Portraits of Success: A Mixed-Method Study of the Enrollment, Persistence, and Success Experiences of Female Graduate Engineering Students at a Hispanic Serving Institution

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PORTRAITS OF SUCCESS: A MIXED-METHOD STUDY OF THE ENROLLMENT, PERSISTENCE, AND SUCCESS EXPERIENCES OF FEMALE GRADUATE ENGINEERING STUDENTS AT A HISPANIC SERVING INSTITUTION

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Dedication

I dedicate this dissertation to my dear aunt Elizabeth B. Asbell (†) for sharing her scarce resources and big heart in allowing me to live with her when I first moved to the United States and for helping me be the woman that I am today. ¡Siempre te estaré agradecida querida tía! I would also like to dedicate my dissertation to my beloved husband Gil Covarrubias for his love, patience, encouragement, support, for letting me be, but most of all for giving me the freedom and strength to pursue my dreams. ¡Gracias mi amor!

I also dedicate this dissertation to my beautiful children Natalia and Gil Covarrubias who are my life and inspiration and who gave me their love, strength, encouragement, and support throughout this journey. ¡Hijos, son mi orgullo, corazón y vida! Espero que Dios me de vida para verlos llegar muy alto.

También dedico esta disertación a mis queridos padres Ramón y Celia Aguirre and my sisters and brothers Maria de los Angeles, Celia, Ramón, Iliana, Jose Felix and Alberto Aguirre who have taught me that everything is possible through hard work and dedication.

And last but not least, I dedicate this dissertation to my dear nephews: Rodolfo Alberto Aguirre, Erick Adrian Aguirre, Alberto Medina, Pedro Chavez y Hugo Blancas but most of all to my precious nieces Nancy Aguirre, Michelle Aguirre, Valeria Aguirre, Itzel Blancas, Paola Medina, Vianey Blancas, Andrea Chavez, Fernanda Medina, Ximena Aguirre, and Regina Aguirre. All of you have the intelligence, strength, and ability to achieve each and every one of your dreams. The key is perseverance. May God give me life to see all of you achieve your dreams and be successful!
PORTRAITS OF SUCCESS: A MIXED-METHOD STUDY OF THE ENROLLMENT, PERSISTENCE, AND SUCCESS EXPERIENCES OF FEMALE GRADUATE ENGINEERING STUDENTS AT A HISPANIC SERVING INSTITUTION

by

SANDRA AGUIRRE-COVARRUBIAS, B.A.; M. Ed.

DISSERTATION

Presented to the Faculty of the Graduate School of
The University of Texas at El Paso
in Partial Fulfillment
of the Requirements
for the Degree of

DOCTOR OF EDUCATION

Department of Educational Leadership and Foundations
THE UNIVERSITY OF TEXAS AT EL PASO
May 2013
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I would like to thank and acknowledge the guidance, support, encouragement, and professionalism of my advisor, mentor, and dear friend Dr. Eduardo Arellano. Thank you for your expertise, commitment, countless hours of support towards the completion of my dissertation and for always seeking nothing but excellence. I would also like to thank my committee members, Dr. Arturo Pacheco, Dr. Penelope Espinoza, and my esteemed friend and colleague Dr. Carlos Ferregut for their valuable advice, support, and encouragement throughout this journey. I would also like to thank Dr. Richard Schoephoerster, Dean of the College of Engineering for allowing me to conduct this study at the College of Engineering and Dr. Benjamin Flores, Dean of the Graduate School and Professor of Electrical and Computer Engineering for facilitating the official list of students who applied for the spring 2012 graduation. I would also like to thank all the women who participated in this study. You know who you are. Without your support, I could not have accomplished this dissertation. Thank you for your trust, for allowing me to interview you, but most of all for sharing such valuable experiences. I learned a lot from you. I would also like to thank my closest friends in Cohort 13; Amber-Archuleta Lucero, Gus Monzon, Catie McCorry-Andalis, and Jesus Hinojos for their friendship, encouragement, and support throughout this journey. And last but not least thanks to my dear colleagues Joseph Ramos who was always willing to provide technical support and Oscar Salcedo who always stopped by my office to ask about the progress of my dissertation. ¡Mil gracias a todos!
Abstract

The current study addresses the underrepresentation of female graduate engineering students. Specifically, its purpose was to gain insight on how enrollment, persistence, and success factors are experienced by female graduate engineering students at a Hispanic Serving Institution located on the U.S.-Mexico border. The topic of underrepresentation of female graduate engineering students is important for higher education practitioners because in spite of the numerous attempts to increase their enrollment in science, technology, engineering and mathematics, their underrepresentation has persisted. The current study is modeled after research conducted by Cordova-Wentling and Camacho (2006). The research question that guides the current study is: How have female graduate engineering students experienced a select number of enrollment, persistence, and success factors? The methodology utilized in the current study consisted of a quantitative portion and a qualitative portion. The quantitative portion included a questionnaire adapted from Cordova-Wentling and Camacho’s study (2006) and a literature review. The qualitative portion included three semi-structured focus groups with master’s level students and one semi-structured interview with a doctoral student. Results of the study indicated a wide array of reasons why participants pursue graduate studies in engineering. The results also indicated that participants experienced a wide array of challenges during their academic programs. However, the students’ persistence and their families’ support allowed them to succeed in their respective programs. The results enabled the researcher to share recommendations to make a greater difference in the enrollment, persistence, and success of female graduate engineering students.
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Chapter 1: The Problem

Introduction

The topic of the underrepresentation of female graduate engineering students is important for scholars and practitioners of higher education because in spite of the strategies that many stakeholders have designed and implemented to increase participation in engineering careers since the 1980s, enrollment in science, technology, engineering, and mathematics (STEM) related fields has, for the most part, remained the same (Thomson and Lyons, 2008). In addition, according to the National Science Foundation’s (NSF) Science and Engineering Indicators (2010) in 2006 about 26% of scientists and engineers were 50 years or older. Thus, one out of four scientists and engineers would be near retirement age by 2017, only six years away (Kettani, 2009). Research shows that minority groups such as Hispanics, African-Americans, and women are an untapped resource that could help overcome the nation’s shortage of engineering graduates (Kettani, 2009; Thomson and Lyons, 2008). However, female engineering students continue to leave their engineering programs during the first two years (Bottomley, Rajala, and Poter, 1999; Seymour and Hewitt, 1997). Studies have suggested that the underrepresentation of female students in engineering is due to social and environmental factors on and off campus (Haden and Lapan, 2007; Hall and Sandler, 1982; Hill, Corbett, and Rose, 2010), performance pressures, lack of role models and financial difficulties (Hartman and Harman, 2006), issues of confidence, and discrimination, (Bottomley et al., 1999; Hall and Sandler, 1982), stereotypes, stress, and feelings of isolation (Anderson-Rowland, Bernstein, and Felipe Russo, 2007) among other factors. In the literature review, I will expand on the topic of enrollment, persistence, and success factors experienced by female graduate engineering students and fully describe and present evidence of the problem of the underrepresentation of women in engineering.
It is vital to examine the factors outlined above to unveil the conditions that female graduate engineering students have faced throughout their academic journey. By conducting an in depth analysis of the factors, administrators of higher education could design effective and sustainable strategies to recruit, retain, and graduate female engineering students in a timely manner. In addition, support services for this particular student population could be developed and serve as a catalyst to change the departmental and institutional cultures that have prevailed at institutions of higher education for decades and which have in turn negatively impacted the enrollment, persistence, and success of female graduate engineering students. Moreover, by increasing the number of female engineering graduates higher education administrators could incorporate different points of views and skills in the profession that have been omitted because of their underrepresentation. Research shows that female perspectives have not been fully been taken into account in engineering designs and therefore some of the items designed by engineers, mostly men, are not completely suitable for women nor accommodate their specific body structure, weight, and needs (Margolis and Fisher, 2002).

Furthermore, attracting and retaining women in STEM related fields will maximize innovation, creativity, and competitiveness due to the fact that engineers design many of the items we encounter in our daily lives including buildings, bridges, computers, cars, wheelchairs, and X-ray machines. However, when women are not involved in the design of these products, needs and desires unique to women may be overlooked (Hill et al., 2010). Furthermore, by increasing the number of women in engineering these women will help increase diversity in the values and perspectives of engineering personnel and will help change methods and processes of delivering class material to future generations of engineers (Anderson-Rowland et al., 2007).
The objective of the current study is to gain insight on how enrollment, persistence, and success factors are experienced by female graduate engineering students. For purposes of the study persistence is operationally defined as continuance of a student in college enrollment while success is operationally defined as students who have applied for graduation. Research regarding the experiences of undergraduate and graduate women in engineering has concentrated on recruitment and retention efforts. Some of these efforts have included innovative and creative strategies to create a pipeline from elementary school to graduate school (Anderson-Rowland, 1996; Anwar, Acar, & Rung, 2002; Dozier, Blaisdell, & Anderson-Rowland, 1997; Martin & Wardle, 1999; Secola, Smiley, Anderson-Rowland, Castro & Tomaszewski, 2001). Other initiatives have analyzed increasing diversity in engineering and have focused their efforts at examining the barriers or challenges minority populations and first generation college students face when pursuing an engineering degree (Cordova-Wentling & Camacho, 2006; Fernandez, Trenor, Zerda, & Cortes, 2008; Haden & Lapan, 2007; Kettani, 2009). A book entitled, Why So Few? (Hill et al., 2010) dedicates ten chapters to address issues related to women and engineering and presents findings that provide evidence that social and environmental factors contribute to the underrepresentation of women in science and engineering. In addition, most studies that have analyzed the recruitment and retention of women in engineering have focused on the factors of the students’ journey at the beginning and/or middle of their programs, but not the end (Cordova-Wentling & Camacho, 2006). However, the current study focuses on female graduate engineering students who are about to graduate from a college of engineering.
Problem Statement

The study will be conducted at an urban Hispanic Serving Institution (HSI) located on the U.S./Mexico border with a student population of over 22,000. The university is home to a majority Hispanic student population many of whom are first generation college students. Currently, the university offers 75 bachelors, 78 masters, and 19 doctoral degrees with others in development. The university is on a quest to become the first national research (Tier One) university aiming to serve an emerging 21st century student demographic population. During fiscal year 2011-2012 the university operated with a budget of $404.6 million and generated approximately 6,905 local jobs contributing an estimated $423 million to the personal income of local individuals. Additionally, it is estimated that the university generated $438 million in university-related local business. Furthermore, it is estimated that the impact of the construction undergoing at the university will increase business volume by $139 million by 2013. The university counts with seven colleges: College of Business Administration, College of Education, College of Engineering, College of Health Sciences, College of Liberal Arts, College of Science, and the School of Nursing. During the fall 2011 semester, the College of Engineering reported an enrollment of about $3, 154 students: 2,575 undergraduate students, 428 master’s students, and 151 doctoral students. 79% of the overall student population, at the college, are Hispanic, 19.3% are female students and 80.7% are male students. Also, in the fall of 2011 the college employed 76 tenure/tenure-track faculty which was composed of 9% female faculty and 91% male faculty.
Table 1: HSI’s Tenure/Tenure-Track Faculty by Gender

![Bar chart showing Tenure/Tenure-Track Faculty by Gender over years]

Source: HSI’s Center for Research in Engineering and Technology Education, 2011

The college offers six bachelors programs, 12 masters programs, and five doctoral programs in addition to featuring active research programs in infrastructure and sustainability, advanced manufacturing and materials, biomedical and health systems, information and security, and engineering education. The college adheres to the following principles: Diversity Drives Innovation, Research Fuels Preeminence, Collaboration Creates Opportunities, and Balance Secures Sustainability through which it intends to Change the Face of Engineering and provide Access to Excellence.

The HSI, as other universities in the US also faces the underrepresentation of women in its engineering programs (American Society for Engineering Education, 2010). Data at the undergraduate level reflects low female enrollment. As shown in Table 2, in the fall 2006, the enrollment of female undergraduate students was 20% compared to 80% of male enrollment. Five years later, the enrollment remains pretty much the same. However, in raw numbers there is an increase of ninety four female students from 2006 to 2011.
Table 2: HSI’s Engineering Enrollment at the Undergraduate Level

<table>
<thead>
<tr>
<th></th>
<th>Fall 2006</th>
<th>Fall 2007</th>
<th>Fall 2008</th>
<th>Fall 2009</th>
<th>Fall 2010</th>
<th>Fall 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>19%</td>
</tr>
<tr>
<td>Male</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
<td>81%</td>
</tr>
<tr>
<td>Undergraduate Total</td>
<td>2106</td>
<td>2106</td>
<td>2218</td>
<td>2323</td>
<td>2436</td>
<td>2575</td>
</tr>
</tbody>
</table>

Source: HSI’s Center for Research in Engineering and Technology Education, 2011

As shown in Table 3, in the fall of 2006, the enrollment of female master’s students was 24% compared to 76% of male enrollment. Again, five years later, in the fall of 2011, the enrollment of female master’s students was 21% compared to 79% of male enrollment.

However, in raw numbers there is an increase of ten female students from 2006 to 2011.

Table 3: HSI’s Engineering Enrollment at the Master’s Level

<table>
<thead>
<tr>
<th></th>
<th>Fall 2006</th>
<th>Fall 2007</th>
<th>Fall 2008</th>
<th>Fall 2009</th>
<th>Fall 2010</th>
<th>Fall 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>24%</td>
<td>23%</td>
<td>25%</td>
<td>23%</td>
<td>20%</td>
<td>21%</td>
</tr>
<tr>
<td>Male</td>
<td>76%</td>
<td>77%</td>
<td>75%</td>
<td>77%</td>
<td>80%</td>
<td>79%</td>
</tr>
<tr>
<td>Master’s Total</td>
<td>334</td>
<td>341</td>
<td>354</td>
<td>368</td>
<td>418</td>
<td>428</td>
</tr>
</tbody>
</table>

Source: HSI's Center for Research in Engineering and Technology Education, 2011

Data at the doctoral level reflects a similar scenario. As shown in Table 4, in the fall of 2006, the enrollment of female doctoral students was 27% compared to 73% of male enrollment.

Five years later, in the fall of 2011, the female doctoral students enrolled at the HSI’s engineering programs consisted of 19% compared to 81% of male students. However, in raw numbers there is also an increase of six female students from 2006 to 2011.

Table 4: HSI’s Engineering Enrollment at the Doctoral Level

<table>
<thead>
<tr>
<th></th>
<th>Fall 2006</th>
<th>Fall 2007</th>
<th>Fall 2008</th>
<th>Fall 2009</th>
<th>Fall 2010</th>
<th>Fall 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>27%</td>
<td>27%</td>
<td>30%</td>
<td>26%</td>
<td>22%</td>
<td>19%</td>
</tr>
<tr>
<td>Male</td>
<td>73%</td>
<td>73%</td>
<td>70%</td>
<td>74%</td>
<td>78%</td>
<td>81%</td>
</tr>
<tr>
<td>Doctoral Total</td>
<td>82</td>
<td>86</td>
<td>84</td>
<td>90</td>
<td>132</td>
<td>150</td>
</tr>
</tbody>
</table>
Source: HSI’s Center for Research in Engineering and Technology Education, 2011

The situation faced by this particular HSI reflects a common scenario at the national level (ASEE, 2010). ASEE’s data at the undergraduate level shows a slight increase of female enrollment. As shown in Table 5, in the fall 2006, the enrollment of undergraduate female engineering students was 17.4% compared to 83.6% of male enrollment. Five years later, the enrollment of female students was of 18.8% compared to 81.2% of male enrollment.

Table 5: ASEE’s Engineering Enrollment at the Undergraduate Level

<table>
<thead>
<tr>
<th></th>
<th>Fall 2006</th>
<th>Fall 2007</th>
<th>Fall 2008</th>
<th>Fall 2009</th>
<th>Fall 2010</th>
<th>Fall 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>17.4%</td>
<td>17.5%</td>
<td>17.9%</td>
<td>18.2%</td>
<td>18.6%</td>
<td>18.8%</td>
</tr>
<tr>
<td>Male</td>
<td>83.6%</td>
<td>82.5%</td>
<td>82.1%</td>
<td>81.8%</td>
<td>81.4%</td>
<td>81.2%</td>
</tr>
<tr>
<td>Undergraduate Total</td>
<td>373,074</td>
<td>385,690</td>
<td>403,191</td>
<td>427,503</td>
<td>450,685</td>
<td>471,730</td>
</tr>
</tbody>
</table>


At the master’s level, ASEE’s data reflects no changes in female enrollment. As shown in Table 6, in the fall of 2006, the enrollment of master’s female students was 22.2% compared to 77.8% of male enrollment. Again, five years later, in the fall of 2011, the percentage of master’s female students enrolled at universities across the nation remains exactly the same although the number has increased.

Table 6: ASEE’s Engineering Enrollment at the Master’s Level

<table>
<thead>
<tr>
<th></th>
<th>Fall 2006</th>
<th>Fall 2007</th>
<th>Fall 2008</th>
<th>Fall 2009</th>
<th>Fall 2010</th>
<th>Fall 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>22.2%</td>
<td>22%</td>
<td>22%</td>
<td>21.6%</td>
<td>21.8%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Male</td>
<td>77.8%</td>
<td>78%</td>
<td>78%</td>
<td>78.4%</td>
<td>78.2%</td>
<td>77.8%</td>
</tr>
<tr>
<td>Master’s Total</td>
<td>83,515</td>
<td>89,573</td>
<td>92,815</td>
<td>99,382</td>
<td>103,335</td>
<td>103,757</td>
</tr>
</tbody>
</table>


At the doctoral level, ASEE’s data reports a slight decrease in the percentage of female students. As shown in Table 7, ASEE reported that in the fall of 2006, the enrollment of doctoral female students was 22.2% compared to 77.8% of male enrollment. Five years later, in the fall of
2011, the female doctoral students enrolled at universities across the nation consisted of 21.8\% compared to 78.2\% of male students.

