the program, students presented their research proposal in a poster session on September 4h, 2015. The leadership of the college, faculty members, and new incoming engineering students attended the event. It is important to mention that we integrated this program to the Yucatan Initiative. That is important because researchers on both sides, Yucatan and their home University, participated in the program by mentoring the students.

During the semesters that followed the program, several students were engaged in research labs as student workers and participated in study abroad programs such as the India Research Internship, Chile Research Internship and the Qatar exchange program. The program also impressed the deans of the College of Engineering; the dean challenged us to offer this course/class for credit as well as to increase the number of participating students.

*The 2016 ELCIR Follow up Program*

With the continued support from LSAMP, and taking on the challenge given to us by our deans, we increased the number of participants to 28 and added, as part of the requirement, a 1-credit course: ENGR 291. Another addition to the 2016 program was the participation of an engineering faculty member, Dr. Zenon Medina-Cetina, as the faculty of record for the class, running the class and participating on the portion of the program that took place in Merida, Yucatan, Mexico; the faculty traveled with the ELCIR Students. The College of Engineering at Texas A&M University funded the faculty salary to support the efforts of Dr. Medina-Cetina.

For the 2016 program, 30 students were selected out of 70 applicants. Two of the selected students had to drop the class due to family reasons. After students were selected, they were enrolled in the ENGR 291 with Dr. Medina-Cetina. During the spring semester they participated in different workshops, including: introduction of the ELCIR Program purpose and goals, introduction to research topics, introduction to LSAMP/NSF sponsored responsibilities, research and research abroad expectations, seminar on cultural competency, expectations living with host families, traveling/departure official documents, etc. The 2016 program was done in collaboration with the Yucatan government one more time, and Universidad Marista in Yucatan, Mexico. During their time in Mexico, students stayed with host families, which allowed for a

richer cultural immersion; participated in the introduction to research course taught by Dr. Medina-Cetina and the vice president for research at Universidad Marista, participated in research expeditions that are part of the Yucatan Initiative being led by the College of Engineering at Texas A&M University, and visited cultural sites. All 28 participants completed their research proposal and poster presentation, presenting their results.

**Methodology:** A research course with a technical field trip to Mexico was employed with the goals of: improving student retention, developing research skills, increasing awareness and practice, and enhancing global competency attitudes. To assess the program impact, we developed mixed methods research questions with pre and post surveys. The preliminary research has shown positive results in terms of retention and global competency development.

The key personnel are: the Directors of Access and Inclusion and Global Programs, the faculty leaders, and a graduate student to carry out data collection and analysis.

## Methods

*Participants*

Participant selection was based on a selective application process. Student qualification was evaluated through assessment of their grade point average (GPA), essay (*Describe how this experience - Engineering Learning Community Introduction to Research in Merida, Mexico, Peninsula of Yucatan, will impact your life and career. What do you expect to gain out of this experience?*), curriculum vitae, and a recommendation letter from a professor. Students in the 2015 cohort were also asked to meet minimum requirements: be a/an recipient of the Regents' Scholarship, underrepresented minority, and first generation college student. While the 2015 cohort was not provided any class credits, the 2016 cohort earned one credit for this class.

Seventeen freshman students participated in the program in 2015, with sixteen completing the surveys for the present study. The participants were from diverse backgrounds, with 75% (n=12) of participants being Hispanic or Latino of any race, 6% (n=1) African American, 6% (n=1) Native American, 6% (n=1) Asian, and 6% (n=1) "International," and 8 (50%) of the participants were female.

Forty-six freshman students participated in the study in 2016, of which 26 (57.5%) were female. Only 37 individuals completed the post-test survey. 59% (n=22) of those individuals were Hispanic or Latino of any race, 16% (n=6) were African American, 16% (n=6) were White, 5% (n=2) were multiracial, and 3% (n=1) were Asian.

There were a wide range of engineering majors represented (Table 1). One person did not report their major for the 2015 cohort.

**Table 1.** 2015 and 2016 Major Categories and Percentages.

| Major | 2015 Participants | Percentage | 2016 Participants | Percentage |
|---|---|---|---|---|
| Aerospace Engineering | 4 | 27% | 1 | 3% |
| Biological & Agricultural Engineering | 1 | 7% | 0 | 0% |
| Biomedical Engineering | 0 | 0% | 2 | 5% |
| Chemical Engineering | 2 | 13% | 2 | 5% |
| Civil Engineering | 0 | 0% | 7 | |
| Computer Engineering | 1 | 7% | 1 | 3% |
| Computer Science | 0 | 0% | 2 | 5% |
| Electrical Engineering | 1 | 7% | 3 | 8% |
| Engineering Technology/Electronic Systems Engineering Technology | 1 | 7% | 1 | 3% |
| Industrial Engineering | 0 | 0% | 1 | 3% |
| Industrial Distribution | 1 | 7% | 1 | 3% |
| Mechanical Engineering | 3 | 20% | 6 | 16% |
| Nuclear Engineering | 0 | 0% | 3 | 8% |
| Ocean Engineering | 0 | 0% | 1 | 3% |
| Petroleum Engineering | 1 | 7% | 3 | 8% |
| No Response | 1 | | 3 | 8% |
| Total | **16** | | **37** | |