Table 7: ASEE’s Engineering Enrollment at the Doctoral Level

<table>
<thead>
<tr>
<th></th>
<th>Fall 2006</th>
<th>Fall 2007</th>
<th>Fall 2008</th>
<th>Fall 2009</th>
<th>Fall 2010</th>
<th>Fall 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>22.2%</td>
<td>22.5%</td>
<td>22.6%</td>
<td>22.9%</td>
<td>22.8%</td>
<td>21.8%</td>
</tr>
<tr>
<td>Male</td>
<td>77.8%</td>
<td>77.5%</td>
<td>77.4%</td>
<td>77.1%</td>
<td>77.2%</td>
<td>78.2%</td>
</tr>
<tr>
<td>Doctoral Total</td>
<td>57,566</td>
<td>58,318</td>
<td>59,450</td>
<td>64,013</td>
<td>67,369</td>
<td>69,796</td>
</tr>
</tbody>
</table>


Although, in some instances, the percentages of female graduate engineering students at the HSI are slightly higher than those at the national level the HSI still faces the underrepresentation of female graduate engineering students in its programs.

**Purpose of the Study**

The purpose of the study is to gain insight on how enrollment, persistence, and success factors are experienced by female graduate engineering students. Although there is considerable research regarding engineering students, it is focused at the undergraduate level (Cordova-Wentling & Camacho, 2006; Hill et al., 2010). Additionally, most research does not address female graduate engineering students who are near completion of a graduate engineering program nor the specific factors associated with their enrollment, persistence, and success at this critical stage with the exception of Cordova-Wentling & Camacho (2006) who studied these factors at the undergraduate level. Furthermore, the knowledge gained from the study may be used by the college of engineering administration, faculty, and professional staff to address issues that may surface in an effort to recruit, retain, and successfully graduate female engineering students thus fulfilling the HSI’s college mission to provide access to excellence (HSI’s College of Engineering, 2011). Moreover, although the demographic characteristics of the
HSI may be unique among other research universities because of its majority Hispanic student population many of whom are first generation college students and because of its geographic location on the U.S./Mexico border, the findings of the current study may serve as the basis to conduct additional research to better understand the underrepresentation of female graduate engineering students at other institutions of higher education across the nation.

Research Question

The current study is modeled after research conducted by Cordova-Wentling and Camacho (2006) in the article entitled: Women Engineers: Factors and Obstacles Related to the Pursuit of a Degree in Engineering. Cordova-Wentling and Camacho (2006) employed a mixed method design which included a questionnaire to determine the factors that have hindered and assisted graduating female engineering students in pursuing and completing an engineering degree (Appendix A). Their qualitative design included focus groups with a random sample of the graduating female engineering students to further probe their experiences in deciding and completing an engineering degree. The current study took Cordova-Wentling and Camacho (2006)’s study further by examining how the enrollment, persistence, and success factors identified by the authors and the literature review, are experienced by female graduate engineering students at the HSI being studied. The research question that guides the study is: How have female graduate engineering students experienced a select number of enrollment, persistence, and success factors?

Thus, the quantitative portion of the current study included a questionnaire which as previously mentioned is an adaptation of Cordova-Wentling and Camacho’s questionnaire and included items based on the literature review. The questionnaire was administered to all graduate engineering students who applied for the spring 2012 graduation in order to compare female and
male responses and identify the most prominent factors experienced by female graduate engineering students. The questionnaire developed for the current study is included in Appendix E.

The qualitative portion of the current study included focus groups in which all of the female graduate engineering students who applied for graduation were invited to further probe the data from the questionnaire. The protocol for the focus groups is included in Appendix G. A detailed description of both the quantitative and qualitative instruments for the current study is fully explained in the methods section where the instruments are discussed.

**Researcher’s Bias**

I work as an associate director for graduate studies & research at the Hispanic Serving Institution where the current study took place. Since I started working at the HSI’s college of engineering five years ago, I noticed that there were not too many women in engineering. Having worked in several positions in higher education for almost twenty years where women were abundant, I could not help but notice the big difference in engineering. When I took a closer look, I realized that the number of undergraduate female students in engineering was rather small compared to that of male engineering students. I also noticed that from undergraduate to masters and from masters to doctoral the number of female engineering students became much smaller. Thus, I was quite intrigued by such a phenomenon and in order to better understand the reasons why this was happening and most importantly in order to help increase the number of female engineering students, I decided to conduct the current study. Because of my position at the HSI’s college of engineering, I work with all the graduate students in engineering and care about them. I also know quite a few of the participants in the current study. Furthermore, I strongly believe that instead of being a burden to the participants, my role as an administrator and the level of
trust I had already gained throughout my tenure in this position made participants feel comfortable and allowed them to be as honest as possible in conveying their respective experiences with me.

**Summary**

The chapter identified a series of social and environmental factors on and off campus that have impacted female engineering students and that previous studies suggest are the cause of their underrepresentation. It provided a brief description of the HSI where the current study was conducted and reported its engineering enrollment statistics along with those reported by ASEE, at the national level. In addition, the chapter pointed out that the current study was focus on female graduate engineering students who are about to graduate from a college of engineering to gain insight on how they have experienced a select number of enrollment, persistence, and success factors. Furthermore, the chapter outlined the research question of the current study and briefly described the quantitative and qualitative portions which are fully explained in the methods section. The next chapter, the literature review will provide an overview of the initiatives and strategies universities have undertaken to address the issue of the underrepresentation of women in engineering in addition to discussing the gaps in research. The literature review will also expand on the factors introduced in chapter 1 and will fully illustrate the conditions that female engineering students have faced throughout their academic programs.
Chapter 2: Literature Review

Introduction

The following literature review describes the research regarding the experiences of undergraduate and graduate women in engineering. The review discusses recruitment and retention strategies aimed at undergraduate students to ensure their success and to increase the participation of under-represented students of color, Latinas/os and African American students, and women; the factors related to the pursuit of a degree in engineering for women in engineering; and the differences in campus climate for undergraduate and graduate women in engineering.

Recruitment and Retention Strategies of Female Engineering Students

The article entitled, Women in Engineering at North Carolina State University: An Effort in Recruitment, Retention, and Encouragement written by Laura Bottomley, Sarah Rajala, and Richard Porter (1999), provides an overview of the approaches used by the North Carolina State University (NCSU)’s Women in Engineering Program to ensure female students’ success. This program emerged because of several conditions that had prevailed at NCSU. According to (Bottomley et al., 1999) female students made up between 19% and 25% of the entering class of engineering students each fall at NCSU and although the proportion of females varied from year to year, it had not increased since 1994. Since 1995, the College of Engineering at NCSU had administered the University of Pittsburgh’s “Attitude about Engineering” questionnaire to entering students during their first year. An analysis of the questionnaire had consistently shown that female engineering students began their academic program with less confidence than their male counterparts. The analysis also indicated that such confidence gap persisted and deepened even though women outperformed their male counterparts by earning a 0.2 higher grade point.
average during their first year in the engineering programs. However, the analysis did not specify the length of the confidence gap. In addition, the analysis indicated that female students left the college and the university at a higher rate than men which seems to indicate, according to the authors, that female students’ experiences differed from that of males. However, the analysis did not describe the experiences the authors are referring to in the article. A study of the same 1996 class of entering students showed that, as of the spring 1999, about 20% of the female students were enrolled in another college and 21% had left the university while 12% of male students were enrolled in another college and 18% left the university. Nevertheless, according to the authors, these findings are consistent with those at other institutions across the country (Fraser & Ismail, 1997). So, presumably the authors concluded that female engineering students tend to have more negative college experiences than male students. Given that the authors did not provide any citations, one is compelled to investigate the experiences of female engineering students.

In 1997 and 1998, NCSU conducted focus groups with entering female students in an effort to assess their needs and plan a program of support and encouragement to meet such needs. Twenty-four female students participated in the focus groups which were announced in class and via electronic mail. Those in attendance claimed that they did not need support programs nor wanted to be singled out. They also stated that the ratio of male to female students was not something they noticed. They also thought that engineering was more difficult for their male peers and indicated that their male peers did not have to study with the frequency that they studied. Furthermore, subsequent to the focus groups some women shared stories of discrimination and harassment, but details of these issues were not addressed in the article. The reasons why students expressed stories of discrimination after the focus groups were not
mentioned either. So, it leaves one wondering if other female students had similar experiences. It also shows a missed opportunity to address important questions.

However, in spite of the feedback received through the focus groups and due to the conditions that until then had prevailed at NCSU, administrators at NCSU felt the need to create a program for women in engineering. Therefore, in 1997, the Women in Engineering Program at NCSU was initiated with the clear understanding that the program should not start or end at the college entry level. According to (Bottomley et al., 1999), research indicates that support and encouragement at the college level will not be sufficient to address the deficit of women in engineering without the addition of significant outreach efforts to students in K-12. Thus, the efforts of the NCSU program began at the elementary and middle school levels with school visits to encourage girls to view math and science as fun disciplines for which they have the ability to succeed. The program also offered summer and freshman year experiences to bridge students from high school to college and provided mentoring and other support-oriented programs and career fairs aimed at facilitating the transition to graduate experiences.

Regarding assessment of the program, the authors stated that each individual program was evaluated annually at critical points, but did not specify the critical points. Overall, the Women in Engineering Program at NCSU was assessed by tracking the number of students participating in some aspects of the program; retention rate for female engineering students; entry rate of female engineering students; and performance of female students versus male students. However, retention and performance were not defined by the authors. In addition, it is assumed that they are referring to undergraduate students but no specific level is mentioned by the authors. The feedback received through this assessment will presumably be taken into account for subsequent program activities.
The analysis of the University of Pittsburgh’s “Attitude about Engineering” survey administered to entering students during their first year is of great value because it provides a set of findings that are consistent with those at other universities in the United States (Fraser and Ismail, 1997). However, the article fails to address the issue of why women begin their careers with less confidence, why the gap persists, why it deepens and for how long. Furthermore, the article also mentions that subsequent to the focus groups some women shared stories of discrimination and harassment but again fails to expand on such critical issues. Nevertheless, the article provides valuable insights and an innovative strategy for its time, aiming at recruiting female students for engineering programs beginning at the elementary and middle school levels and offering summer and freshman year experiences to bridge students from high school to college in an effort to change attitudes about women in engineering.

Another article written in 2006 also illustrates recruitment and retention efforts of female undergraduate engineering students. The article entitled, Work in Progress: An Initial Assessment of the Effect of the First Year Experience on Under-Represented Student Retention in Engineering, written by Lorelle Meadows, Jana Nidiffer, Stephen R. Ball, Cinda-Sue G. Davis, and William W. Schultz (2006) indicates that the under-represented students of color, especially Latina/o and African American students, and women (also referred to as URS) do not enroll in engineering in numbers compared with their enrollment in other disciplines and those who initially enroll in engineering fail to remain in the discipline. The challenge for the authors was to determine what changes in the campus climate and/or engineering curriculum were necessary to increase URS enrollment and persistence. However, the term climate was not defined by the authors. The goal of the project was “…to establish an inventory of student retention data for URS in engineering at the University of Michigan to determine the likelihood of persistence
based on an evaluation of student intentions upon enrollment, deliberateness of course choices, and perceptions of the first year experience” (Meadows et al., 2006). Furthermore, the objective of the project was to follow these students based upon their initial choices and intentions to seek patterns of difference in female and under-represented minority students. The motivation behind the study was because at the University of Michigan women and students of color dropped from engineering at a much higher rate than the majority of students, resulting in a loss of diversity among those graduating. However, the authors did not provide statistics to support their claims. According to the article, nationally, students leave engineering due to “performance pressures”, “financial difficulties”, “lack of role models” and “lack of relevance to personal goals.” However, none of these concepts were fully described in the article. Therefore, one still wonders why female students do not pursue engineering fields; why they drop; whether they experience a campus climate different from male students; and if changing the engineering curriculum is the key to the persistence and success of female graduate engineering students.

The study employed a voluntary online questionnaire for engineering students enrolled from 2001 to 2005. The article does not mention the reason why this timeframe was chosen. The questionnaire was developed through focus groups composed of personnel from the counseling, advising, and a research team on URS in Science, Technology, Engineering, and Mathematics (STEM) fields. However, no specific reason was given by the authors as to why these staff members were chosen. The questionnaire was composed of three main categories that questioned students regarding motivation, institutional integration, goals in engineering, first year courses, and questions regarding campus climate. However, the term institutional integration was not operationalized by the authors. All questions were accompanied by Likert-type scale responses option. The questionnaire was sent to a total of 5,531 students of which 757 (14%) participated
in the study. Female students comprised 35% of the sample, compared to 39.9% of the same population at the college. Minority students comprised 21.8% of the sample, compared to 27.4% of the same population at the college. Thus, according to the authors, although the response rate was relatively modest, sub-groups of interest were well represented, and the sample served the research interest. An initial analysis of the survey results indicated that:

- The majority of the students understood the necessity of enrolling in science and math courses and saw their relevance to the field in engineering;
- Eighty percent understood that engineers are involved in communities but almost half of them felt that they work behind the scenes rather than in the forefront. However, the article did not define what “behind the scenes” meant.
- Sixteen percent did not feel socially connected to their college. But the article did not describe what “socially connected” meant.
- Twelve percent had difficulty envisioning themselves as engineers in the future;
- Six percent did not plan to continue in engineering;
- Seventy percent were concerned about their grades;
- Fifty percent were concerned about financing their education; and
- Overall students felt much more discrimination from their male peers than from faculty. Although the article mentions that in regards to discrimination the highest occurrence was related to gender, it failed to provide specific details.

The (Meadows et al., 2006) article introduces key concepts that have been utilized in other articles but that are not fully described. For instance, according to the article the concepts of “performance pressures” and “relevance to personal goals” among others are reasons why students leave engineering at the national level. However, these concepts are not defined. In
addition, the survey results indicated that “16% did not feel socially connected to their college” and that “overall students felt much more discrimination from their male peers than from faculty” which leads the reader to believe that there is some sort of alienation among these students that may be worth further exploring. Furthermore, if students leave engineering due to “performance pressures” and the survey results indicated that “70% are concerned about their grades,” it would be worth exploring why. Finally, a way to complement this study is to conduct a qualitative study to further explore some of the responses and consider other relevant issues in engineering education such as campus climate and lack of role models, among others.

Challenges for Women in Engineering

Cordova-Wentling and Camacho’s (2006) article addresses the challenges women face in their pursuit of a degree in engineering. The article begins by laying out facts regarding women’s lack of participation in STEM related fields. According to the 2004 Science and Engineering Indicators from the NSF there is a decline in the number of U.S. citizens pursuing a STEM related field while the number of jobs requiring scientists and engineers is increasing. In addition, according to the U.S. Department of Commerce (2011) although women fill close to half of all jobs in the U.S. economy, they continue to be underrepresented in STEM jobs holding only less than 25% of STEM jobs. Furthermore, according to Bell, Spencer, Iserman, & Logel (2003) only 41.9% of women who enroll in engineering programs complete their undergraduate degree which Cordova-Wentling and Camacho (2006) indicate that women are encountering barriers that have prevented them from completing their education. Furthermore, according to several authors (Anderson-Rowland, 1996; Anwar et al., 2002; Dozier et al., 1997; Martin and Wardle, 1999; Secola et al., 2001) a limited number of universities and research studies have concentrated on determining and creating effective ways to recruit women into engineering.
throughout the educational pipeline from elementary school to graduate school. But the authors
do not address specific, creative ways. Martin & Wardle (1999) also argue that researchers have
hypothesized that the pipeline problem is caused by factors in society that relate to the
socialization process of young women, and characteristics of engineering fields that create
implicit barriers for underrepresented populations. However, the authors do not specify the
factors in society that impact the socialization process of women or the characteristics in
engineering fields that create such barriers. The authors also mentioned that most studies that
have analyzed the recruitment and retention of women in engineering have focused on the factors
of the students’ journey at beginning and/or middle of their programs. They point out that there
is very little systemic empirical research that focuses on students who are about to graduate from
an engineering department and stress the importance of studying these students’ experiences.
This approach is needed because by analyzing the factors that have led female engineering
students to the completion of their engineering programs administrators of higher education
could unveil new factors that have not been considered before in the literature.

Thus, Cordova-Wentling and Camacho (2006) focused on the factors that have hindered,
encouraged and assisted graduating female students, in pursuing and completing an engineering
degree at the undergraduate level. Four major research questions guided Cordova-Wentling and
Camacho (2006) study:

1) What factors have hindered women when deciding to pursue a degree in engineering?
2) What factors have assisted women in deciding to pursue a degree in engineering?
3) What factors have hindered women while completing a degree in engineering?
4) What factors have assisted women in completing a degree in engineering?
This study’s conceptual framework was based on Lent, Brown, and Hackett’s Social Cognitive Career Theory (1994) which claims that over the course of our childhood and adolescence, we are exposed to cognitive-person factors, contextual mechanisms, and experiential/learning mechanisms that are crucial when deciding which career to pursue due to the fact that they influence the formation of academic/career interests, which in turn results in the choice of academic/career goals. Once the career is chosen, the cycle repeats itself and we are exposed, once again, to person factors, contextual, experiential, and learning mechanisms that influence our performance and persistence of educational goals. A detailed explanation of how this theory applies to the study will be included in the framework section.

According to Cordova-Wentling & Camacho (2006), their study focused on the experiences women go through when deciding to pursue and in completing an engineering degree in order to recognize the patterns and increase our understanding of the positive and negative factors that impact women. Both quantitative and qualitative data were collected. The quantitative data was collected through a questionnaire. The qualitative data was collected through focus groups with a random sample of the graduating female engineering students at a university in the U.S. Midwest. The population involved all the senior female engineering students who were graduating from the Midwest University in the spring of 2005. The master list of 127 female engineering students was obtained from the Women in Engineering Office at the University in the Midwest. Of the 127 female students who were graduating, 89 students completed the survey, constituting a return rate of 70.08% and a total of 24 female students participated in the focus groups. The students for the focus groups were randomly selected from the master list of students also.
The survey results for the first research question: What factors have hindered women when deciding to pursue a degree in engineering? indicated that the five most frequent high school obstacles that participants faced included those shown in Table 8.

Table 8: High School Factors that Hinder Women when Deciding to Pursue an Engineering Degree

<table>
<thead>
<tr>
<th>Factor</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited career information/exposure</td>
<td>49%</td>
</tr>
<tr>
<td>Lack of advice from school counselor on engineering career options</td>
<td>39%</td>
</tr>
<tr>
<td>Lack of university engineering programs information</td>
<td>15%</td>
</tr>
<tr>
<td>Attended a high school with limited math/science/technology course opportunities</td>
<td>15%</td>
</tr>
<tr>
<td>Lack of encouragement from teachers to pursue math/science/technical field</td>
<td>10%</td>
</tr>
</tbody>
</table>

Regarding family factors, 62% of study participants could not identify any family factors that hindered them in their academic decision process, and 38% of participants identified family factors that hindered them in their academic decision process. Of the latter group, the five most frequent family obstacles reported are included in Table 9.

Table 9: Family Factors that Hinder Women when Deciding to Pursue an Engineering Degree

<table>
<thead>
<tr>
<th>Factor</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of assistance in math/science/technology homework at home</td>
<td>44%</td>
</tr>
<tr>
<td>Lack of family role models and/or mentors</td>
<td>35%</td>
</tr>
<tr>
<td>Lack of financial support from parents for college tuition</td>
<td>32%</td>
</tr>
<tr>
<td>Parents did not support my decision to major in engineering</td>
<td>15%</td>
</tr>
<tr>
<td>Parents wanted me to pursue a degree in a traditional female field like nursing/teaching</td>
<td>12%</td>
</tr>
</tbody>
</table>

As far as personal factors are concerned, the five most frequent personal factors that hindered the participants when deciding to pursue a degree in engineering included those shown in Table 10.
Table 10: Personal Factors that Hindered Women when Deciding to Pursue an Engineering Degree

<table>
<thead>
<tr>
<th>Factor</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of knowledge related to engineering careers</td>
<td>45%</td>
</tr>
<tr>
<td>Feeling like an outsider in advanced math/science/technology classes</td>
<td>24%</td>
</tr>
<tr>
<td>Low self-esteem/confidence related to math/science/technology courses</td>
<td>22%</td>
</tr>
<tr>
<td>Lack of understanding of courses needed for getting accepted into</td>
<td>12%</td>
</tr>
<tr>
<td>engineering program</td>
<td></td>
</tr>
<tr>
<td>Lack of interest in engineering field</td>
<td>10%</td>
</tr>
</tbody>
</table>

In regards to societal factors, the five most frequent societal obstacles reported by the study participants are included in Table 11.

Table 11: Societal Factors that Hindered Women when Deciding to Pursue an Engineering Degree

<table>
<thead>
<tr>
<th>Factor</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering is represented as a male dominated field</td>
<td>45%</td>
</tr>
<tr>
<td>Public image of engineering field is mostly male</td>
<td>38%</td>
</tr>
<tr>
<td>Lack of women engineer role models/mentors in my community</td>
<td>36%</td>
</tr>
<tr>
<td>Low expectation of females</td>
<td>34%</td>
</tr>
<tr>
<td>Traditional views about education/careers for women</td>
<td>25%</td>
</tr>
</tbody>
</table>

The results of the survey for the second research question: What factors have assisted women in deciding to pursue a degree in engineering? indicated that the five most frequent high school factors identified by the participants included those outlined in Table 12.

Table 12: High School Factors that Have Assisted Women when Deciding to Pursue an Engineering Degree

<table>
<thead>
<tr>
<th>Factor</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did well in classes related to math/science/technology</td>
<td>90%</td>
</tr>
<tr>
<td>Classes taken in high school (e.g., math, science, physics, technology)</td>
<td>88%</td>
</tr>
<tr>
<td>Excellent math/science/technology teachers</td>
<td>73%</td>
</tr>
<tr>
<td>Teachers who encouraged me to pursue my interest in</td>
<td>55%</td>
</tr>
<tr>
<td>math/science/technology</td>
<td></td>
</tr>
<tr>
<td>Participation in extracurricular activities in high school (e.g., math</td>
<td>26%</td>
</tr>
<tr>
<td>science/olympiad)</td>
<td></td>
</tr>
</tbody>
</table>

Regarding family factors, the five most frequent family factors reported by participants included those shown in Table 13.
Table 13: Family Factors that Have Assisted Women when Deciding to Pursue an Engineering Degree

<table>
<thead>
<tr>
<th>Factor</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parents support of my personal career choice</td>
<td>83%</td>
</tr>
<tr>
<td>Parents encouragement to pursue an engineering degree</td>
<td>62%</td>
</tr>
<tr>
<td>Male engineer role-model in my family (e.g., father, brother, uncle)</td>
<td>44%</td>
</tr>
<tr>
<td>Parents provided advice and information about careers in engineering</td>
<td>30%</td>
</tr>
<tr>
<td>Female engineer role-model in my family (e.g., mother, sister, aunt)</td>
<td>16%</td>
</tr>
</tbody>
</table>

As far as personal factors, the five most frequent personal factors reported by participants included those shown in Table 14.

Table 14: Personal Factors that Have Assisted Women when Deciding to Pursue an Engineering Degree

<table>
<thead>
<tr>
<th>Factor</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like problem solving</td>
<td>71%</td>
</tr>
<tr>
<td>Personal satisfaction</td>
<td>66%</td>
</tr>
<tr>
<td>High aptitude in engineering fields</td>
<td>65%</td>
</tr>
<tr>
<td>Interested/fascinated by science and technical things</td>
<td>55%</td>
</tr>
<tr>
<td>Engineering will give me opportunities to make a difference</td>
<td>48%</td>
</tr>
</tbody>
</table>

As far as the societal factors, the five most frequent ones reported by participants included those shown in Table 15.

Table 15: Societal Factors that Have Assisted Women when Deciding to Pursue an Engineering Degree

<table>
<thead>
<tr>
<th>Factor</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering has many different job opportunities</td>
<td>78%</td>
</tr>
<tr>
<td>Engineering is an interesting and challenging field</td>
<td>73%</td>
</tr>
<tr>
<td>Engineering is a high salary field</td>
<td>65%</td>
</tr>
<tr>
<td>Engineering has a good job market</td>
<td>62%</td>
</tr>
<tr>
<td>I was inspired by progress and accomplishments in science and technology</td>
<td>40%</td>
</tr>
</tbody>
</table>

The results of the survey for the third research question: What factors have hindered women while completing a degree in engineering? indicated that the ten most frequent university obstacles the participants encountered included those shown in Table 16.
Table 16: University Factors that Hindered Women while Completing an Engineering Degree

<table>
<thead>
<tr>
<th>Factors</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ineffective professors</td>
<td>55%</td>
</tr>
<tr>
<td>Professors who did not motivate me</td>
<td>49%</td>
</tr>
<tr>
<td>Low grades in engineering classes</td>
<td>44%</td>
</tr>
<tr>
<td>Poor teaching quality</td>
<td>36%</td>
</tr>
<tr>
<td>Too much homework</td>
<td>36%</td>
</tr>
<tr>
<td>Excessively competitive environment</td>
<td>35%</td>
</tr>
<tr>
<td>Curriculum too demanding</td>
<td>29%</td>
</tr>
<tr>
<td>Class material too difficult</td>
<td>28%</td>
</tr>
<tr>
<td>Lack of female professors</td>
<td>25%</td>
</tr>
<tr>
<td>Lack of female classmates</td>
<td>25%</td>
</tr>
</tbody>
</table>

Regarding family factors, 85% of the study participants could not identify any factors in their families that hindered them while completing a degree in engineering and 15% of the participants identified family factors that hindered them while completing their engineering degrees. Of the latter group, the three most frequent family obstacles reported were lack of family involvement, support, and/or encouragement (69%); lack of financial support from family (23%) and family too far away (23%).

Regarding personal factors, the five most frequent ones are shown in Table 17.

Table 17: Personal Factors that Have Hindered Women while Completing an Engineering Degree

<table>
<thead>
<tr>
<th>Factors</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of free time</td>
<td>66%</td>
</tr>
<tr>
<td>Doubts about career goals</td>
<td>56%</td>
</tr>
<tr>
<td>Low self-esteem/confidence</td>
<td>31%</td>
</tr>
<tr>
<td>Lack of motivation</td>
<td>25%</td>
</tr>
<tr>
<td>Lack of self-discipline</td>
<td>19%</td>
</tr>
</tbody>
</table>

The results of the survey for the fourth research question: What factors have assisted women in completing a degree in engineering? indicated that the six most frequent university factors identified by the participants included those shown in Table 18.
Table 18: University Factors that Have Assisted Women in Completing an Engineering Degree

<table>
<thead>
<tr>
<th>Factor</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involvement in campus student organizations</td>
<td>54%</td>
</tr>
<tr>
<td>Teaching quality/excellent professors</td>
<td>46%</td>
</tr>
<tr>
<td>Good performance in engineering classes</td>
<td>43%</td>
</tr>
<tr>
<td>Internships</td>
<td>39%</td>
</tr>
<tr>
<td>Supportive/encouraging/motivational professors</td>
<td>37%</td>
</tr>
<tr>
<td>Enjoyed engineering classes</td>
<td>37%</td>
</tr>
<tr>
<td>Good guidance by advisors/counselors</td>
<td>35%</td>
</tr>
<tr>
<td>Received scholarship/fellowship</td>
<td>34%</td>
</tr>
<tr>
<td>Good relationships with professors</td>
<td>30%</td>
</tr>
<tr>
<td>Not wanting to lose credit if switching majors</td>
<td>30%</td>
</tr>
</tbody>
</table>

Regarding family factors, the four most frequent family factors reported by the participants included those shown in Table 19.

Table 19: Family Factors that Have Assisted Women in Completing an Engineering Degree

<table>
<thead>
<tr>
<th>Factor</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supportive and encouraging family</td>
<td>88%</td>
</tr>
<tr>
<td>Family helped financially</td>
<td>75%</td>
</tr>
<tr>
<td>Family members assisted in engineering homework</td>
<td>13%</td>
</tr>
<tr>
<td>Family helped me get an internship</td>
<td>11%</td>
</tr>
</tbody>
</table>

As far as personal factors, the ten most frequent personal factors reported by the participants included those shown in Table 20.

Table 20: Personal Factors that Have Assisted Women in Completing an Engineering Degree

<table>
<thead>
<tr>
<th>Factor</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I make sure my assignments are turned in on time</td>
<td>83%</td>
</tr>
<tr>
<td>I am a hard worker</td>
<td>78%</td>
</tr>
<tr>
<td>I study with my classmates/friends</td>
<td>76%</td>
</tr>
<tr>
<td>Perseverance/determination</td>
<td>72%</td>
</tr>
<tr>
<td>I am self-motivated</td>
<td>69%</td>
</tr>
<tr>
<td>Support from classmates/friends</td>
<td>64%</td>
</tr>
<tr>
<td>I am highly disciplined</td>
<td>60%</td>
</tr>
<tr>
<td>I study enough to make sure I do well in my classes</td>
<td>58%</td>
</tr>
<tr>
<td>I am happy I chose to major in engineering</td>
<td>58%</td>
</tr>
<tr>
<td>I am rarely absent from classes</td>
<td>57%</td>
</tr>
</tbody>
</table>
Regarding the feedback obtained from the focus groups, the following outlines what I considered to be some of the most important concepts learned in the Cordova-Wentling & Camacho’s study (2006). First, engineering faculty are described by participants in this study as “unfriendly, rude, condescending, unavailable, self-righteous, uncaring, impersonal, and unkind.” A participant in this study claimed that an engineering faculty made the following statements to her: “You should know these kinds of things…my third grade daughter knows how to do this.” Another participant also stated that “many of my professors were not dedicated to their teaching and undergraduate students instead they were more focused in their research and graduate programs.” Another participant stated that “My advisor was rude and used a tough approach in his advising. Nothing I did was ever good enough for him.” These examples describe the rudeness of some of the professors at this Midwest University as pointed out by the authors. However, the examples cited above also lead the reader to believe there is an unconscious bias and perhaps even discrimination against women in engineering which was not addressed by the authors. Second, participants of the focus groups also stated that “In several of my advance engineering classes, I was literally the only female…you don’t have anybody to relate to in your classes and you probably won’t have anybody to relate to in the workplace…” Another participant said “Male and females come from a different mindset; therefore there should be a different course structure so that women feel a little more at home when they are pursuing a degree in engineering.” The authors explained that participants felt that professors in engineering courses should provide a class structure that includes more opportunities for girls to have positive and successful experiences. Another participant stated “It was hard to find other people in my classes that I felt I could talk with, because there were only a few girls… At first it was hard for me to meet people, so I felt so lonely.” Another participant said “When students in
your classes are mostly male, I think in general it is so hard to not let the intimidation get to you because it is so prevalent.” The examples above described issues of self-doubt, low self-confidence, intimidation, and fear of failing as described by the authors. However, they also lead the reader to believe there is a great sense of isolation among the participants in this study that is not addressed by the authors. Third, participants of the focus groups also stated that they actively participate in campus students organizations. One participant had this to say: “I made a lot of friends through my association with the Society for Women in Engineering (SWE).” Another participant stated that “My first three years here I lived in one of the dorms that had a living-learning community for women, it was called women in math, science, and engineering (WIMSE)…It was really good to meet people in your major right away, so you can establish a support network immediately.” These findings revealed the importance of study groups and of having a good support network as described by the authors.

In conclusion, the literature and findings of Cordova-Wentling & Camacho’s study (2006) revealed that traditionally society has not favored women to pursue engineering degrees. Therefore, it is important to encourage and support female students to enroll in science, math, and technology classes at the high school level. And high school teachers and counselors should encourage and motivate female students’ interest to pursue an engineering degree. It is also imperative to expose female students to science and engineering to awake at an early age to increase their interest and aptitude. Higher education administrators should be aware that perceived low ability, academic difficulties, performance problems or perceptions of low grades are major reasons why female students reject or quit particular choices. In addition, Cordova-Wentling & Camacho’s study (2006) addressed a gap in women in engineering literature that can help improve the engineering environment. Furthermore, their study analyzed the experiences of
undergraduate female engineering students while completing their degree but also examined the experiences that these women went through when deciding to pursue an engineering degree.

**Campus and Classroom Environments: A Chilly Climate for Women in Engineering**

An article that addressed the issue of climate is entitled, *Differences in Climate for Undergraduate and Graduate Women in Engineering: The Effect Context*, written in 2006 by Elizabeth Litzler and Sheila Edwards Lange. The authors begin their introduction by stating that Hall & Sandler (1982, 1984) first coined the term “chilly climate” to describe the classroom experiences of undergraduate women and that the construct of the term has been extended to include experiences outside the classroom, graduate student experiences and the academic workplace for female faculty and administrators. According to the authors, a chilly climate is defined by the isolation, subtle discrimination and persistent micro-inequities experienced by women and underrepresented groups in academic settings. Litzler and Lange (2006) also claim that what constitutes a gender difference in climate at the undergraduate level is not always a gender difference at the graduate level. Several studies use the term “climate” or “chilly climate” but this is the first article that defines it. In addition, Litzler and Lange (2006) also state that department climate in terms of STEM graduate education is characterized by departmental differences in the orientation and support provided to students, faculty expectations of and relationships with graduate students, and the quality of student peer relationships. According to the authors, there is research on gender differences in climate for graduate students and gender differences in climate for undergraduate students but there is no research that compares gender differences in climate experiences at the different educational levels. There is also limited research on the climate at engineering colleges. According to Litzler and Lange (2006), their study was intended to fill these gaps. The research questions that guided their study were: How
does the educational climate experienced by female engineering students at the graduate and undergraduate level differ? Are gender differences in climate pervasive, or does the context of engineering education affect the experience climate? However, these questions were not clear to the reader because the concepts utilized were not fully explained.

The conceptual framework that guided Litzler and Lange’s study (2006) is based on previous research. The expectation is that multiple factors such as classroom experiences, laboratory experiences, relationships with faculty, degree of professional development, and work/family balance affect ones overall perception of climate. And climate has an effect on the retention of students, especially women. Their study focuses on classroom experiences and faculty relationships.

The methodology of Litzler and Lange (2006) included two surveys; the “Engineering Undergraduate Student Experience Survey” and the “Science and Engineering Graduate Student Experience Survey”, which were administered in 2004 at the University of Washington (UW). The surveys explored the students’ experiences and included questions regarding the quality of teaching, lab experiences, departmental climate, professional development, relationships with faculty and mentors, and degree progress, among others. The authors state that the “Engineering Undergraduate Student Experience Survey” was administered in April/May of 2004 to a sample of engineering undergraduate students and that a total of 447 surveys were completed resulting in a 31% response rate. However, the authors do not mention the total number of participants. The web-based Science and Engineering Graduate student Survey was administered to graduate students enrolled in 19 UW science and engineering departments. But the authors do not specify the names of these departments. The survey was administered to 1224 participants of which 574 returned usable surveys, resulting in a response rate of 47%. 
In regards to the analysis and results, Litzler and Lange (2006) employed a t-test analysis to assess gender differences among undergraduate students and gender differences among graduate students. The t-test measured whether there were statistically significant differences in the means for the two groups. The similarities in climate for undergraduate and graduate women were enlightening. According to the authors, women in engineering continue to feel singled out because of their gender, and gender biases continue to exist. Another climate issue that crosses educational level lines is that women feel overwhelmed by the pace and workload of engineering. However, the authors point out that it is unclear why women feel more overwhelmed than men by the pace and workload of engineering but sustain that this finding, which had had supporting evidence in the early 1990’s, continued to be true in 2006.