Participants engaged in a two-week research class in the Yucatan Peninsula, Mexico. Activities included expeditions of local sites (e.g., Chichen Itza archeological site) and lectures by local professors of University of ANAHUAC and Universidad Marista on various topics (e.g., Coastal Dynamics, Early Warning Systems, Introduction to Research). The central objective of the program was for the students to create a research project in a selected area (e.g., Aquifers: Biogeochemical transformation of organic and inorganic contaminants in Yucatan cenotes; Biofuel incorporation into planes to lower CO2 emissions), collaborate with peers and professors to bring the research project to fruition, and present a poster of the results of their research during the final days of class.

Participants were provided a pre- and post-survey. Survey questions (see Appendix) were a combination of seventeen multiple choice, open-ended, and Likert response scales (1 being strongly agree and 5 being strongly disagree). Likert scale survey questions for 2016 were reverse-coded and on a 4-point Likert scale, thus 1 was associated with strongly disagree and 4 was associated with strongly agree. The questions covered the following topics: personal and

professional skills, expectations of ELCIR experiences, research knowledge, prior research experience, plans for after graduation, and perceptions of cross-cultural knowledge and attitudes.

*Statistical Analysis*

To empirically evaluate the growth, decline, or stability of the students from pre- to post-survey, paired *t*-tests were utilized. Central tendency measures (e.g., mean, minimum, maximum) were fundamental to the descriptive data analysis. Significance tests were conducted to compare whether mean value responses improved from pre- to post-survey. Improvement was gauged through a significance level of $p<.1$ or less (i.e., $p<.05$ or $p<.01$). Post-program analyses were also conducted in the form of retention rates, or whether the students are enrolled in the U.S. University 1 College of Engineering at Texas A&M as of the Spring 2017 semester, and intention (i.e., future academic plans). Qualitative data (e.g., choice of major) were also reported. While *t*-tests were used to analyze the differences in means from pre- to post-survey for the majority of questions, the written responses were analyzed for overarching themes.

## Results

*Research Experience*

The 2015 ELCIR cohort participants were asked about prior research experience (see Table 5). It is evident that the majority of ELCIR participants (n=14) had no prior research experience before the ELCIR program. Only two other students had prior experience, one having a semester's experience and the other having two semesters of experience. ELCIR served as an experience that provided a foundation in basic research skills and experience for the majority of students.

The 2016 cohort were not provided with this question, and so it is unknown how much research experience they had.

**Table 6.** 2015 Cohort Prior Research Experience.

| Response | Number of Participants | Percentage |
|---|---|---|
| No prior research experience | 14 | 88% |
| Yes, 1 academic semester (1 academic semester= fall or spring or summer). | 1 | 6% |
| Yes, 2 academic semesters. | 1 | 6% |
| Yes, 3 academic semesters. | 0 | 0% |
| Yes, 4 academic semesters. | 0 | 0% |
| Yes, more than 4 academic semesters | 0 | 0% |
| Other | 0 | 0% |

*Personal and Professional Skills*

The 2015 Cohort student perceptions of their personal and professional skills showed slight improvements (Table 2). The purpose was to assess what difference, if any, the ELCIR program had upon students' skill development in a variety of areas. The results indicate that the participants felt confident in their own personal skills of a more general nature (e.g. leadership skills, working with others), but had less confidence when it came to specific research and writing skills (e.g. writing abstracts or proposals). Statistically significant differences between the pre- and post-test responses (at the $p<.10$ level), included the student's confidence in their ability to write a research abstract ($p=.0344$) and their ability to create a research poster ($p=.0592$), which are basic foundational skills useful to students who plan to engage in research throughout their undergraduate career. Mean responses indicate that, overall, students strongly agreed or agreed at pre-test with statements indicating higher confidence in their skills, which shows that they felt fairly confident before the ELCIR Program took place and it would be difficult to produce a significant positive change.

The 2016 Cohort showed remarkable improvements from pre- to post-test, with significant differences being found for all responses (Table 3). It should be noted once more that the scores for the 2016 Cohort were reverse-coded and only a 4-point Likert scale, so a score of 1 meant strongly disagree and a score of 4 meant strongly agree. This shows that those participating in the 2016 program felt they grew both in their personal and professional skills. While they showed a significant difference in their ability to write a research abstract and develop a research proposal, as the 2015 cohort did, they also showed significant differences in their confidence in their leadership skills, interpersonal skills, time-management skills, and their communication skills with others in their field. These differences from the 2015 cohort are likely due to the substantial changes made in the 2016 program.

*Research Knowledge*

The 2015 ELCIR participants were also able to indicate the level of knowledge they possessed in the area of research they were working on over the summer (Table 4). All responses on the post-test indicated a stronger tendency to feel knowledgeable in their research area than the participants did during the pre-test.