Regarding gender differences in climate unique to undergraduate students these are primarily related to classroom experiences, which according to Litzler and Lange (2006) support the hypothesis that the context of education has effects on gender differences in the experience of climate. According to the authors, women reported being taken seriously by faculty in the classroom more than men but felt isolated and negatively affected by competition more than men reported. The authors attribute the female students’ sense of isolation and negative experiences to competition to the lack of working relationships with their male classmates.

As far as gender differences in climate unique to graduate students, these revolve around relationships with faculty. According to Litzler and Lange (2006) one of the most important factors related to a graduate students’ matriculation is their relationship with their advisor. However, in this regard they also indicate that it is alarming that women consistently reported lower satisfaction in their relationships with faculty compared to men. According to the authors, women reported being treated with less respect by their advisor. They felt their advisor was less
available to them. They felt that grades were not based solely on performance in the classroom, and also reported greater experiences of sexual harassment than graduate men reported. The authors point out that the finding that women feel they are treated with less respect by their advisor and that their advisor is less available to them has serious implications for women’s outcomes during and after graduate school, but do not describe the implications. Nevertheless, the authors point out that the support of faculty in general and mainly the support of an advisor is of great importance for a graduate student’s retention and advancement in engineering. Litzler and Lange (2006) also state that the fact that female graduate students’ experiences with sexual harassment are greater than male graduate students is not unexpected. They claim that historically, females have been the subject of harassment by male colleagues and professors. What concerns them is that the harassers are likely to be the women’s advisors, faculty members, and colleagues not so much the issue of sexual harassment itself which they fail to address leaving the reader with the perception that perhaps it is to an extent somewhat common to observe this type of behavior.

In summary, Litzler and Lange’s study (2006) outlines the similarities in climate for undergraduate and graduate women in engineering and claim that women feel singled out because of their gender, that gender biases continue to exist, and that women feel overwhelmed by the pace and workload of engineering. The authors also point out the differences in climate for undergraduate and graduate women in engineering and state that a “chilly climate” for undergraduate students is mainly experienced in the classroom while graduate students consider that their experiences with faculty and advisors is what constitutes a “chilly climate” for them.
Summary

The analysis of the articles described above illustrate some of the research available regarding the initiatives that many institutions of higher education have undertaken to address the issue of underrepresentation of women in engineering. A review of the literature available indicates that most of the research has taken place in the West, Midwest, and Northeast regions of the U.S. Few research has been conducted in the South. In addition, most of the research available addresses students at the undergraduate level. Few studies address graduate level students. Furthermore, some of these studies employ a quantitative design and some a mixed methodology. However, those studies which employed a mixed design do not fully address some of their findings and in some cases fail to establish a correlation between them. What is also common in the research available is that the authors fail to describe the concepts utilized in their studies but what is most alarming is that issues of discrimination and sexual harassment are prevalent in their findings. Nevertheless, the articles analyzed outline valuable characteristics of the research available regarding the underrepresentation of women in engineering.
Chapter 3: Methodology

Research Design

As discussed in the introduction, the research question of the study was: How have female graduate engineering students experienced a select number of enrollment, persistence, and success factors? In order to address the research question, the current study built on a mixed method design conducted by Cordova-Wentling and Camacho (2006) and included additional factors found through a literature review. Specifically, students were asked to report the extent to which they experienced the selected factors. Permission to conduct the current study at the HSI being studied was requested and granted. See Appendix B for the Institutional Review Board (IRB) approval. The following describes the participants, the instruments, the data collection, and its analysis.

Participants

A master list of all the graduate engineering students, who officially applied for the spring 2012 graduation, was requested and granted from the HSI’s Graduate School Dean. Thus, the list included all students at the end of their programs because the focus was on the success stories. The quantitative portion of the current study included both female and male graduate engineering students in order to compare female and male responses and identify the most prominent factors experienced by female students. However, the qualitative portion only included female graduate engineering students who were invited and agreed to participate through the questionnaire. Permission from the HSI’s College of Engineering Dean was requested (See Appendix C for letter of request) and granted (See Appendix D for permission granted). The participants’ confidentiality and anonymity was protected by not identifying them.
individually. Only the researcher had access to the data. The data was stored in a password protected computer in the researcher’s office which was also locked when the researcher was not present. Hard copies were stored in a locked file cabinet to which only the researcher has access. The results of the study are reported in aggregate form only. Furthermore, the information gathered was solely used to gain insight on the enrollment, persistence, and success factors experienced by female graduate engineering students.

**Instruments**

The quantitative portion of the current study included a questionnaire adapted from Cordova-Wentling and Camacho’s study (2006) and a literature review to address the enrollment, persistence, and success factors experienced by female and male graduate engineering students at a single HSI. The questionnaire is included in Appendix E. The questionnaire consisted of four major sections: factors that may have contributed to the students’ enrollment, factors that may have contributed to the students’ persistence, factors that may have contributed to the students’ success, and the students’ profile section. All but the profile section used a 4-point Likert type scale. The values of the scale were assigned as follows: 1 = “Not At All”, 2 = “A Little”, 3 = “Some” and 4 = “A Lot.”

The questionnaire consisted of closed-ended items. The current study required participants to check from a list provided. It is assumed that the participants of the study were truthful when answering the questionnaire. Furthermore, some of the concepts used in the questionnaire were described to ensure participants in the study clearly understood the questions being asked. The questionnaire included a cover letter (Appendix F) explaining the purpose of the study, its potential benefit to the advancement of the college mission, the protocol to be followed in gathering and storing data, and consent to participate in the study.
The qualitative portion of the current study included one semi-structured interview with a doctoral student and three semi-structured focus groups with master’s level students. Only one doctoral student participated in the qualitative portion of the current study because only one doctoral female student applied for graduation during the spring 2012 semester. However, the researcher felt it was valuable to incorporate the doctoral participant’s feedback. The final protocol is included in Appendix G. Female students were invited and agreed to participate in the qualitative portion of the current study through the questionnaire. The interview and focus groups were hosted during final exams week as soon as the students completed their respective exams and final presentations. The first focus group took place outside the college of engineering but within the HSI to ensure the participants’ comfort. However, the interview and the remaining two focus groups took place at the researcher’s home for the comfort and convenience of the students. Participants in the interview and focus groups were asked to complete a demographic sheet. The information gathered from the demographic sheet (Appendix H) was used in the development of the participants’ profile. Participants were also asked to complete a consent form (Appendix I) which addressed the protocol to be followed in addition to a promise of confidentiality form (Appendix J). The interview and focus groups were audio recorded by using an IPod and notes were also taken to ensure proper documentation of students’ participation. The interview and focus groups audio recording time averaged seventy two minutes. The minimum audio recording time was forty five minutes and the maximum audio recording time was ninety five minutes. The audio files were stored in a locked file cabinet in the researcher’s office which was also locked. The researcher transcribed the audio files. The average number of pages transcribed was fifteen pages per interview. The minimum number of pages transcribed was nine pages and the maximum number of pages transcribed was nineteen pages per interview. Each
participant was provided $20.00 in cash as an incentive to participate in the interview and focus groups.

Data Collection and Analysis

The survey was administered towards the end of the spring semester right before final exams week because the researcher wanted to focus on the success stories. The survey was administered via the Internet through SurveyMonkey.com beginning on April 9, 2012. The first reminder was sent five working days later, the second reminder was sent after ten working days, and the survey was finally closed 15 working days after it was originally sent. The survey was sent to a total of 86 students which included 60 male students and 26 female students. The response rate was 46.91% which represented 22 male students and 13 female students, and an additional 5 students who did not respond to the gender question.

SurveyMonkey.com was used because it has the ability to administer questionnaires using e-mail invitations, it records respondents and non-respondents, and it has the ability to analyze results as soon as the data is entered. Furthermore, the data can be easily downloaded into statistical and spreadsheet programs such as Excel and SPSS or it can be viewed through SurveyMonkey.com in graphic or table format (Gay, Mills and Airasian, 2009).

Conducting an online survey offers several advantages. It allows the researcher to reach groups and individuals who otherwise would be difficult to reach (Garton, Haythornthwaite, & Wellman, 1999; Wellman, 1997). It allows the researcher to reach thousands of people with common characteristics in a short amount of time, despite their geographic location (Bachmann & Elfrink, 1996; Garton et al., 1999; Taylor, 2000). And it saves money avoiding printing, postage, and data entry costs (Bachmann & Elfrink, 1996; Couper, 2000; Llieva, Baron, & Healey, 2002). However, there are also disadvantages in utilizing on-line questionnaires. These
may include having multiple email addresses for the same person, multiple responses from participants, and invalid/inactive email addresses (Andrews, Nonnecke, & Preece, 2003; Couper, 2000). However, SurveyMonkey allows the researcher to restrict responses to one per IP address to ensure participants can only take the survey once (SurveyMonkey, 2011). An IP address is a unique number that every computer connected to the Internet is assigned. If more than one participant is connected to the same IP address, the researcher can assign each participant a specific link through a special tool offered by SurveyMonkey to avoid multiple responses from participants. The same tool also offers the researcher to track responses and send reminders to those participants who haven’t responded.

The data was analyzed using frequency distributions which allowed the researcher to identify the factors in the study that reported the highest frequency. Only factors with means of 3.5 out of 4.0 were considered in the focus groups protocol. A higher than 3.0 threshold was set so as to not have an excessive amount of focus group questions.

In addition to the questionnaire, a qualitative method was used because it allows the researcher to provide an account of the world through observation and theoretical interpretation of what is seen, by asking specific questions and interpreting what is said, by writing field notes and transcribing audio-and video-recordings (Hammersley and Atkinson, 1983). A qualitative method also allows the researcher to make the invisible, visible through documentation of concrete details which in turn yields to understanding the social phenomenon being analyzed (Ericson, 1986). In the case of the current study, the social phenomena are a select number of enrollment, persistent and success factors experienced by a group of female graduate engineering students. Specifically, the qualitative data of the current study was analyzed using grounded theory. Grounded theory allows the researcher to develop theory from the data, rather than the
other way around, making it an inductive approach that moves from the specific to the general (Strauss and Corbin, 1998). Therefore, during an initial analysis of the transcribed material, the researcher identified emerging themes and patterns by coding, memoing, and sorting. After these steps, the researcher re-examined the transcribed material to find quotes that support the patterns and themes identified in the initial analysis and then write an accurate report of what transpired during the focus groups. The initial analysis, re-examination, and write up of findings took approximately six to eight weeks.

**Summary**

This chapter addressed the research design reiterating the research question that guides the current study. It also provided a detailed description of the participants and emphasized that in order to identify the most prominent factors experienced by female students; the researcher included female and male responses in the quantitative portion of the current study. The chapter also pointed out the instruments utilized in the current study for both the quantitative and qualitative portions. And concluded with a thorough description of how the data was collected and analyzed again in both the quantitative and qualitative portions of the current study. The following chapter will discuss in detail the results of the current study by describing the participants and by rendering an account of the experiences they reported.
Chapter 4: Results of the Study

Introduction

This chapter provides the participants’ demographic information for both the quantitative and qualitative portions of the current study. Regarding the quantitative portion, this chapter identifies the factors that reported a mean of 3.5 or higher among female graduate engineering students in the enrollment, persistence, and success sections of the questionnaire. These factors in addition to those identified through the literature review were considered for the focus group protocol. In the Likert type scale used in the current study, 3.0 means “Some” but a higher than 3.0 threshold was set so as to not have an excessive amount of focus group questions. Regarding the qualitative portion, the chapter also describes in detail the experiences reported by the participants for each of the questions addressed in the focus group protocol (See appendix G). Thus, the chapter describes what about engineering encouraged participants to enroll in graduate engineering studies and how having a positive attitude, self-confidence, and time management skills contributed to their persistence and success. In addition, the chapter describes the participants’ experiences in their respective programs and addresses their experiences regarding discrimination and overall climate in their respective programs.

Profile of Participants for the Quantitative Portion

The participants in the quantitative portion of the current study included male and female graduate engineering students who applied for the spring 2012 graduation. As previously mentioned in chapter 3 the response rate of the questionnaire was of 46.91% which included 22 male students, 13 female students, and 5 students who did not respond to the gender question. Of the 22 males, 82% were Hispanic/Latino, 4.50% were Asian American/Pacific Islander, 4.50%
were White/Caucasian, and 9% stated that they belonged to another race or ethnicity. Of the 13 females, 61% were Hispanic/Latino(a), 31% were White/Caucasian, and 8% said they belonged to another race or ethnicity. Of the 22 male students, 86.36% were master’s students and 13.36% were doctoral students. Of the master’s students 26.3% of them specialized in Mechanical Engineering, 15.8% in Industrial Engineering, 10.5% in Civil Engineering, 10.5% in Computer Engineering, 10.5% in Computer Science, 10.5% in Engineering Multidisciplinary which encompasses a concentration in either Biomedical Engineering, Software Engineering, or Education Engineering, 10.5% in Systems Engineering, and 5.3% in Electrical Engineering. Of the doctoral students, 66.66% of them specialized in Electrical & Computer Engineering and 33.33% in Computer Science. Of the 13 female students 92% were master’s students and 8% represented a doctoral student. Of the master’s students, 25% specialized in Civil Engineering, 25% in Electrical Engineering, 17% in Engineering Multidisciplinary, 17% in Systems Engineering, 8% in Environmental Engineering, and another 8% in Metallurgical & Materials Engineering. The doctoral student’s specialization was in Environmental Science and Engineering. On average, male students studied 16 hours a week compared to 24 hours of study by female students. Of the 22 male students, 59.09% were single and 40.90% were married and of the 13 female students 92.30% were single and 7.69% were married. Male students’ age ranged from 23 to 48 while female students’ age ranged from 23 to 46 years old.

Select Comparisons of Quantitative Portion Responses

A full comparison of male and female responses obtained from the questionnaire administered in the quantitative portion of the current study is included in Appendix K. Table 21 below indicates the enrollment factors experienced by female graduate engineering students that reported a mean of 3.5 or higher compared to the means of male participants.
Table 21: Comparison between Male and Female Responses Regarding Enrollment Factors

Table 22 below indicates the persistence factors experienced by female graduate engineering students compared to male participants. Again, only factors that reported a mean of 3.5 or higher by female participants are included.
Table 22: Comparison between Male and Female Responses Regarding Persistence Factors

Table 23 below indicates the success factors experienced by female and male graduate engineering students. Again, only factors that reported a mean of 3.5 or higher by female participants are included.

Table 23: Comparison between Male and Female Responses Regarding Success Factors
Profile of Participants for the Qualitative Portion

The participants in the qualitative portion of the current study were female graduate engineering students who applied for the spring 2012 graduation. Of the nine participants, 78% were Hispanic/Latino(a) and 22% were White/Caucasian. Also of the nine participants, 89% were master’s students and 11% represented the doctoral student. Of the master’s students, 62.5% of them were international students: One from Brazil, one from the Czech Republic, two from Mexico, and one from the Slovak Republic. The remaining 37.5% were domestic students, U.S. citizens or permanent residents. The doctoral participant was also a domestic student. Of the eight master’s participants, 37.5% specialized in Electrical Engineering, 25% in Civil Engineering, 12.5% in Environmental Engineering, 12.5% in Metallurgical and Materials Engineering, and 12.5% in Systems Engineering. The doctoral participant’s specialization was in Environmental Science and Engineering. The participants’ ages ranged from 23 to 46 years old (See Appendix K) for a full listing of the participants’ age.

Reasons why Participants Pursued Graduate Studies in Engineering

When asked to describe what about engineering encouraged them to pursue graduate studies in the field, participants reported a wide array of reasons for their enrollment in engineering. Some participants stated that they loved engineering and felt that by being enrolled in engineering they could make a difference in their communities. Others felt that having an undergraduate degree in engineering was not enough academic preparation to be truly successful in their own field. Some said that they enrolled in engineering because they enjoyed math and physics and had inspiring teachers in high school. While some stated that their motivation to enroll in graduate engineering studies was the possibility of having a well-paid job upon
graduation. Azucena for instance loved engineering and felt engineering would provide her with tangible tools to make a difference in her community:

I love engineering. I think it is the best field. If you want to do something for your community I think it is the best field because the area provides you with tools, with tangible with real facts to do something about changing, evolving, about development, about everything, I mean engineering is the core. Even at your house, you have to use those tools and skills and mindset to solve problems.

Margarita felt that her undergraduate degree in engineering was not enough academic preparation to be truly successful in her field and decided to pursue a master’s degree:

I thought that I had not learned enough with my bachelor’s so I always thought that I could learn more and more about my field in order to work on it, that’s why I decided to get going with my studies.

Paloma and Genoveva picked engineering after high school because they both liked math and physics and were very good at the subjects. Paloma also wanted to learn more about her field and believed that by pursuing graduate studies she could accomplish her goal:

My undergraduate degree is in Electrical Engineering. I guess I picked that up after high school. I wanted either to be a pediatrician or an engineer which is like two opposite things. I guess too. I like working with kids very much but I was also very good at my physics classes in high school. I thought they were easy and I liked math too. It was something that I enjoyed, it’s kind of weird but I enjoyed it. So, once I started at [the university] I was in between Civil Engineering and Electrical Engineering. Civil because in high school I was like in drawing and designing and all sorts of things like that but I guess I picked, I picked Electrical because I heard that that area was very challenging and
for my graduate level… I don’t know if at the time I wasn’t ready to go working because I
didn’t want to or but… now I think I understand that it was more like… I thought there
was something much more to learn for me that I needed to stay at school, but now I do
feel like that I need to work and experience other things and learn from the field and
school and apply all that I learned in my graduate level.

In addition to enjoying math and physics while in high school, Genoveva was also
inspired by her math professor and a friend who at the time was also pursuing an engineering
degree:

My bachelor’s I did it in Electrical Engineering and my Master’s in Electrical
Engineering as well. I went into the engineering field because I did most of school in Cd.
Juarez, Chihuahua [in Mexico] and when I started high school my parents moved to El
Paso and I didn’t speak any English at all and I remember that I was in the classes and I
didn’t understand most of the stuff the professors were talking about but when I was in
my math and physics class I was able to visualize what the professor was talking about
and I really enjoyed science so that was mainly why I went in that field. Also, my math
professor he was a mechanical engineer and he worked for Boeing and I remember I used
to talk to him a lot about it and I went especially in electrical engineering because I had a
friend, he is a mechanical engineer and he was at [the university] at the time. I was still in
high school and he was always saying that electrical engineering was really hard, and I
am a really competitive person, so I went into electrical engineering.