According to the post-test data, there were statistically significant differences between the pre- and post-test responses (at the $p<.10$ level). Students felt that their knowledge of the process of research in their area improved ($p=.0020$), along with their knowledge of the research literature in their area ($p=.0584$). Students also felt their knowledge of the research skills and/or lab techniques in their area improved ($p=.0439$), as well as their knowledge of how to do statistical analysis of research data ($p=.0519$).

In 2016, all post-test responses were significantly different from the pre-test responses (Table 5). Students felt they had gained knowledge of the processes of their research, the literature in their research area, the lab techniques relevant to their work, statistical analyses, interpretation of data, and how to apply research data. There was also a significant increase in knowledge of the

graduate school application process, where students have potential to carry on their research interests.

**Table 2.** 2015 Cohort Responses to Skill Questions.

| Question | Pre-Test Mean | Pre-Test Minimum Value Response | Pre-Test Maximum Value Response | Post-Test Mean | Post-Test Minimum Value Response | Post-Test Maximum Value Response |
|---|---|---|---|---|---|---|
| I have strong leadership skills | 1.69 | 1 | 3 | 1.69 | 1 | 2 |
| I have strong interpersonal (social) skills. | 2.13 | 1 | 4 | 1.88 | 1 | 3 |
| I am able to develop a professional network. | 1.69 | 1 | 3 | 1.69 | 1 | 3 |
| I am able to work effectively with others. | 1.33 | 1 | 2 | 1.56 | 1 | 2 |
| I am able to work effectively on my own. | 1.38 | 1 | 2 | 1.50 | 1 | 2 |
| I am able to manage my time effectively. | 1.94 | 1 | 3 | 1.88 | 1 | 4 |
| I am able to work through obstacles or challenges. | 1.63 | 1 | 3 | 1.56 | 1 | 2 |
| I am able to write a research proposal/plan. | 2.44 | 1 | 5 | 2.00 | 1 | 3 |
| I am able to write a research abstract. | 2.63 | 1 | 5 | 1.88** | 1 | 3 |
| I am able to create a research poster. | 2.44 | 1 | 5 | 1.81* | 1 | 3 |
| I am able to give an oral research presentation. | 1.81 | 1 | 3 | 1.69 | 1 | 3 |
| I am able to communicate technical information to people within my discipline. | 1.94 | 1 | 3 | 1.69 | 1 | 3 |
| I am able to communicate technical information to people outside my discipline | 2.13 | 1 | 3 | 1.75 | 1 | 3 |

*significant at the p<.10 level
**significant at the p<.05 level
***significant at the p<.01 level

**Table 3.** 2016 Cohort Responses to Skill Questions.

| Question | Pre-Test Mean | Pre-Test Minimum Value Response | Pre-Test Maximum Value Response | Post-Test Mean | Post-Test Minimum Value Response | Post-Test Maximum Value Response |
|---|---|---|---|---|---|---|
| I have strong leadership skills | 3.30 | 2 | 4 | 3.87*** | 3 | 4 |
| I have strong interpersonal (social) skills. | 3.23 | 1 | 4 | 3.76*** | 2 | 4 |
| I am able to develop a professional network. | 3.17 | 2 | 4 | 3.81*** | 3 | 4 |
| I am able to work effectively with others. | 3.56 | 2 | 4 | 3.95*** | 3 | 4 |
| I am able to work effectively on my own. | 3.74 | 3 | 4 | 4*** | 4 | 4 |
| I am able to manage my time effectively. | 3.19 | 2 | 4 | 3.76*** | 2 | 4 |
| I am able to work through obstacles or challenges. | 3.60 | 3 | 4 | 3.97*** | 3 | 4 |
| I am able to write a research proposal/plan. | 2.44 | 1 | 4 | 3.95*** | 3 | 4 |
| I am able to write a research abstract. | 2.35 | 1 | 4 | 3.95*** | 3 | 4 |
| I am able to create a research poster. | 2.58 | 1 | 4 | 3.97*** | 3 | 4 |
| I am able to give an oral research presentation. | 2.91 | 1 | 4 | 3.92*** | 3 | 4 |
| I am able to communicate technical information to people within my discipline. | 3.21 | 2 | 4 | 4*** | 3 | 4 |
| I am able to communicate technical information to people outside my discipline | 3.10 | 2 | 4 | 3.95*** | 3 | 4 |

*significant at the p<.10 level
**significant at the p<.05 level
***significant at the p<.01 level

**Table 4.** 2015 Cohort Level of Knowledge in Summer Research Area.

| Question | Pre-Test Mean | Pre-Test Minimum Response Value | Pre-Test Maximum Response Value | Post-Test Mean | Post-Test Minimum Response Value | Post-Test Maximum Response Value |
|---|---|---|---|---|---|---|
| Knowledge of the process of research in this area | 2.69 | 1 | 5 | 1.75** | 1 | 3 |
| Knowledge of the research literature in this area | 2.88 | 2 | 4 | 2.38* | 1 | 4 |
| Knowledge of the research skills and/or lab techniques in this area | 3 | 2 | 5 | 2.38** | 1 | 4 |
| Knowledge of the graduate school application process. | 3.44 | 2 | 5 | 3.47 | 1 | 5 |
| Knowledge of how to do statistical analysis of research data. | 3.31 | 2 | 5 | 2.69* | 1 | 4 |
| Knowledge of how to interpret research data. | 2.81 | 1 | 5 | 2.31 | 1 | 4 |
| Knowledge of how to apply research data. | 2.81 | 2 | 5 | 2.38 | 1 | 4 |