Sofia and Yadira reported that their motivation to pursue graduate studies in engineering
was the possibility of having a well-paid job upon graduation. Sofia had this to say:
For me the motivation was that people in engineering degrees usually get good jobs and they are like…how to say it…they have a different point of view. It makes you think. I really like it. I don’t know why. I really like it. I just feel good in this field.

In addition to having a good job upon graduating, Yadira also said that engineering could allow her to make a difference in society:

…I guess my goal is…you look at society and you say there are a lot of people that need our help…and also you can get a lot of good jobs…you are thinking in capitalism form, right? So, I guess I thought engineering was the best option for me since I really, really want to help people. So, I guess I am not good talking in front of people but I am good at solving problems. That’s why I did my undergraduate degree in metallurgy, that’s why I just finished with my master’s in environmental engineering, and that’s why I will probably do a Ph.D. in environmental engineering as well.

Carolina stated that her decision to pursue graduate studies in engineering was based on the pressure of the society in her home country. She felt that in order to be recognized she needed to pursue a master’s degree:

I continued with the master’s because of the pressure of the society in the Czech Republic because when you are going to go to the university and you end up with a bachelor’s degree is something like you ended up with high school. It’s like there is no difference between a degree from high school and a bachelor’s. It’s like the bachelor’s program takes three years but it is considered like nothing so in order to be like university educated you have to continue with the masters to be recognized.

Mireya reported that her participation in an internship made her question pursuing a graduate degree in engineering. Mireya’s first intention upon completing her undergraduate
degree and participating in an internship was to pursue a Master’s in Business Administration but after working in a graduate research position she changed her mind and instead decided to pursue graduate studies in metallurgical and materials engineering:

I honestly, to be completely honest, did not want to get a master’s degree in engineering. I wanted to do a master’s degree in business because I had done an internship in a research laboratory with the Air Force and that’s not what I wanted to do at all. But when I came back to El Paso I found an opportunity to do this graduate research position within the college of engineering so I took that position instead of getting my MBA and ended up doing a master’s degree in engineering.

Contrary to Mireya’s experience, Deyanira’s participation in an internship reaffirmed her desire to pursue graduate studies in engineering and become much more marketable:

I think it had to do with my internships. I did two research internships. I did one at Purdue University and one at Lehigh University so I think that had to do a lot with going on to graduate school because I know it opens a lot of doors if you have a master’s degree so that’s why I decided to pursue it right away and also because of…I am an international student so it was really hard for me to find a job and getting a master’s degree really helped me go that extra step and make myself more profitable, I guess, out in the market.

The next section describes how having a positive attitude helped participants persist and succeed in their program.

Positive Attitude’s Contribution to Persistence and Success

When asked to describe how having a positive attitude helped participants persist and succeed in their program, they reported that having a positive attitude helped them overcome some of the challenges faced during their respective programs. And although the challenges
faced by each participant varied from student to student and from program to program, most of them concurred that having a positive attitude helped them overcome the obstacles they encountered. However, there were also a few students that instead of answering how having a positive attitude helped them persist and succeed in their respective program they explained what positive attitude meant to them, described what they associate it with or reflected on its impact. For instance, some participants described how having a positive attitude contributed to their persistence and success. For example, Margarita reported that having a positive attitude helped her focus on the objectives of the program:

I think that having a positive attitude in the program helps you to focus better on the objectives and to understand that not everything may work as you expected but if you keep a good attitude towards those problems it will be easier for me to understand them and… and… be able to deal with them.

Azucena stated that having a positive attitude helped her succeed when she faced program or family issues:

I think it [having a positive attitude] is the most important thing to help you succeed because you face a lot of obstacles, a lot of challenges and if you don’t have that attitude you are not going to succeed because there are many, many obstacles; family issues, money issues, teachers, administrators, this and that… so if you give up… if you don’t have that attitude you are not going to succeed.

Deyanira reflected back on her experiences and stated that having a positive attitude helped her push harder and try her best:

I think that having a positive attitude helped me push harder to finish both of my degrees because there are not many girls in the engineering field so you are always, I guess,
alone, everyone is watching you, you can say that you are always trying to make yourself look good in all situations and prove people wrong that women can succeed in the engineering field. So, I just pushed myself to try my best at all times.

Genoveva, like Deyanira also reported that having a positive attitude helped her try harder to reach her goal:

…having a positive attitude helped me in the sense that I was able to look and search for jobs and opportunities that would help me get experience. Also, in classes even though I did badly on an exam or in homework. I always put more effort on the next one and try to succeed. You have to persist to reach your goal.

Paloma, on the other hand, explained having a positive attitude as:

…more in the sense that if I had a bad grade in a test I just wouldn’t give up and think or say oh, this is not for me, engineering is not for me. I would study a little bit more or try a little bit harder, try to understand more about the subject and then just have a good grade.

While Yadira associated having a positive attitude as:

…looking at the future and what I want to accomplish…I think about how important our career is to help the world, to help persons. So, when I feel like I want to drop, I look at the big picture and I realize I am doing the right thing by staying.

Sofia also associated having a positive attitude with the way she handled a stressful situation and having a classmate providing help:

For me to have a positive attitude is associated with the way I handle a stressful situation. For example, when I have a deadline coming for a project and I don’t know what to do. I appreciate when somebody comes to me, talks to me, and helps me.
Carolina agreed with Sofia and also associated having a positive attitude as having a classmate providing help:

I agree with Sofia that it is important to have someone in the class who can help you, who you can turn to and who can explain to you and also is important that the reason why you are here is because you wanted to be here not because your parents wanted you to get enrolled in a certain program. You handled stress more easily and your attitude is different when you are convinced that that is for your own good rather than for someone else.

On the other hand, Mireya confirmed the impact of having a positive attitude:

I guess having a positive attitude allowed me to give it the best that I could during school. I knew that I knew just as much as any other student in my program no matter if they were male or female or their age. Thanks to it [a positive attitude] I was able to succeed and go all the way to getting my master’s degree and now I have a full time engineering position and I think that having a positive attitude helped me then and its really helping me now in my new venture.

The next section describes how having self-confidence helped participants persist and succeed in their program.

**Self-Confidence’s Contribution to Persistence and Success**

When asked to describe how having self-confidence helped participants persist and succeed in their program most of them stated that self-confidence played a key role in their persistence and success because they faced challenging programs and difficult courses or programs that were not fully established. But most of all, because they were away from their families which they credited as their source of self-confidence. However, there were also some
participants that instead of describing how having self-confidence helped them persist and succeed in their program, they defined it or described their struggles because of lack of self-confidence.

Azucena, for instance, stated that her program was not fully established when she began her studies which created a lot of uncertainty as well as additional constraints for her but her self-confidence allowed her to remain in the program:

Well, well… my case is very particular because the program…was kind of ah…challenging program within the college of engineering…and it was always facing a lot of…the program itself was facing a lot of obstacles so it was not only me but the program itself…but I always thought that it was what I needed so I just stayed there. I stuck with the program and tried to do the best I could. And due to the fact that the program was not as stable as the other programs, I had to rely on myself, mostly.

When questioned why the program was not stable Azucena pointed out that the program was unstable because there was no orientation, there was no guidance, and there was no financial support provided. She said that students had to rely on themselves and had to obey certain rules that were mostly subjective, that these were not easy to follow and that the best students could do was to rely on themselves and have self-confidence. But she did not elaborate on what these rules were.

In the same manner, Margarita felt that having self-confidence helped her to actively participate in class in addition to allowing her to establish a better communication with the students she taught since she was a teaching assistant:

It helps you in the class because when you are confident about yourself you are able to ask questions and when you participate, you understand more deeply the content of the
class so the professor is able to answer the questions that you have and you can discuss them better. I think that having self-confidence also helped me when I had to teach. I had to teach one lab and it really helps you if you have that confidence that you are able to do that. It is very difficult at the beginning but if you trust in yourself you are able to succeed on that.

Some participants stated that having self-confidence allowed them to persist and succeed in a program that at times was challenging and included a sense of isolation because some of them were away from their families. In addition, most of them attributed their self-confidence to their families. Mireya, for instance, defined having self-confidence as believing in herself because at times she wanted to change majors due to the complexity of her program in addition to attributing her self-confidence to her family:

I guess having self-confidence is believing in myself… because there was several times that I did want to change my major because I did think I was not going to be able to complete the engineering degree. There was times where I was hard on myself…and I think a lot of it came from my family, a lot of my self-confidence, they were the ones who believed in me which raised my confidence level and because of them, my self-confidence grew throughout the years and I was able to complete both degrees.

Paloma like Mireya also defined having self-confidence as believing in herself especially when she faced what she considered difficult courses and also attributed her self-confidence to her family, particularly her mom:

I guess for me believing in me was more… I faced that more in the harder classes that were for me. Sometimes, I would say oh! I don’t think I would be able to make it through this class but then I thought about it and I am like if this person can do it, so can I, why
can’t I? And also, my family too, my mom, she is always encouraging us and my brothers and my sisters.

Similarly, Deyanira credited her persistence and success to her self-confidence and like Paloma and Mireya also reported that her family was the source of her support:

My self-confidence, I think it was like about 90% of my success because I was living on my own. I moved out of my house at 18, that’s when I went to the university and I was always by myself. My family was 2 hours away and it just helped me really overcome all the obstacles I had to go through, even at engineering, because there was a lot of times that…I would just come home and I needed some support…somebody to say “Hi” and asked me how my day was and there was nobody there…so I think my self-confidence was the main, one of the main reasons why I was able to finish my degrees, too and also it came from my family too, always supportive in everything I wanted to do at all times, and also my friends I met in El Paso.

When asked to describe the obstacles she faced, Deyanira stated that she missed a lot of family functions and that this was personally hard to overcome. She also pointed out that academically speaking, the field of engineering is composed of classes that are really hard and that it is hard to keep a positive attitude at all times.

Yadira, like the others, also attributed her self-confidence to her family: “For me, I think part of it [self-confidence] comes from my family. They encourage me to pursue this career and also the influence I have received from different people like my advisors, and friends who have Ph.Ds.”

Genoveva, on the other hand, spoke about how her self-confidence helped her throughout college and also acknowledge the support she received from her family:
I think that my self-confidence helped me throughout my career at the college level because it gives you that extra oomph [push] that you need to accomplish your career and not only in your classes but having self-confidence helps you network which is one of the most important things in the real world, I guess because it opens doors, it helps you to get experience inside and outside of school which is really important in the real world when you graduate. Also, the support of my family helped me a lot because my parents always told me you can do whatever you want if you set your goals and you fight for your dreams.

However, Sofia, an international student, struggled because she felt she lacked self-confidence to speak in public which was required in some of her classes. However, she also felt that being in the United States helped her improve her self-confidence and felt less afraid to participate in class and express her opinions:

… I know I have a problem with self-confidence. I know because a lot of times, I am afraid to sometimes express my attitude so I need to improve my skills. For an example, when we are in class and the teacher asks for something and I think I know the answer but I am afraid to express it because maybe I am afraid of failure or something. So, I miss my self-confidence to believe in myself… but I saw… but I saw some improvement here because I gave a presentation…it forced me to speak in public so I feel better.

The next section describes how participants’ time management skills helped them persist and succeed in their program.

**Time Management’s Contribution to Persistence and Success**

When asked to describe how participants’ time management skills helped them persist and succeed in their program, participants reported different points of view regarding their time
management skills and almost half of them focused on describing how difficult it was for them to manage their time. Some wondered how they handled all the activities they were managing at the time. Others faced a hard time dealing with their own time management skills, and a few of them learned to manage their time at an early age, at home, during high school, or while at college. Azucena, for instance, said: “I don’t know. Sometimes, I wonder how I did it. Maybe because I was younger or something (she laughs). I couldn’t do it now. I don’t know. Sometimes, I wonder how I did it.” Azucena was taking full-time classes, she was teaching, she was working, and she was a single mom.

Some participants reported having had a hard time managing their time. Margarita, for example, usually left things for the last minute which caused her to feel stress:

I think it is important for the stress. If you leave things to the last minute as I usually do also it is very difficult. You end up working on the weekends on the holidays and you end up not having time to enjoy yourself to enjoy the city for example for us that come from a different country.

Sofia also stated that she lacked time management skills. She said “I miss these skills because all the time I do things like right before the deadline. I miss these skills. I have to work on them.” When asked what they [Sofia and Margarita] felt was the problem, Sofia said, “I can get away with doing things at the last minute.” While Margarita considered that the Internet was a distraction for her:

For me I think, I get really distracted because most of my work is in front of a computer so sometimes when I don’t know what to do I go to the Internet and I get lost in the Internet. So I think is more a distraction that prevents me from working on time.
Yadira also reported having had a hard time managing her time and thought of it as a skill that she needed to further develop:

For me it was, very, very hard. I don’t’ know. I guess it’s the culture. Because in Mexico, even the professor did not teach you…didn’t give you strict deadlines. So, when I arrived here…in my family, my dad is very precise. He always does things when he has to do them. But for me…I didn’t realize that, at the beginning of my career, I thought it was just like high school. I invested more time in my personal life. I made mistakes in my bachelor’s and I learned from those mistakes that I made and because of that I realized the importance of time and…but it was hard. It’s kind of like a new skill that you try to get better at and better at…and right now, I am o.k. I am not very good at it but I am o.k. and I think that helped a lot too to reach my point. It is very, very important that students and all people learn how to manage their time.

Like Yadira, Genoveva also reported having initial difficulties managing her time:

When I started my college education it was kind of hard for me to manage my time. I was probably not really focused on my education. I was thinking something else. But I think I hit bottom and it was when I started realizing that I was not, I was not managing my time in the way I was supposed to and I needed to start investing more time doing school work, doing homework, studying after class, and catch up in class with the professor. Once, I figured out how to do it… It helps you a lot to manage your time correctly because you have certain classes and sometimes those classes have projects and assignments that are due the same week or the same day even and you have to think of a plan or strategy about how to manage all the pressure that you have because some of us
also have work after school and you have to learn how to balance and also balance your personal life because you also need your own time.

On the other hand, some participants stated that they prefer to prioritize and do things in advance to avoid stress and be successful. Carolina, for example, reported that she prefers to do things in advance to avoid stress. She said, “For me time management is very important because I prefer to do things in advance not at the last minute because I don’t like to stress and I think it is important in order be successful.”

Mireya reported having a similar preference and attributed her persistence and success to her time management skills:

I think early on I was the type of person, especially in high school, that was part of a lot of different organizations so when I got to [the university] I wanted to continue that so I joined several organizations not just engineering organizations I was part of honor’s societies and professional societies as well. I was able to I guess manage my time wisely and I think that helped me succeed…and…a lot of it was based on a check list that I always had. I always had to prioritize between what came first, of course my family always came first and then school, and then work and everything else in between and I think just being able to prioritize your time and always allowing time for school is what really helped me succeed and… and its really helping me right now in my current position because I am able to do a lot of tasks at once and able to complete all of them so I think it really did helped me succeed learning how to manage my time and of course it was hard because there was times that I was stressed for time, it wasn’t easy and it did not come naturally to me, but I learned to manage my time along the way.
Deyanira also stated that her time management skills allowed her to complete her school assignments in a timely manner as well as have enough time for family and friends:

I have always been good with managing my time, at school, outside activities too, and family and friends. So, I think it did help me in regards to setting aside time to study and getting assignments done and also having fun throughout my college experience. So, I didn’t really have a hard time adjusting to college life. I have always been in a family where time is very important, I learned that from my parents how to manage my time and have a balance between life and school life.

Paloma also stated that her time management skills enable her to prioritize:

I have always been good at time management. I have always tried to prioritize things. I have always been a person…since I started college I started working as well so I always had to plan ahead if I had any tests or like Genoveva said if we had homework that was due the same week or even the same day. You know just plan ahead.

The next section describes the participants’ experiences in their respective engineering programs which focused on four major areas: faculty, advisors, peers, and financial aid issues.

**Participants’ Experiences with Faculty**

When asked to describe their experiences in their respective engineering program, students reported a variety of experiences that focused on four major areas: faculty, advisors, peers, and financial aid issues. Regarding faculty experiences, most of the participants reported having had positive faculty experiences which were characterized by faculty who had open door policies, who provided academic and personal advice, who were supportive and encouraging, who served as mentors and coaches but who also had high expectations and were, at times, demanding. Azucena, for instance, briefly stated that she felt under a lot of pressure because the
professors expected a lot from the students. She said, “You were under a lot of pressure because the professors had very high expectations.”

Margarita, on the other hand, felt that the professors were very busy because they were handling hectic schedules that prevented them from properly advising students:

…the professors are very busy because they have to focus on lectures and research and many, many students. I think the university could have more lecturers so the professors who wanted to do some research could focus on that and understand more what the students are doing.

Some participants reported having had good experiences with their professors. Mireya, for instance experienced having had professors who had an open door policy and who were willing to offer not only academic but also personal advice:

Well, I came from the metallurgic department which is a very small department so every single one of our professors no matter what the time of day or…anytime…like it didn’t matter if it was their office hours or not. Their doors were always opened to us. They helped us with anything and everything with any projects. If we had a project in one class another professor will undoubtedly discuss it and help you if you needed any help so that was a very positive experience. I know my professors were also great mentors to us as well. If we needed any advice from school or with life or any problems we were having in general. They were always there to help us with anything that we ever needed. Mireya also pointed out that thanks to her professors and the mentoring and coaching she received from them she was able to find a job sooner than her classmates:

I really didn’t mention this but I think my professors were really the ones who helped me get to the point that I am at right now, especially finding a job. I know a lot people are
still having a tough time finding a job but my professors, one of them especially, well two of them really went above and beyond just mentoring me and giving me advice for interviews and giving me their different positions about the industry and I think that is something great about the department that I came from. They do that not only for graduate students but they do that for undergraduate students as well and I think that says a lot when a department really does care about undergraduate and graduate students and teach these students everything they ought to know.