*significant at the p<.10 level
**significant at the p<.05 level
***significant at the p<.01 level

**Table 5.** 2016 Cohort Level of Knowledge in Summer Research Area

| **Question** | **Pre-Test Mean** | **Pre-Test Minimum Response Value** | **Pre-Test Maximum Response Value** | **Post-Test Mean** | **Post-Test Minimum Response Value** | **Post-Test Maximum Response Value** |
|---|---|---|---|---|---|---|
| Knowledge of the process of research in this area | 2.33 | 1 | 4 | 3.86*** | 2 | 4 |
| Knowledge of the research literature in this area | 1.95 | 1 | 4 | 3.62*** | 2 | 4 |
| Knowledge of the research skills and/or lab techniques in this area | 2.26 | 1 | 4 | 3.78*** | 3 | 4 |
| Knowledge of the graduate school application process. | 2.19 | 1 | 4 | 3.41*** | 1 | 4 |
| Knowledge of how to do statistical analysis of research data. | 2.57 | 1 | 4 | 3.47*** | 2 | 4 |
| Knowledge of how to interpret research data. | 2.67 | 1 | 4 | 3.92*** | 3 | 4 |
| Knowledge of how to apply research data. | 2.57 | 1 | 4 | 3.89*** | 3 | 4 |

*significant at the p<.10 level
**significant at the p<.05 level
***significant at the p<.001 level

*Higher Education Goals*

The 2015 ELCIR cohort were asked to share their current post-graduation plans (see Table 6). The majority of responses (n=14) indicated they planned to pursue a graduate level degree either in the near future or after obtaining some work experience. The remaining 2 individuals were uncertain about their future plans.

The 2016 cohort had similar patterns (Table 7), with a shift towards more research-oriented plans after ELCIR took place. Only 2 individuals had no plans to go to graduate school, and 4 were unsure. The rest had an interest in pursuing graduate school in the future.

**Table 6.** 2015 Cohort Graduation Plans.

| Response | Pre-Test Number of Participants | Pre-Test Percentage | Post-Test Number of Participants | Post-Test Percentage |
|---|---|---|---|---|
| Go to graduate school full time for a Doctoral degree (PhD) in an engineering-related field | 2 | 13% | 1 | 7% |
| Go to graduate school full time for a Masters (non-research oriented) in an engineering-related field | 2 | 13% | 0 | 0% |
| Go to graduate school full time for a Masters (research oriented) in an engineering-related field | 0 | 0% | 3 | 20% |
| Go to graduate school full time for a Medical degree (MD, DO) | 0 | 0% | 0 | 0% |
| Go to graduate school full time for a Law degree (JD) | 1 | 6% | 0 | 0% |
| Go to graduate school full time for another advanced degree outside engineering (e.g. business, occupational therapy, psychology, etc.) | 0 | 0% | 0 | 0% |
| Go to work, then not pursue a graduate degree | 0 | 0% | 0 | 0% |
| Go to work, then pursue a doctoral degree in an engineering-related field | 1 | 6% | 1 | 7% |
| Go to work, then pursue a masters (non-research) degree in an engineering-related field | 4 | 25% | 5 | 39% |
| Go to work, then pursue a masters (research oriented) degree in an engineering-related field | 3 | 19% | 2 | 13% |
| Go to work, then pursue a Medical degree (MD, DO) | 0 | 0% | 0 | 0% |
| Go to work, then pursue a Law degree (JD) | 0 | 0% | 0 | 0% |
| Go to work, then pursue an advanced degree outside engineering (e.g. math, physics, business, occupational therapy, psychology, etc.) | 1 | 6% | 1 | 7% |
| I am uncertain | 2 | 13% | 2 | 13% |

**Table 7.** 2016 Cohort Graduation Plans.

| Response | Pre-Test Number of Participants | Pre-Test Percentage | Post-Test Number of Participants | Post-Test Percentage |
|---|---|---|---|---|
| Go to graduate school full time for a Doctoral degree (PhD) in an engineering-related field | 1 | 6% | 2 | 5% |
| Go to graduate school full time for a Masters (non-research oriented) in an engineering-related field | 3 | 19% | 2 | 5% |
| Go to graduate school full time for a Masters (research oriented) in an engineering-related field | 1 | 6% | 9 | 24% |
| Go to graduate school full time for a Medical degree (MD, DO) | 0 | 0% | 1 | 3% |
| Go to graduate school full time for a Law degree (JD) | 1 | 6% | 0 | 0% |
| Go to graduate school full time for another advanced degree outside engineering (e.g. business, occupational therapy, psychology, etc.) | 0 | 0% | 2 | 5% |
| Go to work, then not pursue a graduate degree | 0 | 0% | 2 | 5% |
| Go to work, then pursue a doctoral degree in an engineering-related field | 1 | 6% | 2 | 5% |
| Go to work, then pursue a masters (non-research) degree in an engineering-related field | 1 | 6% | 9 | 24% |
| Go to work, then pursue a masters (research oriented) degree in an engineering-related field | 5 | 31% | 3 | 8% |
| Go to work, then pursue a Medical degree (MD, DO) | 0 | 0% | 1 | 3% |
| Go to work, then pursue an advanced degree outside engineering (e.g. math, physics, business, occupational therapy, psychology, etc.) | 2 | 13% | 2 | 5% |
| I am uncertain | 0 | 0% | 4 | 11% |

*Cross-Cultural Perspectives*

Finally, participants were asked about cross-cultural perspectives, and their viewpoints on working and engaging with others of different backgrounds, challenges to their personal beliefs, self-concept, and cultural values.

For the 2015 cohort, there were no significant changes from pre- to post- test (Table 8). The 2016 cohort, however, had many significant differences in their post-test results compared to their pre-test results (Table 9). This may be due to the fact that students in this cohort stayed with local families, as part of a "home stay," whereas the 2015 cohort had stayed in hotels. This may have had a greater impact on their cultural perspectives.

As the results show, students felt they had a greater purpose after ELCIR, along with better overall understanding of their cultural beliefs either in regards to themselves or to others.

**Table 8.** 2015 Cohort Cross-Cultural Perspectives.

| Question | Pre-Test Mean | Pre-Test Minimum Response Value | Pre-Test Maximum Response Value | Post-Test Mean | Post-Test Minimum Response Value | Post-Test Maximum Response Value |
|---|---|---|---|---|---|---|
| When I notice cultural differences, my culture tends to have the better approach. | 3.19 | 1 | 5 | 3.44 | 1 | 5 |
| I have a definite purpose in my life. | 1.75 | 1 | 5 | 1.38 | 1 | 2 |
| I can explain my personal values to people who are different from me. | 1.6 | 1 | 2 | 1.56 | 1 | 2 |
| Most of my friends are from my own ethnic background. | 3 | 1 | 5 | 2.69 | 1 | 4 |
| I think of my life in terms of giving back to society. | 1.75 | 1 | 3 | 1.88 | 1 | 3 |
| I am informed of current issues that impact international relations. | 2.06 | 1 | 3 | 2.25 | 1 | 4 |
| I know who I am as a person. | 1.56 | 1 | 3 | 1.56 | 1 | 3 |
| I feel threatened around people from backgrounds very different from my own. | 4.13 | 3 | 5 | 4.19 | 1 | 5 |
| I often get out of my comfort zone to better understand myself. | 2.38 | 1 | 5 | 2.06 | 1 | 3 |
| I am willing to defend my own views when they differ from others. | 1.88 | 1 | 3 | 1.63 | 1 | 2 |
| I am confident that I can take care of myself in a completely new situation. | 1.69 | 1 | 3 | 1.5 | 1 | 3 |
| I see myself as a global citizen. | 1.69 | 1 | 3 | 1.69 | 1 | 3 |
| I understand how various cultures of this world interact socially. | 2.19 | 1 | 4 | 2.13 | 1 | 3 |
| I get offended often by people who do not understand my point-of-view. | 3.88 | 2 | 5 | 4 | 1 | 5 |
| I am able to take on various roles as appropriate in different cultural and ethnic settings. | 1.88 | 1 | 3 | 1.75 | 1 | 3 |
| I put my beliefs into action by standing up for my principles. | 2.06 | 1 | 4 | 1.94 | 1 | 3 |
| I consider different cultural perspectives when evaluating global problems. | 1.94 | 1 | 4 | 1.75 | 1 | 3 |
| I know how to analyze the basic characteristics of a culture. | 1.88 | 1 | 3 | 1.69 | 1 | 3 |
| I am sensitive to those who are discriminated against. | 1.88 | 1 | 5 | 1.88 | 1 | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| I prefer to work with people who have different cultural values from me. | 2.5 | 1 | 3 | 2.5 | 1 | 3 |
| I am accepting of people with different religious and spiritual traditions. | 1.5 | 1 | 3 | 1.56 | 1 | 2 |
| I put the needs of others above my own personal wants. | 2.25 | 1 | 4 | 2.13 | 1 | 4 |
| I can discuss cultural differences from an informed perspective. | 1.88 | 1 | 3 | 1.88 | 1 | 3 |
| I am developing a meaningful philosophy of life. | 1.69 | 1 | 3 | 1.81 | 1 | 3 |
| I intentionally involve people from many cultural backgrounds in my life. | 2.25 | 1 | 4 | 2.31 | 1 | 4 |
| I rarely question what I have been taught about the world around me | 4.19 | 3 | 5 | 3.69 | 1 | 5 |
| I constantly need affirmative confirmation about myself from others. | 3.75 | 3 | 5 | 3.69 | 1 | 5 |
| I enjoy when my friends from other cultures teach me about our cultural differences. | 1.5 | 1 | 2 | 1.38 | 1 | 2 |
| I consciously behave in terms of making a difference. | 1.88 | 1 | 3 | 2.06 | 1 | 3 |
| I am open to people who strive to live lives very different from my own life style. | 1.5 | 1 | 3 | 1.81 | 1 | 3 |