Deyanira expressed a similar view regarding her professors, particularly one of them, who she thanked for her participation in a couple of internships which in turn opened a lot of doors for her:

On my part, I do think that my mentor… he is the reason why…why I was able to I guess find a job right now because he was the one who actually gave me the opportunity to go to Purdue, that was my first internship ever, and after that he gave me the opportunity to work as a research assistant under him for two years and then later after that I actually was chosen to go to work at Lehigh University after giving a presentation at Purdue. So, it opened a lot of doors for me. So, I can’t thank him enough. He was really supportive and he was always trying to find something for me to put in my resumé and I think I owe a lot to the faculty at [the university] because they opened a lot of doors for me.

Paloma also experienced having had positive relationships with her professors which she qualified as very rewarding:

…with the professors, very nice, I never had a problem. What I noticed is that professors notice who is in class and who is not and of course if they don’t see you there and you go and tell them, I don’t understand this. I don’t know this. They will get…well if you are
not in class…if you are not even there…the treatment is different. I noticed that with professors. If they see you don’t care, I don’t think they are not going to care but I never had any problems with any professor at all. My experience with the program was very rewarding, very rewarding.

Yadira, on the other hand, experienced having had what she considered “tough” professors but in spite of this she acknowledged their support and encouragement:

Well, in metallurgy I met Dr. […]. He was very good, very encouraging and in his class we did a presentation for the final project and I learned a lot. With Dr. […] it was very, very hard. I mean, it was the hardest professor I have had. He was tough. He would tell us to pay attention and if not you could leave the class. He would tell us to ask questions and also if you would go to his office to ask questions he would encourage you to keep trying and would say, you can do it, just study more. I didn’t pass his class the first time and the second time I took it I learned a lot. I loved his class. We still talk a lot. I finished the program with great professors because in metallurgy, professors care a lot about students, especially women. I never had any problems with my professors.

Genoveva, reported having had good experiences with most of her professors and felt they were approachable and supportive as well:

With the professors I had good experiences with most of them…but with other professors, in classes, I never had an issue with anybody. Everybody treated me well and any time I had a question or if I need to go to their office to ask after class or about the homework everybody was reachable at least that was my experience with the professors that I took classes with.

The next section describes participants’ experiences with their advisors.
Participants’ Experiences with Advisors

As for their experiences with their advisors, participants reported different experiences that included difficult academic relationships and lack of support to participate in internship opportunities during the summer. Other participants experienced advisors who would not take their opinions or feedback into account. While other participants experienced a lack of communication with their advisors or advisors who were unreachable because of hectic schedules which according to the participants prevented them to fully immerse in the students’ research. And another participant reported not having had an advisor at the beginning of her doctoral program and when she was assigned an advisor, she felt his support wasn’t very strong. Three of the participants, for example, experienced a difficult academic relationship with their respective advisors. Margarita reported what she considered having had a bad relationship with her advisor which in turn prevented her from getting a job during a summer:

With my advisor I had a really bad experience; we recently had a fight, because he thinks that the students belong to him. So, that is very difficult to handle with an advisor like that because I tried to get a job and he did not want me to get a job so…he was always complaining about other students that had left him…that for me was really bad because it really holds the student at the school, it doesn’t help you to advance. I never felt from him a good encouragement to go and pursue a Ph.D. from somewhere else as I had felt before from my advisor in the bachelors at my university.

When questioned why she felt her advisor thought she belonged to him, she stated that she felt this way because since her advisor was supporting her, through a teaching assistantship, he wouldn’t allow her to find another job or participate in an internship during the summer.

Carolina reported a similar experience:
I had a similar experience like Margarita. I think that professors they take everything very personally. They don’t allow you to go away for Spring break or the break on Christmas because when they are paying you they think they own you and also when you want to go away for an internship in the summer they don’t support you…instead that they would be happy for you so that you can bring more knowledge to your thesis or dissertation that you gained outside…they just want to keep you here to work for them…

Genoveva also reported that the professor she was working with tried to prevent her from leaving in the summer to participate in an internship:

I worked with Dr. […]. I did research for him. I started working with him in 2009. I was still doing my bachelors. When he offered me the job, I already had an offer for an internship with General Motors for the summer and he told me that if I wanted to accept the job I was not going to be able to leave for the summer…

In addition, she stated that students need internship experiences, “They [professors/advisors] don’t realize that for us as students and as future workers, I guess, in the field we need the experience to test other…different companies.” Furthermore, she mentioned that professors should encourage student participation in internships:

…I think a lot of professors are missing that to try to give opportunities to the students even though you are working for them. Try to let them go for the summer and when they come back allow them to continue with their research.

Even though Genoveva was discouraged from participating in internships, she applied to several internships and ended up doing internships at General Motors, AT&T, and the Navy.

Some participants reported having experienced a lack of communication with their respective advisor. All of them, except for Mireya, also felt that their respective advisor would
not listen to them or take their respective suggestions into account when it came to the students’ research. Sofia, an international student, attributed her advisor’s lack of communication to his busy schedule which according to her forced her to seek the support of her advisor in her home country:

I think that my immediate supervisor here was very, very busy so he did not have time for me so all the time I had to e-mail my supervisor in my country…because they were very busy here. They all had masters and Ph.D. students so they did not have much time for me. One of them…was super busy. He was from my field, from transportation, but the other one….knows nothing about transportation or about my problem so he did not know how to help me properly.

Additionally, Sofia also felt the university did not provide the support she needed to succeed because she was not assigned the right advisor, although in spite of it, she succeeded:

…They failed because they assigned me a supervisor from a very different field of study and the second one [advisor] was really, really busy and had a lot of students to supervise so it did not work at all.

Carolina supported Sofia’s comment and added, “In my opinion the advisors are very busy. The professors are really busy. I think the results from their research would be much better if they take more time to guide the students.” Margarita supported what Sofia and Carolina reported but also added that her advisor would not listen or take into account her suggestions regarding her research:

I agree with what they said that the professors are very busy because they have to focus on lectures and research and many, many students. I think the university could have more lecturers so the professors who wanted to do research could focus on that and understand
more what the students are doing because many times I would to talk to my advisor and I had to tell him everything again, what I was doing, because he had no idea what I was doing. And sometimes, I faced the problem of suggesting something to my advisor and he wouldn’t listen too much and simply asked me to do what he had told me to do. So, for example, he would tell me to do something and I would come up with a different solution for that or try a different method for our study. He wouldn’t listen too much he would just say no, no, you are not doing this, just keep doing that. It’s difficult because you cannot learn very well like that if you are suggesting something or trying, at least listen to you [the students] and discuss it. He would just say no, no, just do what I am telling you to do and that is it.

Sofia also reported a similar experience with her advisor:

I had the same experience with my supervisor. He would say yeah, yeah, it’s good but rather do it like that…and also for example when he checked my thesis there were some paragraphs and he made some edits and I was asking why and he said it is better for me, yours and mine are the same, so why can’t I use mine if they have the same meaning …oh, no, no, this is better. So, it is like pressure to know that you are not so good that you have to obey me and listen to me, my opinion is better.

Mireya experienced having had the same experience with her advisor but contrary to three participants, she also stated that her advisor addressed such lack of communication at the end of her program:

…he [the advisor] was a tough advisor and there was times when it was just difficult to work with him. I know there was a lack of communication, that’s what it was, but…He was a positive mentor and I learned so much from him. There is nothing really negative
about the program. It’s just sometimes there is a lack of communication and I think that is something we already addressed with our advisors. So, I think that was helpful, in a sense, trying to fix the climate within our own department because when we graduated we had a final meeting and he [the advisor] wanted to know what he [the advisor] could fix. So, I think that was really positive within my graduate program that helped him a lot and that will help students after us just by giving him suggestions about how to fix the climate and how to work better with the students.

Deyanira experienced having had a hard time reaching her advisor:

My advisor didn’t really help me a lot…it is actually kind of weird because he actually became my mentor later on, I think in the junior year, he became my mentor since he was the one that actually picked me to go to my internship at Purdue but after that I had a hard time trying to find him…setting up appointments and stuff like that it was tough so most of them the time I kind of chose the classes that I was going to be taking and then...I think that was hard but besides that I got support from everybody else, the faculty, all the professors that I went to for help they were really nice and helped me and that was about the only thing that I could think of from the Electrical Engineering Department…it was just the advising situation.

Contrary to most of her peers, Yadira experienced a positive academic relationship with her advisor:

When I moved to the graduate program in environmental, I met my advisor Dr. […]. He is 30 years old but he is wonderful. He is a great teacher. He offered me a job at the end of that semester. He was very encouraging. I have always worked on campus. When you work on campus, it is safe and comfortable. You don’t have to go outside but he
encouraged me to go on internships. I applied before but I was a bit afraid. He gave me advice on how to behave and what to do. He was very cool.

Azucena, on the other hand, reported not having an advisor at the beginning of her program and having to rely on herself to succeed:

…you had to rely on yourself or if you didn’t have a professor or were assigned a professor before you got into the Ph.D. [doctoral] program you were completely out of luck. Completely…and just like in my situation there are a lot of colleagues that entered the program but didn’t finish because of that. It was very difficult.

Azucena also stated that when she was finally assigned an advisor his support wasn’t very strong. She said, “I didn’t have any support to work on my dissertation… nobody…only Dr. […] said okay let’s do it but his support wasn’t very strong.” The next section describes the participants’ experience with their peers.

Participants’ Experiences with Peers

As far as peer experiences, participants reported male peers who were friendly, supportive, and competitive. In addition, participants reported having had to prove themselves to gain their male peers’ respect in the classroom and in the lab. Furthermore, because of the low number of female students enrolled, the lack of camaraderie, and the level of competitiveness among students, participants also reported feeling isolated. Azucena, for instance reported having experienced a lot of solidarity and friendship from her peers:

There was a lot of solidarity; there was a lot of friendship amongst our peers; a lot of encouragement. If it wasn’t for that it would have been very difficult and I would have given up. It was my peers…they were very supportive, they were very, very nice, and they even supported me in my legal battles with my children’s custody they even served
as witnesses. They lived my life and I lived theirs. We were deeply involved with each
other and very supportive of each other as well.

When asked if she was referring to her female or male peers Azucena stated that back then there
were not many women. “Back then, there were not many women…we were very few…very
few,” she said. Mireya reported having had a similar experience:

With my classmates, I met a great group of people, it was a small department so we all
knew each other and we always did the same things together so I think that really helped
us get through our degree and really support each other…

In contrast to Azucena and Mireya’s experience, Margarita reported what she considered a
certain level of competitiveness from her peers which caused her a sense of isolation:

In Brazil, we usually help more each other so the students get together to study and
discuss everything and here I felt more that it is more like a competition, the students
treat ..they are always comparing grades and making questions about your grades and
they don’t really get together like friends is more like a competition for me it was really
bad because you ended up being more by yourself studying by yourself, you don’t learn
as much as you could if you were discussing everything with your other colleagues.

When asked if she felt the same about her male and female peers or if there was a difference,
Margarita stated the following:

…sometimes the girls were a bit more receptive but it was still pretty much the same. The
guys asked more about grades and compare much more…the girls were more to
themselves…but still you feel that you cannot build a friendship in your class.

Sofia, on the other hand, mostly relied on her Czech peers [mostly females] for support and like
Margarita stated that in her country students work together:
For me it was like a really big change compared to my country…we are here more from Europe. So, I spend more time with the Czech students so when we have a problem, we solve it together, because we have learned to work together…group work…we help each other. So, I communicate a lot with just the Czech students or the Slovak students.

When asked if she was able to communicate with other students in her classroom other than the Czech or the Slovak students she said, “I think more with the guys…there were not so many girls in my class…”

Carolina also felt that it was easier to communicate with her male peers because according to her, her female peers were kind of cold:

I also think that is much easier to communicate with boys if it is study related or when you are going to do homework because the girls…yes they will help you but it is kind of cold they don’t really want to share their knowledge with you so it is easier to ask some boy for advice.

Genoveva, on the other hand, experienced the competitiveness that Margarita experienced but also felt that she had to gain her male peers’ respect in the classroom:

Regarding my peers, I was fortunate to meet wonderful people in the program, students, classmates and also I had several experiences with people like when I barely started the program, I was taking one of the classes that are in the core curriculum and the first exam that we had I did really well and one of my peers that was sitting beside me, they were three guys, so what did you get in your exam.? I think they thought I was going to bad…and I told them … I think I had like a 97 or something like that…and they told me…because this guy felt that he was the smartest guy in the group… I don’t know and he got like an 80 something and he was like, oh, ¿a quién le copiaste? [Who did you copy
And things like that. At the beginning, I felt like they see us, like, I don’t know women…they try to put us down but after that I mean I was able to gain their respect.

Paloma, like Genoveva also had to prove herself among her male peers but in the lab:

You know with my peers of course like Genoveva said in the labs…I would have this…in my team there was this person, this guy and of course he wanted to do everything and I was like no. I had to step up and say no. I need to learn, too. I have to do something, too. And even if I am right or wrong I am learning, we are learning here. The labs are here for us to learn. At the beginning, it was a little tense but afterwards we were friends. I guess since they see you, oh, she is a girl, they think she is going to get scared, I don’t know…it’s a little judgmental but I guess I had to prove myself, too.

The next section describes participants’ experiences with financial aid.

Participants’ Experiences with Financial Aid

Several participants reported not having received financial support such as tuition waivers, teaching/research assistantships, scholarships, or stipends and those who did receive some sort of financial support claimed that it was not enough to cover their respective academic expenses. Azucena, for instance, reported having received support from a faculty member outside her college to apply for scholarships. In addition to this, she also worked to pay for her studies:

I never had any financial support other than loans. I had to work. Dr. […] helped me apply for scholarships and I got them. I got the Hispanic scholarship. I got the National Science Foundation scholarship. I got…I don’t remember…but I got a good amount…it was very difficult even to apply but I got them because Dr. […] helped me.
In addition, she also pointed out that the financial situation for her male peers was different from that of her female classmates:

Back then there were not many women…we were very few…very few… What is important to say…what I noticed…it is a subjective opinion…very subjective opinion…is that the males, the males were the ones who had like a path…like a lot of support, financial…ah…they had a well-established financial plan, well established family plan, well established academic plan and the women that were there were taking one class and then skipping one year and then taking another class and skipping another year…

Sofia and Carolina received financial support from their respective home institutions to pursue their graduate studies but Margarita and Deyanira, also international students, struggled to make ends meet. For instance, Margarita, reported her teaching assistantship was cut in the middle of her program:

…they [Sofia and Carolina] may have not experienced it [lack of financial support] because they are being supported by the European Union but the students here are suffering because of the different laws, the different rules, that the College of Engineering has placed on the department to hire students. Because now the students can only be hired as a teaching assistant for two years, and that really restricts the students. It’s only bad for the students. I think what we have heard from the professors is that the college was trying to make the professors work more to get more funding to support their students, but actually the professors don’t worry about that, because they get paid. So, if the students don’t get paid, the only ones that are suffering with that are the students themselves. Two years ago, the rules were different, you could have as many teaching assistantships as the time you stayed here, and in the middle of your Ph.D. or M.S.
program they changed that, suddenly you see yourself with no funding and no other options. Because of the crisis, I think it has been more difficult to find a job here and you waste a lot of time, if you have to find a job, you would spend a lot of time finding a job while you could be studying. I’ve seen many friends struggling with that because their advisors don’t have funding, they don’t plan to get any funding, they once in a while try to request funding somewhere but they don’t get it and they don’t mind. So, the students are really suffering because of that. I think that has been pushing the students away from the department. We are seeing many students leaving the department, just something to think about, the funding, because it’s something that really affects if you are away from home. Sometimes your parents cannot help you with all the money that you would need to be here and the department cannot do anything for you, you just go away.

Deyanira also stated that it was hard for her to find a job as an international student. “I am an international student so it was really hard for me to find a job…” she said.

Some participants worked to help finance their studies. Mireya stated that: “… I was also a research assistant so at the time I had a lot on my plate especially working at school and having a second job at a restaurant.” Paloma also reported having worked at several places throughout her program. She first began working as a tutor out of campus. Afterwards, she said, “I started working at [the university] as a pre-calculus tutor and also worked in the Professional and Continuing Education Department as well…” She also reported having participated in several internships at the Army at Brokle Arsenal and at AT&T throughout her program. Yadira also worked at the university. “I have always worked on campus. When you work on campus it is safe and comfortable.” As previously mentioned Genoveva also worked throughout her program
and participated in several internships as well. The next section describes participants’ experiences regarding discrimination.

Participants’ Experiences Regarding Discrimination

When asked to describe their experiences regarding discrimination, most of the participants with the exception of Azucena reported not having experienced discrimination during their graduate studies. Instead, they felt welcomed, encouraged, and supported although a couple of them did express having experienced what they considered a sense of intimidation from their male peers. However, Azucena reported having experienced discrimination because of her accent, because she was a woman, and because she was a single mom. She felt discriminated because of her accent and because most of the time she spoke in Spanish: “Well, the biggest discrimination, the biggest, the biggest was because according to…I don’t speak English but I was teaching in English…I can only write in English.” She also felt discriminated by a specific member of the administration that was serving at the time she first entered her doctoral program. She said, “…many times we tested this person in the program, we would send a male student with the same issues that we had and his issues were resolved and ours were not”. She also added that she felt a lot of discrimination being a single mom:

A lot of discrimination…being a single mom I think counted a lot against me because, not with the professors, not with my peers, but with the administration. I even heard comments. They said, she is not going to make it because she is a single mom and she is always taking care of her daughters. She is not going make it. She is not going to make it. I heard it all the time. All the time and thank God those comments didn’t hit me but it
certainly counts to say that it was discrimination, a lot of discrimination…a lot of discrimination…being a single mom…

Carolina also felt discriminated while attending an off-campus event with a classmate and one of her professors:

Once I went to an event, it was me, my classmate…this guy…, and my professor and the guy and the professor shook hands so I thought that the professor would also shake my hand so I extended my hand and he looked at me and started laughing…so I thought what am I doing …so I felt like inappropriate and thought that because I was a woman I wasn’t allowed to shake hands with him but it was off campus…I think when we were on-campus he would treat me the same way but somehow when we were off campus he would treat me like something less…I don’t know…

Some participants reported not experiencing discrimination while in their respective programs. On the contrary, they felt encouraged and welcomed. Margarita, for instance, felt that being a woman in her program was beneficial to her:

I have not encountered any discrimination, I think that being a woman in engineering is sometimes even easier that being a man because you are a minority. Sometimes, the professor treats you more respectfully than they treat the men so I have not seen…I haven’t felt any discrimination in the program in general.

Sofia concurred with Margarita and said, “I have not experienced any discrimination.” Mireya also supported Margarita and Sofia’s comment: “I honestly, me neither. There was really never anybody who discriminated against me being either professor or my peers so I am glad I never experienced anything like that.”
Deyanira joined the rest of the group and asserted, “I don’t think I ever experienced any
discrimination at all that I recalled. If anything, they all encouraged having girls around and they
all see it as a good thing.” Yadira also felt the same way, “During my master’s I didn’t
experience discrimination”, she said.
Paloma did not experience discrimination but rather what she considered a sense of intimidation
by some of her peers:

I guess, not discrimination, like I mentioned before this person, maybe thinking…you
know…like she is a girl, she may get scared, she may not do it right but not
discrimination to a point where I would feel like, no, I don’t want to do it anymore. I
guess I felt a little intimidated but by that you grow and you say I can do it, I can do it
and afterwards it’s rewarding but not something that really affects my studies, no, not me.
Genoveva reported not experiencing discrimination but rather felt her male peers were
sometimes harsh on them [female students]. She said, “…sometimes the [male] students they
tend to be harsh on you because they fear a woman but not discrimination, no.

The next section describes participants’ experiences regarding the overall climate of their
program.

Participants’ Experiences Regarding the Overall Climate of their Program

When asked to describe the overall climate of their programs most of the participants felt
the overall climate of their respective programs was fine. However, some expressed discontent
with the mixing of undergraduate and graduate students in graduate level courses while others
experienced what they considered a cold climate because of a lack of interaction with their peers.
Margarita, for instance, felt that the overall climate of her program was fine but felt that mixing
undergraduate and graduate students in a graduate level class prevented her from gaining a true graduate experience:

My experience with the program in general was okay. The level of the classes for me was not too challenging, a few of them were but some of them were not and I think that is mainly because you have classes with undergraduate students, you know classes are taught for both levels so it ends up being a little bit less than what the graduate level students get.

Although overall she felt her program’s climate was fine she also mentioned that she experienced a cold climate regarding peer interaction because, as previously stated in the peers’ experience section, students in her country “help more each other” and “get together to study”. She said, “I felt that the climate in the program is a little bit colder between the students than what I felt with my bachelor’s in Brazil”. In addition, because she was unable to participate in an internship during her program, she recommended professors to encourage students to participate in internships:

I think that would be something good, to have an internship, to have more encouragement from the professors to have an internship, because you go somewhere else and learn another way of thinking and you bring good things, you bring more knowledge to yourself and to your advisor; you can show him different ways to approach a problem.

Genoveva experienced a similar situation regarding the mixing of undergraduate and graduate level students and felt it was not a good idea to mix them either:

…it is a class that is graduate and undergraduate. So they have students combined taking the same class but the graduates have to like do a small project or a different project or the exam is slightly different for the graduates and I noticed that a lot of the
students were unable to…they did not even know or were familiar with Ohm’s law [this law states that the current through two points on a conductor is directly proportional to the potential difference across the two points and inversely proportional to the resistance between them] which is the basic of basics of Electrical Engineering what they teach you in the first class that you take in Electrical Engineering…mixing us [the undergraduate and graduate students] is not a good idea…they hold us [graduate students] back.

Mireya, on the other hand, as previously stated in the advisors’ experiences section, commented that in an effort to “fix the climate” within her department, her advisor had met with them [the students] and “wanted to know what he could fix”. She felt that this initiative would “help students after us just by giving him suggestions about how to fix the climate and how to work better with the students”, she said.

Paloma believed her program was of high quality although she had demanding professors:

I believe the program is really good. They have very committed professors. One in particular, for example for me she was very hard and, I would try to understand her. I think she was the only woman in the program. As a professor, I guess, she was trying to prove herself to other men [other male faculty] there…all of them were very nice but she was very hard. I guess it was the culture maybe. She was from India. She moved to another university now. But now that I see the big picture, I learned a lot from her. I learned a lot in that class. I would complain maybe because of this and that and the presentations. I think she is rude or something but it helped me. It helps you to have a strong personality…it helps you.
Paloma also commented that another professor in her program shared valuable experiences with them [the students]:

There is also another professor that is working at Fort Bliss or White Sands, I think. All the experience he shared with the class it was very helpful because you know they are real world problems that he presented to us.

Regarding climate, Sofia and Carolina reported experiences that mostly dealt with their peers and advisors that have been previously addressed in each of these sections. Likewise Azucena reported experiences that mostly dealt with discrimination which were also addressed in that section. The next section describes participants’ additional experiences in their program.

Participants’ Additional Experiences in their Program

Regarding any additional comments about their experience in the program, some participants commented about being resourceful, about their family’s support or lack thereof when deciding to pursue a graduate degree in engineering and about their concern in coming to study in a foreign country. Genoveva, for instance, commented about being resourceful and taking an active role in her education:

I think at the end, most of the time, it doesn’t matter from what college you come from, and you are going to end up working with people from all over the place. Where I am working, there are people from the Massachusetts Institute of Technology (MIT), from Stanford, from really nice universities and there are also people from University of New Mexico (UNM) which is the university in Albuquerque. So, even though sometimes the professor is a big part of your education, it is also not a one way street, it has to be… you have to do your part and also take advantage of what the professor offers and if you are in
a class and the professor doesn’t teach you anything, you have to learn to be resourceful and continue and go on.

Margarita, on the other hand, commented about how her parents felt about her decision to study engineering and said:

Well, for pursuing a career in engineering, I think my parents were very supportive because it a prestigious career so I think the parents are usually proud of their kids for doing that for going for that field even though my parents wouldn’t understand very well what I was doing or studying they were supportive on that, but they were not supportive at all for me leaving the country but I think also because of their experiences, they are always in the country, they are very related to our culture and they don’t have too much the idea of going out and going away from your family so your leaving your family…I would hear from my mother, you left me here and all that kind of things, so it is sad, it hurts, it’s very difficult . I think it makes more difficult to stay here and focus here while your family is telling you that you should go back or something like that…that is my experience.

Sofia also expressed a similar sentiment:

My parents really support me. They are amazing and wonderful. They were very happy when I decided for college and also they really support me to go to the US…before I left I wasn’t really hesitant to come or not but they told me that I would never had this chance to see this country because I should know they never had this chance and they said I could do it…so it really helped me to have this motivation…and also I am skyping with them every week and my mother is talking to me for an hour about what happened in the
village but I don’t have time for that (everyone laughs) …they are grateful for this opportunity. So, I really appreciate it.

Carolina also received the support of her family although she felt that at first they doubted that she could pursue an engineering degree:

When I told my family that I wanted to study engineering, they were very supportive but they really didn’t believe that I could do that…like the first two years they were really waiting to see if I would fail in that case they would tell me something else to do… but I made it and as for the thing that I went abroad, at first they were like excited, like it is a prestigious opportunity to go abroad but lately I have been feeling like pressure, like I left them. So, I think they would like to…I think they would like me to go back but I want to stay here for a Ph.D. so I think they are not satisfied with my decision but they are supporting me but I can feel it that they don’t like it too much…

The next section provides a summary of the chapter.

Summary

This chapter provided the participants’ profile for both the quantitative and qualitative portions of the current study. Regarding the quantitative portion, the chapter identified the top factors experienced by female graduate engineering students in the enrollment, persistence, and success sections of the questionnaire and pointed out that only those factors that reported a mean of 3.5 or higher among female graduate engineering students were considered for the focus group protocol. Regarding the qualitative portion, the chapter also rendered a detail description of the participants’ experiences for each of the questions addressed in the focus group. It described what about engineering encouraged participants to pursue graduate studies in engineering and provided a wide array of reasons for their enrollment. Some of these reasons
included loving engineering, wanting to make a difference in their community, wanting to learn more about their filed, enjoying math and physics while in high school, having inspiring professors also while in high school, and having a good paying job upon graduation. The chapter also pointed out that having a positive attitude helped participants persist and succeed in their programs despite the challenges they faced. It described how having self-confidence helped participants persist and succeed in their programs and pointed out that it played a key role in their persistence and success. The chapter also described that almost half of the participants reported having had difficulties managing their time. Regarding participants’ experiences in their respective engineering program, the chapter described positive faculty experiences, difficult academic relationships with advisors, peers who were friendly and supportive but also competitive, and struggles with financial aid. As for participants’ experiences regarding discrimination is concerned, the chapter outlined that most participants with the exception of one felt welcomed, encouraged, and supported although some of them experienced what they considered a sense of intimidation from their male peers. In regards to participants’ experiences regarding the overall climate of their program, the chapter described that participants felt the overall climate of their programs was fine but some of them expressed discontent with the mixing of undergraduate and graduate students in graduate level courses as well as a cold climate because of a lack of peer interaction. And finally, regarding additional participants’ experiences in their program, the chapter described that some participants commented about being resourceful, about their family’s support or lack thereof when deciding to pursue graduate studies in engineering as well as their concern in coming to study in a foreign country. The next chapter will provide the summary of the study as well as conclusions and recommendations.
Chapter 5: Summary, Conclusions, and Recommendations

Summary of the Study

The purpose of the current study was to gain insight on how enrollment, persistence, and success factors are experienced by female graduate engineering students. The research question that drove the current study was: How have female graduate engineering students experienced a select number of enrollment, persistence, and success factors? The current study took place at an HSI located on the U.S.-Mexico border. The HSI, as other universities in the nation, also faces the underrepresentation of female graduate engineering students at its college of engineering. The evidence is that the HSI’s percentage of female engineering students at the master’s level from 2006 to 2011 showed a 3% decrease and an average of 23% female enrollment compared to a 3% increase and an average of 77% male enrollment during the same years. Data of the HSI at the doctoral level showed an 8% decrease and an average of 25% female enrollment compared to an 8% increase and an average of 76% male enrollment also during the same years. The HSI reflects data reported by the American Society for Engineering Education (ASEE) at the national level. At the master’s level, ASEE reported an average of 22% female enrollment compared to an average of 78% male enrollment during the same years. ASEE’s data at the doctoral level, showed a slight decrease of .4% and an average of 22% female enrollment compared to a slight increase of .4% and an average of 78% male enrollment during the same years.

The methodology utilized in the current study consisted of a quantitative portion and a qualitative portion. The quantitative portion consisted of a questionnaire adapted from Cordova-Wentling and Camacho’s study (2006) and additional enrollment, persistence, and success factors identified in the literature review. The questionnaire was administered via the Internet through Survey Monkey to both female and male graduate engineering students who applied for graduation in the spring of 2012. Male students were included only in the quantitative portion of the current study to compare male and female responses in order to assess what factors were greater for female students which would then were considered for the qualitative portion of the study. The questionnaire was sent to 86 participants and a response rate of 46.91% was obtained.
In the qualitative portion of the current study, female students were asked about their experiences with some of the factors identified in the quantitative portion through a semi-structured interview with a doctoral student and three semi-structured focus groups with master’s level students. The students were invited and agreed to participate in the qualitative portion of the current study through the questionnaire. The first focus group was held on the campus of the HSI, but not at the college of engineering to ensure the participants’ confidentiality and comfort. The interview and the remaining two focus groups took place at the researcher’s home for the convenience of the students. The interview and the focus groups were audio recorded using an IPod and the researcher transcribed all the audio files. The next section will address the conclusions of the study.

**Conclusions**

The following are the conclusions of the current study. Participants described a wide array of reasons why they decided to pursue graduate studies in engineering. Some participants stated that they “loved engineering” because they felt that engineering was “the core” of many of the items people use in their daily lives and would provide participants with tangible tools “to solve problems” and “make a difference” in their communities. A few others “liked math and physics” since they were in high school, had male teachers and friends that inspired them to pursue careers in engineering and also felt that having an undergraduate degree in engineering was not enough academic preparation to be truly successful in the field. Another participant stated that her motivation to pursue graduate studies in engineering was the possibility of having “a good paying job” upon graduation. The notion that engineering is the core of many of the items we use in our daily lives is also expressed by Hill, Corbett, and Rose (2010) which along with Margolis and Fisher (2012) point out that because of the underrepresentation of women in engineering, many of the items designed by engineers, mostly men, have overlooked the needs
and desires unique to women. In the same manner, the notion of liking problem solving, math and science, and being interested in making a difference in their communities, as some participants mentioned, are identified by Cordova-Wentling and Camacho’s (2006) study as some of the factors that have assisted women when deciding to pursue an undergraduate degree in engineering. Based on the current study’s findings, the same factors have assisted women when deciding to pursue a graduate degree in engineering. It is significant to point out that those who inspired participants to pursue careers in engineering were men not women which speaks of a lack of female role models as outlined by Hartman and Hartman (2006); Hill et al., (2010); and Meadows, Nidiffer, Ball, Davis, and Schultz (2006). In the same manner, the possibility of having “a good paying job” upon graduation concurs with Hill et al., (2010) in that workers in science and engineering fields tend to be well paid and enjoy better job security than do other workers. Furthermore, the notion that engineering is a high salary field was identified by Cordova-Wentling and Camacho’s (2006) study as one of the factors that have assisted women when deciding to pursue an undergraduate degree in engineering. Again, the findings support the same for female graduate engineering students. However, none of the participants mentioned that they decided to pursue graduate engineering studies because of recruitment strategies implemented while pursuing their undergraduate engineering degree as implemented at other institutions (Thomson and Lyons, 2008).

Throughout their programs, female graduate engineering students faced many challenges. Some of the challenges were personal because they had to deal with their own insecurities and reassure themselves that they could be successful in their engineering programs and when they failed, if they failed, they were hard on themselves and pushed themselves harder and continued striving to achieve their goals which speak of a high level of persistence. The notion of feeling
insecure coincides with Bottomley, Rajala, and Poter’s (1999) study in the sense that undergraduate female engineering students begin their academic programs with less confidence than their male counterparts. However, the current study demonstrates that this is also true at the graduate level because study participants also expressed feelings of insecurity at the beginning of their academic programs. In addition to their insecurities, participants also faced challenging classes, professors, and programs which caused them stress on top of having to prove themselves to their male peers and feeling intimidated. The notion of feeling stress and having to prove themselves to their male peers is also identified by Anderson-Rowland, Bernstein, and Felipe Russo (2007) who stated that several women in their study reported feeling stressed to constantly prove that they were as good as the male graduate students with whom they worked. However, as the participants of the current study stated, the notion of “looking at the future” and knowing what they “want to accomplish” allowed them to keep a positive attitude to persist and succeed in their program.

In addition to the challenges previously outlined, the doctoral participant faced a program that in her own words offered “no orientation”, “no guidance” and “no financial support” which caused her to rely on her self-confidence to persist and succeed. Other participants also relied on their self-confidence to persist and succeed in what they considered challenging programs that made them feel isolated because there were few female students they could relate to in the classroom, because the academic relationship with their male peers was at times challenging, but most of all, because the majority of the participants were living away from their families. And all of the participants, with the exception of the doctoral student, credited their families as the source of their self-confidence which speaks of close family relationships in spite of living away from their families. The notion of facing challenging programs concurs with Litzler and Lange’s
study which states that women feel overwhelmed by the pace and workload of their engineering programs. The same study, which involved undergraduate and graduate students, claimed that this finding had supporting evidence in the early 1990’s and continued to be true in 2006. Clearly, the findings of the current study show that it continues to date. In the same manner, the notion of not having someone in the classroom they could relate to because of low female enrollment, feeling intimidated by their male peers, and feeling isolated are also identified in Cordova-Wentling and Camacho’s (2006) study of undergraduate female students. Yet again, the findings of the current study show the same at the graduate level because participants of the current study also expressed the same sentiment.

Likewise, most of the participants experienced having difficulty managing their time because of all the activities they were involved in which included school, work, participation in extra-curricular activities, and a personal life. Regarding school, they pointed out that it was particularly difficult to manage their time to comply with the rigorous demands of their respective academic programs which included class projects, special assignments, homework, and studying. And although they struggled at the beginning and as one participant stated, once they “hit bottom”, they soon learned how to manage their time. As far as work was concerned, they had no choice because they needed their financial earnings to live. Most of them were living on their own and although their families provided some type of financial support, the money they received, usually from their parents, was not enough to pay all their living and school expenses. The few participants that successfully managed their time were not only working, but were also involved in extracurricular activities that included participation in honor societies and professional engineering associations. These participants credited their time management skills
to the development of a check list which allowed them to prioritize and get tasks done in a timely manner which in turn allowed them to be stress free.