*significant at the p<.10 level

**significant at the p<.05 level

***significant at the p<.001 level

**Table 9.** 2016 Cohort Cross-Cultural Perspectives.

| Question | Pre-Test Mean | Pre-Test Minimum Response Value | Pre-Test Maximum Response Value | Post-Test Mean | Post-Test Minimum Response Value | Post-Test Maximum Response Value |
|---|---|---|---|---|---|---|
| When I notice cultural differences, my culture tends to have the better approach. | 2.33 | 1 | 4 | 2.76* | 1 | 4 |
| I have a definite purpose in my life. | 3.35 | 1 | 4 | 3.76*** | 2 | 4 |
| I can explain my personal values to people who are different from me. | 3.37 | 2 | 4 | 4*** | 4 | 4 |
| Most of my friends are from my own ethnic background. | 2.12 | 1 | 4 | 2.92*** | 1 | 4 |
| I think of my life in terms of giving back to society. | 3.51 | 1 | 4 | 3.89*** | 2 | 4 |
| I am informed of current issues that impact international relations. | 2.93 | 1 | 4 | 3.73*** | 2 | 4 |
| I know who I am as a person. | 3.47 | 2 | 4 | 3.84*** | 2 | 4 |
| I feel threatened around people from backgrounds very different from my own. | 1.49 | 1 | 4 | 1.47 | 1 | 4 |
| I often get out of my comfort zone to better understand myself. | 2.98 | 1 | 4 | 3.73*** | 2 | 4 |
| I am willing to defend my own views when they differ from others. | 3.26 | 2 | 4 | 3.68*** | 2 | 4 |
| I am confident that I can take care of myself in a completely new situation. | 3.44 | 2 | 4 | 4*** | 4 | 4 |
| I see myself as a global citizen. | 3.14 | 1 | 4 | 3.81*** | 1 | 4 |
| I understand how various cultures of this world interact socially. | 3.07 | 1 | 4 | 3.81*** | 2 | 4 |
| I get offended often by people who do not understand my point-of-view. | 1.47 | 1 | 4 | 1.78* | 1 | 4 |
| I am able to take on various roles as appropriate in different cultural and ethnic settings. | 3.28 | 2 | 4 | 3.91*** | 3 | 4 |
| I put my beliefs into action by standing up for my principles. | 3.21 | 1 | 4 | 3.86*** | 3 | 4 |
| I consider different cultural perspectives when evaluating global problems. | 3.14 | 1 | 4 | 3.86*** | 2 | 4 |
| I know how to analyze the basic characteristics of a culture. | 3.16 | 1 | 4 | 3.94*** | 3 | 4 |
| I am sensitive to those who are discriminated against. | 3.14 | 1 | 4 | 3.76*** | 2 | 4 |

| | | | | | | |
|---|---|---|---|---|---|---|
| I prefer to work with people who have different cultural values from me. | 2.70 | 1 | 4 | 3.43*** | 1 | 4 |
| I am accepting of people with different religious and spiritual traditions. | 3.74 | 2 | 4 | 3.87 | 2 | 4 |
| I put the needs of others above my own personal wants. | 3.05 | 1 | 4 | 3.57*** | 1 | 4 |
| I can discuss cultural differences from an informed perspective. | 3.05 | 2 | 4 | 3.89*** | 2 | 4 |
| I am developing a meaningful philosophy of life. | .321 | 1 | 4 | 3.84*** | 3 | 4 |
| I intentionally involve people from many cultural backgrounds in my life. | 2.91 | 1 | 4 | 3.57*** | 1 | 4 |
| I rarely question what I have been taught about the world around me | 1.93 | 1 | 4 | 2.27 | 1 | 4 |
| I constantly need affirmative confirmation about myself from others. | 2 | 1 | 4 | 2.24 | 1 | 4 |
| I enjoy when my friends from other cultures teach me about our cultural differences. | 3.75 | 2 | 4 | 3.89 | 3 | 4 |
| I consciously behave in terms of making a difference. | 3.35 | 2 | 4 | 3.76*** | 2 | 4 |
| I am open to people who strive to live lives very different from my own life style. | 3.33 | 1 | 4 | 3.86*** | 3 | 4 |

*Academic Influence*

Each student's overall GPA was calculated in an effort to obtain an independent and quantitative measure of improvement that was not based on the surveys alone (Tables 10 and 11). While there were no significant differences between the two cohorts' overall GPAs from one semester to the next, both demonstrated improvement. The increase in grade differences among the 2016 cohort may be explained by the higher number of participants as well as marked differences between the pilot in 2015 and 2016 implementation of the program (e.g., instead of staying in hotels, students stayed with host families; after 2015, the class was worth 1 credit research hour). Other changes to the ELCIR Program from the 2015 to the 2016 cohort were: 1) having an engineering faculty member from the Southern University travel with the students and co-teach the class, 2) hands-on during the lab tours rather than a more passive non-hands tour in 2015, which allowed for in-depth interaction(s) with Mexican researchers, and finally, 3) more engagement on the cultural activities while in Merida, Yucatan.

The retention of both cohorts in the College of Engineering at Texas A&M University has been remarkable. For the 2015 cohort, 96% pursued a major within the College of Engineering at Texas A&M University, while 100% remained enrolled at Texas A&M University. For the 2016 cohort, 88% pursued a major within the College of Engineering at Texas A&M University. Twelve percent of the 2016 group left the university entirely. In the cohort of 2015, 88% were retained with Texas A&M University and the College of Engineering. While that in the cohort of 2016, 96% were retained at the College of Engineering at Texas A&M and 100% at Texas A&M University.

**Table 10.** Cohort 2015: Grade Differences from Spring to Fall Semester.

| Spring 2015 Overall GPA | Fall 2015 Overall GPA | Difference |
|---|---|---|
| 2.88 | 2.89 | .01 |

**Table 11.** Cohort 2016: Grade Differences from Spring to Fall Semester.

| Spring 2016 Overall GPA | Fall 2016 Overall GPA | Difference |
|---|---|---|
| 3.14 | 3.25 | .11 |

## Limitations

This study was only applied to first generation, low-income students who participated in an Engineering Success Program (ESP) first-year seminar.

## Future Directions

Program outreach may be increased by offering the ELCIR Program more broadly to other first generation students at the College of Engineering at Texas A&M University who may not necessarily be included in the targeted ESP first-year seminar for first generation, low-income students.

## Conclusion

Although these findings are preliminary, several positive conclusions can be identified in this study. Based on the students' answers, we can deduce that the experience helped the students to develop their personal and professional skills. For instance, there were statistically significant results in their confidence in research skills, the process of research, literature review, and cultural competency. Moreover, based on students' qualitative responses, this program allowed them to become more in touch with their engineer identity and encouraged thinking about professional work, furthering their careers beyond and undergraduate degree which, in turn, results in retention. Some of the students asserted that:

"This research trip has fueled my desire to be an engineer because I have now seen firsthand how an engineer affects millions of people and can bring forth many positive effects."

"It has given me added purpose to complete my degree. Research can open up new doors to create innovative approaches that can influence a change in the world and affect people's lives."

"I believe that this research trip has greatly opened my eyes to the international world of engineers in the sense that we are all interested in innovation and work for the same causes."

"This research trip allowed me to incorporate my ethnic background and use that knowledge and experience when needed. I feel like I know more and know how to apply it in the working field."

With further study and positive findings, research courses abroad, when they include a team of faculty and researchers from both countries, may prove an impactful resource to the research engineering portfolio for first generation, low-income, minority students. It may also be an important key to improving retention, creating pathways to graduate school, and providing access and affordability to global experiences for more students who fall in this category.

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## Appendix

Survey

1. Please answer the following open ended questions to the best of your ability to describe your educational experience during the course of the Engineering Learning Community Introduction to Research seminar. In your own words, please describe what it means to be a global engineer?
2. In your opinion, what do you expect to gain from this seminar?
3. What do you think you will gain from this trip to Merida, Yucatan, Foreign University 1?
4. How do you think this trip will impact and/or change your experiences as a U.S. University 1 Engineer student?
5. How do you think this trip will impact and/or change your knowledge of your ethnic identity?
6. In your own words, how do you determine what is right and what is wrong when making decisions?
7. In a few sentences, provide your own definition of research or describe what you think research is all about.
8. Please consider your current abilities or skills and indicate your level of agreement with each of the following statements (Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree):
    a) I have strong leadership skills.
    b) I have strong interpersonal (social) skills.
    c) I am able to develop a professional network.
    d) I am able to work effectively with others.
    e) I am able to work effectively on my own.
    f) I am able to manage my time effectively.
    g) I am able to work through obstacles or challenges.
    h) I am able to write a research proposal/plan.
    i) I am able to write a research abstract.
    j) I am able to create a research poster.
    k) I am able to give an oral research presentation.
    l) I am able to communicate technical information to people within my discipline.
    m) I am able to communicate technical information to people outside my discipline
    n) I have strong leadership skills.
    o) I have strong interpersonal (social) skills.
    p) I am able to develop a professional network.
9. What tasks or activities do you expect to do as part of your study abroad research experience? Check all that apply:
    a) Defining a research problem
    b) Developing a research hypothesis or research questions
    c) Conducting a literature review
    d) Designing an experiment
    e) Gathering data
    f) Analyzing data
    g) Modeling data
    h) Writing about research process/results

i) Presenting research process/results
j) Working in a research group or team
k) Work in a laboratory setting
l) Work in an office setting
m) Field work outside of a laboratory or office setting
n) Developing/using databases
o) Developing/using spreadsheets
p) Developing computer programs
q) Computational analysis
r) Statistical analysis
s) Other: _____

10. Please consider the area of research you are working in this summer, and indicate your level of knowledge with each of the following statements (Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree):

a) Knowledge of the process of research in this area
b) Knowledge of the research literature in this area
c) Knowledge of the research skills and/or lab techniques in this area
d) Knowledge of the graduate school application process.
e) Knowledge of how to do statistical analysis of research data.
f) Knowledge of how to interpret research data.
g) Knowledge of how to apply research data.

11. Please indicate your level of agreement with each of the following statements (Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree):

a) When I notice cultural differences, my culture tends to have the better approach.
b) I have a definite purpose in my life.
c) I can explain my personal values to people who are different from me.
d) Most of my friends are from my own ethnic background.
e) I think of my life in terms of giving back to society.
f) I am informed of current issues that impact international relations.
g) I know who I am as a person.
h) I feel threatened around people from backgrounds very different from my own.
i) I often get out of my comfort zone to better understand myself.
j) I am willing to defend my own views when they differ from others.
k) I am confident that I can take care of myself in a completely new situation.
l) I see myself as a global citizen.
m) I understand how various cultures of this world interact socially.
n) I get offended often by people who do not understand my point-of-view.
o) I am able to take on various roles as appropriate in different cultural and ethnic settings.
p) I put my beliefs into action by standing up for my principles.
q) I consider different cultural perspectives when evaluating global problems.
r) I know how to analyze the basic characteristics of a culture.
s) I am sensitive to those who are discriminated against.
t) I prefer to work with people who have different cultural values from me.
u) I am accepting of people with different religious and spiritual traditions.

v) I put the needs of others above my own personal wants.
w) I can discuss cultural differences from an informed perspective.
x) I am developing a meaningful philosophy of life.
y) I intentionally involve people from many cultural backgrounds in my life.
z) I rarely question what I have been taught about the world around me
aa) I constantly need affirmative confirmation about myself from others.
bb) I enjoy when my friends from other cultures teach me about our cultural differences.
cc) I consciously behave in terms of making a difference.
dd) I am open to people who strive to live lives very different from my own life style.

12. I identify my gender as:

13. Which of these do you identify as your ethnic origin?

a) White Only
b) American Indian Only
c) Asian Only
d) Black only + 2 or more/1 Black
e) Hispanic or Latino of any Race
f) Native Hawaiian Only
g) 2 or more/excluding Black
h) International

14. In general engineering, indicate what engineering major you would like to pursue. Please select one.

a) Aerospace Engineering
b) Biological & Agricultural Engineering
c) Biomedical Engineering
d) Chemical Engineering
e) Civil Engineering
f) Computer Science
g) Computer Engineering
h) Electrical Engineering
i) Engineering Technology/Electronic Systems Engineering Technology
j) Industrial Distribution
k) Industrial Engineering
l) Materials Science & Engineering
m) Mechanical Engineering
n) Nuclear Engineering
o) Ocean Engineering
p) Petroleum Engineering
q) Radiological Health Engineering

15. Outside of the ELCIR/Regents' Scholar Program, have you participated in any prior research experience? If so, please indicate how many academic semesters you were involved in.

a) No prior research experience.

b) Yes, 1 academic semester (1 academic semester= fall or spring or summer).
c) Yes, 2 academic semesters.
d) Yes, 3 academic semesters.
e) Yes, 4 academic semesters.
f) Yes, more than 4 academic semesters (provide number _____)
g) Other please specify: _____

16. If you answered "yes" above, please indicate the type of compensation (select all that apply).

a) Voluntary (received no compensation)
b) Course Credit
c) Monetarily as an employee (e.g. student worker)
d) Monetarily through a scholarship/grant
e) Other please specify: _____

17. Currently, what are your plans after graduation (choose one)?

a) Go to graduate school full time for a Doctoral degree (PhD) in an engineering-related field
b) Go to graduate school full time for a Masters (non-research oriented) in an engineering-related field
c) Go to graduate school full time for a Masters (research oriented) in an engineering-related field
d) Go to graduate school full time for a Medical degree (MD, DO)
e) Go to graduate school full time for a Law degree (JD)
f) Go to graduate school full time for a other advanced degree outside engineering (e.g. business, occupational therapy, psychology, etc.)
g) Go to work, then not pursue a graduate degree
h) Go to work, then pursue a doctoral degree in an engineering-related field
i) Go to work, then pursue a masters (non-research) degree in an engineering-related field
j) Go to work, then pursue a masters (research oriented) degree in an engineering-related field
k) Go to work, then pursue a Medical degree (MD, DO)
l) Go to work, then pursue a Law degree (JD)
m) Go to work, then pursue an advanced degree outside engineering (e.g. math, physics, business, occupational therapy, psychology, etc.)
n) I am uncertain
o) Go to work, then pursue a masters (research oriented) degree in an engineering-related field
p) Go to work, then pursue a Medical degree (MD, DO)