Participants described their experiences in their respective engineering programs and focused on four major areas that included faculty, advisors, peers, and financial aid issues. Regarding their experiences with faculty, most participants reported having had a positive experience. According to participants, faculty had open door policies, provided academic and personal advice, and was supportive and encouraging. The faculty also served as mentors and academic coaches. However, the faculty was also demanding and had high expectations which caused participants to feel under a lot of pressure. The participants’ experiences with faculty at the HSI being studied sharply contrasts with the participants’ experience in Cordova-Wentling and Camacho’s (2006) study which described engineering faculty at the Midwest University where that study took place as “unfriendly, rude, condescending, unavailable, self-righteous, uncaring, impersonal, and unkind.” Why there is such a difference in the way students described faculty from one institution to another? Is this due to a difference in climate between undergraduate and graduate programs for women that Litzler and Lange’s (2006) study described? Or a difference in climate between the institutions? In addition, the notion of feeling “under a lot of pressure” as described by some participants, is also outlined by Hartman and Hartman (2006) and Meadows et al., (2006) which claim that the underrepresentation of women in engineering is due to performance pressures. Thus, if students continue to feel “under a lot of pressure” they may also be considering leaving their engineering programs (Bottomley et al., 1999; Hill et al., 2010; and Seymour and Hewitt, 1997) and therefore continue contributing to their underrepresentation (Haden and Lapan, 2007; Hall and Sandler, 1982; and Hill et al., 2010).
As for the participants’ experiences with their advisors, most participants described them as being difficult because the participants did not receive the support they needed to participate in internships, their opinions were not taken into account, and there was a lack of communication which participants believed was due to their advisors’ hectic schedules which in turn, prevented advisors to properly advise them. Such level of dissatisfaction concurs with Litzler and Lang’s (2006) study which pointed out that it was alarming that women in their study consistently reported lower satisfaction in their academic relationships with their advisors compared to men. Additionally, women in Litzler and Lang’s (2006) study also reported being treated with less respect, felt their advisor was less available to them, felt that their grades were not only based on their academic performance, and also reported greater experiences of sexual harassment than graduate men reported. The same notion concurs with a study conducted by Anderson-Rowland et al., (2007) which pointed out that a “bad” advisor was a major discourager among participants in their study. According to the same authors, the “bad” advisor was described as critical, demeaning, and too busy to pay attention to the student, gives no feedback, cares only about getting another publication, has harsh expectations, and is a poor match with the student’s work style. But what are the implications of such a lack of academic relationship with advisors and how does the poor relationship impact persistence and success in graduate engineering programs? The researcher’s perspective on the issue is that not allowing students to participate in internship opportunities hinders the professional development of students because they need these professional experiences to evaluate the work environment of different companies or organizations to make an informed decision as to where students want to work upon graduation. In addition, by participating in internships, students may acquire practical and real life experiences not taught or acquired in university settings. An article entitled, *UTS Engineering*
Internships: A Model for Active Workplace Learning written by Stephen Johnston, Elizabeth Taylor, and Alan Chappel (2001) described internships as an innovative approach to work based education. The same article outlines the partnership of the faculty at the University of Technology, Sydney (UTS) with the Institution of Engineers Australia (IEA) and with an Industry Advisory Network of senior executives from local and international engineering organizations to develop a model to incorporate internships in UTS’ undergraduate programs. Students who participated in the internships reported that engineering experience, integrated with their undergraduate academic program provided significant motivation. The students also reported that their participation in internships helped them to direct their studies towards areas they discovered to be of interest to them. In addition, Johnston et al., (2001) also pointed out that students’ greater maturity and focus, and the experience they bring from the workplace are the basis for a more collegial atmosphere in the classroom which in turn makes teaching more effective and rewarding for both students and faculty. Furthermore, having a difficult academic relationship with a student’s advisor hinders the student’s progress towards a timely and successful completion of degree. As pointed out by Litzler and Lange (2006), the support of faculty in general and mainly the support of an advisor is of great importance for a graduate student’s retention and advancement in engineering.

Regarding the students’ peer experiences, participants of the current study stated that their peers, mostly men, were friendly, supportive, and competitive. In addition, some participants indicated that at times, they needed to prove themselves to their male peers in the classroom or in the lab to gain their respect. Furthermore, the participants also indicated that because of the underrepresentation of female students in engineering and the level of competitiveness among students, they lacked camaraderie and felt isolated. A participant also
pointed out that she felt it was easier to communicate with her male peers because she felt her female peers were “kind of cold”. Moreover, an international participant also pointed out that in her country, students “usually help each other more” and “get together to study and discuss everything.” Another international participant shared a similar perspective and stated that in her country when students have a problem, the students “solve it together” because they “have learned to work together.” It is important to point out that the doctoral participant of the current study described her male peer experiences as friendly and supportive while most of the master’s level students described their male peer experiences as competitive. Perhaps the reason behind the difference between master’s and doctoral students is because doctoral students see each other as equals. However, a study conducted by Anderson-Rowland et al., (2007) stated that the doctoral women, domestic and international, who participated in their study complained that men from cultures in which women are considered inferior to men treat women, both domestic and international, as their servants in the lab. Moreover, the notion of feeling isolated coincides with Cordova-Wentling and Camacho’s (2006) study in which one of the participants in their study stated that it was hard for her to find people she could talk to in her classes because there were only a few females and that this made her feel lonely. Furthermore, the same notion is also identified by Anderson-Rowland et al., (2007) who claim that even when engineering departments welcome women, they may later find themselves isolated by a “system” established long before their arrival but do not elaborate on what they meant by a “system”. However, the researcher infers that the same authors refer to the departmental and institutional climate established before the students’ arrival. Additionally, the notion that female students feel that it is easier to communicate with their male peers than with their female peers raises the following question: Are the experiences of female engineering students with their fellow female
The notion of facing financial difficulties and leaving or considering leaving their engineering programs concurs with Meadows, et. al., (2006) study in that students leave their engineering programs due to financial difficulties. In addition, the notion of struggling because of financial aid constraints coincides with Hartman and Hartman (2006) in that the lack of financial aid is one of the factors that has contributed to the underrepresentation of women in engineering. Furthermore, the notion of being financially supported by their families was also identified by Cordova-Wentling and Camacho’s (2006) study as one of the family factors that have assisted women in completing an engineering degree at the undergraduate level. The findings of the current study show support for the above at the graduate level. It is also significant to point out that the reason why some
teaching assistantships were terminated in the middle of the students’ programs was because the administration changed the rules regarding the number of times a student could have a teaching assistantship. Prior to 2009, there was no limit on the number of times a student could have a teaching assistantship, students were appointed as long as the advisor and/or the department chair had funds to appoint them. After 2009, the rules changed and students were appointed a teaching assistantship for a maximum period of two years in order to encourage faculty to graduate students in a timely manner and in order to encourage students to complete their degree programs in a timely manner as well.

Regarding discrimination, most participants with the exception of the doctoral participant reported not having experienced discrimination. The doctoral participant reported having felt discriminated because of her accent, because she was a woman, and because she was a single mom. On the other hand, most of the participants felt welcomed, encouraged, and supported although some of them did express having felt a sense of intimidation by their male peers because of the level of competitiveness in their engineering programs, an issue that has been previously addressed. The notion of feeling discriminated concurs with Bottomley’s et al., (1999) study which states that undergraduate participants of their focus groups shared stories of discrimination and harassment but failed to described them so the researcher was unable to discern if the discrimination issues experienced by these participants are the same as those experienced by the doctoral participant of the current study. It is significant to point out that the discrimination issues previously detailed by the doctoral participant of the current study were non-existent when she rejoined her doctoral program in the fall 2011 semester which leads the researcher to believe that these were addressed by the HSI’s current administration because according to the doctoral participant she found a different environment when she returned to the
program. On the other hand, the notion of feeling intimidated by their male peers, as described by some participants, coincides to an extent, with Meadows’ et al., (2006) study which indicated that participants of the same study felt much more discrimination from their male peers than from faculty. It is significant to point out that the notion of feeling intimidated rather than discriminated by their male peers, as pointed out by some participants, leads the researcher to believe that they may not be fully aware of what discrimination means. According to Collins, Chrisler, and Quina (1998) sex discrimination refers to the unequal and harmful treatment of people because of their sex. The same authors claim that there are several types of sex discrimination that range from what they considered “blatant” or obvious discrimination such as some forms of sexual harassment which are very visible, to subtle discrimination which is less apparent, and covert discrimination such as sabotaging someone’s work or using date-rape drugs. The authors define subtle discrimination as unequal and harmful treatment of women that is typically less visible and less obvious than “blatant” sex discrimination. The same authors point out that it is often unnoticed because most people have internalized subtle sexist behavior as normal, natural, or acceptable and claim that it can be innocent or manipulative, intentional or unintentional, well-meaning or malicious. Considering Collins’ et al., (1998) description of discrimination, the researcher concludes that the participants who reported being intimidated by their male peers may have been discriminated due to their gender.

Regarding the overall climate of their programs, most participants described them as being fine. In other words, they felt it provided the infrastructure they needed to be academically successful. However, some participants expressed discontent with the mixing of undergraduate and graduate students in their graduate level courses because they felt that such mixing of levels prevented participants from gaining a true graduate experience. Other participants described their
overall climate experiences in terms of the faculty. These participants described faculty as being demanding but also valued the experiences the faculty shared in their classrooms. A participant experienced what she considered a cold climate because of the lack of interaction with her peers. And another participant pointed out that in order to “fix the climate” in her department, her advisor asked for the students’ feedback on the effectiveness of his advising. Most of the climate experiences described by the participants of the current study concur with Litzler and Lange’ (2006) study in the sense that STEM graduate education is characterized by departmental differences in the orientation and support provided to students, faculty expectations of and relationships with graduate students, and the quality of student peer relationships. Furthermore, the wide array of experiences described by the participants clearly demonstrates that students view climate in many different ways and that their experiences are related to their own needs.

As far as additional experiences in the program is concerned, a participant commented that in the end it does not matter what college one comes from, what matters is taking ownership of one’s education, being resourceful and not leaving it entirely in the hands of faculty. An international participant commented about the support she received from her parents when she decided to pursue a career in engineering. She said they were supportive because they thought of engineering as being a prestigious career but she also pointed out that they were not supportive when she decided to leave her home country to study engineering in the US. She particularly pointed out that her mother made her feel guilty for having left her and that it was difficult for the participant to deal with such feelings and focus on her studies. In contrast, another international participant stated that she felt hesitant about coming to the US to pursue graduate studies in engineering but that her parents encouraged her to come by telling her she would never have another chance to see this country. Yet another international student felt the support of her
parents when she informed them she was going to pursue graduate studies in engineering but she also felt they doubted that she could be academically successful in this field. Nevertheless, her parents felt that coming to the US was a prestigious opportunity as well. However, when she informed her parents she was going to stay in the US to pursue a doctoral program in engineering she felt their pressure. She said she felt pressured because her parents wanted her to return home after having completed her master’s degree but she wanted to stay in the US to pursue a doctorate. However, in spite of disagreeing, her parents supported her decision to remain in the US to pursue a doctorate. It is significant to point out that the domestic participants of the current study received the support of their families to pursue graduate studies in engineering even though they were living away from their families. And although the international students also received support of their families to come to the US to pursue graduate studies in engineering, some of them also have to deal with feelings of guilt because they left their families in their home country. The notion of not being supported by family to major in engineering, as one of the participants of the current study pointed out, was also identified by Cordova-Wentling and Camacho’s study (2006) as a factor that hindered women when deciding to pursue an engineering degree. However, the same study also identified parents’ encouragement to pursue an engineering degree, as stated by some participants of the current study, as a factor that has assisted women when deciding to pursue an engineering degree. Additionally, a supportive and encouraging family was identified by the same study and pointed out by participants of the current study as a factor that has assisted women in completing an engineering degree.

**Programmatic Recommendations**

In order to connect each finding to a recommendation, the findings of the current study are again briefly outlined. Again, the current study found that female graduate engineering
students begin their academic engineering programs with less confidence, feel isolated, and constantly prove themselves to their male peers. The current study also found that female graduate engineering students face challenging classes, professors, and programs. Likewise, the current study found that female graduate engineering students struggle because of limited financial support. Additionally, the current study found that the same students lack time management skills to cope with the rigorous demands of their programs along with work, their participation in school organizations, and family commitments. Furthermore, the current study found that there was a lack of availability, communication and support provided to students’ research due to the advisors’ hectic schedules. And lastly, the current study corroborated that the HSI being studied, as other institutions of higher education in the nation, faces the underrepresentation of women in its college of engineering. The following recommendations are included for the programs from which the participants’ are students:

To address issues of confidence and isolation, the researcher proposes that engineering programs do the following:

1) Encourage the formation of a female graduate engineering student organization. The purpose of this organization is to have students support each other throughout the course of their respective engineering programs and provide additional support services needed to ensure their success and timely graduation. As a way to recruit students, engineering programs should have a professional staff or administrators (e.g., coordinator, assistant director, associate director or director of graduate engineering studies) work in conjunction with a representative of the information technology (IT) department to create a report listing all the female graduate engineering students enrolled at any given semester. The report should be very
specific and should at least include some of the following fields; student’s full name, identification number, major, level, and e-mail address, among others. By having IT create such a report professional staff or administrators will be able to run it as needed. Once the report is created, have the same professional staff or administrator contact the students via e-mail to invite them to join the organization. The e-mail should also be creative and most importantly should outline the benefits of joining the organization. For example, students can become aware of fellowships, internships and study abroad opportunities. Students can share their program experiences and learn from the experiences of successful recent female graduates, among others.

2) Professional staff or administrators should develop and share a list of social activities or community events that are already taking place at the university and college. Most of these activities are usually open to students, alumni, and the public in general. At the university level, this list could include plays sponsored by the university’s Department of Theatre and Dance or the Dinner Theater where in addition to seeing a play the audience can also enjoy a gourmet dinner prior to the performance, tailgate gatherings prior to football games, as well as football and basketball games, and special events or concerts among others. At the college level, this list could include engineering summer camps where high school students come to campus to learn about engineering through activities developed by college of engineering’s faculty and graduate students, engineering lecture series where speakers, usually renowned professionals in the field of engineering, come to campus to address relevant topics or current issues or trends in engineering, or special events sponsored by the college of engineering where the university recognizes outstanding
graduates from the college of engineering. Once the list of activities at the university level is developed, have a professional staff or administrator contact the sponsoring departments to negotiate special deals for female graduate engineering students. Some of these special deals could include two tickets for the price of one, tickets at a discounted rate, or special group rates. Once a special deal is negotiated ask the female graduate student organization leaders to notify and encourage female graduate engineering students to attend. By doing so, one will begin creating a community of female graduate engineering students that can support each other not just in an academic setting but also in a more personal and social environment. In addition, one will also promote university sponsored events and therefore increase not just student awareness but also participation. Regarding the list of activities at the college level, negotiate female graduate engineering students’ participation with internal departments or units sponsoring these activities or events. By getting female graduate engineering students to participate in engineering summer camps, for instance, they will not only help develop activities for high school students but will gain experience sharing their knowledge which in turn could boost their confidence, and could also serve as role models for female high school students. In the same manner, the participation of female graduate engineering students in the college of engineering lecture series could help expand their knowledge regarding current issues or trends in engineering. In addition, since most of the speakers come from industry, female graduate engineering students could compare views not presented to them in academic settings. Furthermore, female graduate engineering students could also see themselves reflected in the speakers if these are female.
3) Encourage engineering faculty to actively participate in the design of on-going mentoring and support programs for female graduate engineering students. Have a professional staff or administrator work with graduate program directors and key representatives of the alumni chapter in the development of such mentoring programs. Graduate program directors are usually faculty assigned to serve as the point of contact for any given engineering department and act as liaisons between the faculty and the administration regarding any departmental matters. They also assist in the students’ admissions evaluation process and advise students and monitor their progress towards timely completion of degree programs. Most alumni chapters usually aim at connecting, in one way or another, alumni back to their college or university in an effort to support or engage them in activities sponsored by their college or university. By having these two groups of people working together one will have people whose forte is in academia and industry and would be able to provide not only support for female graduate engineering students, but also well-rounded mentoring experiences and networking and employment opportunities. One of the activities for this mentoring program could include hosting monthly meetings where students can share their issues, stories, experiences, or academic needs with faculty and alumni chapter members to get their advice and guidance. In order to ensure such meetings do not turn into complaint sessions, have a professional staff or administrator survey the students through the female graduate student organization or host focus groups prior to hosting the meetings and have the same professional staff or administrator work in conjunction with the graduate program directors and alumni members to develop a specific agenda for each meeting. By doing so, one would also
be able to identify the academic needs, if any, of the students and also involve key university personnel to address such needs or refer students to appropriate campus units to receive the service needed. Students are often not fully aware of all the support services provided by IHEs such as graduate student services, library services, writing centers, and counseling services, among others.

To also address feelings of isolation because students often live away from their families and to develop or foster a sense of family in their programs the researcher proposes the following:

1) Have a professional staff or administrator develop and implement a continuous needs assessment plan by periodically conducting a series of focus groups with female graduate engineering students to determine what type of support services they would like to receive to make them feel at home.

2) Since a substantial percentage of graduate engineering students are foreign nationals - 44% of foreign students were enrolled in graduate engineering programs at the HSI being studied during the fall 2011 semester, 39.8% of foreign students were enrolled in master’s engineering programs at the national level, and 54.2% of foreign students were enrolled in doctoral programs also at the national level during the same semester-, it is imperative for the engineering programs to work in conjunction with their office of international programs or related offices to organize a series of social events throughout the semester where students from a given country can share their culture through a movie, a meal, a dance, or a student show. Such events can also be tied to a holiday or special celebration in the students’ home countries. By doing this, one will not only engage domestic female graduate engineering students socially but
will also provide an avenue for foreign female graduate engineering students to feel a sense of belonging which in turn will strengthen and deepen student-to-student relationships, generate a sense of community within their respective programs, and create cultural awareness.

To address the issue of students facing challenging classes, professors, and programs, the researcher proposes that engineering programs do the following:

1) Encourage departmental mid-term course evaluations to identify the challenges students are facing and provide the academic support needed throughout the rest of the semester to ensure the students’ academic success. As a follow-up activity, the engineering programs should encourage departmental course evaluations at the end of the semester to determine if the initiatives implemented worked. Make amendments to the initiatives implemented as needed on a semester by semester basis. The intent of these course evaluations is to provide an avenue for the faculty member to improve his or her practice but mostly to support the student in his or her learning quest.

To address the issue of limited financial support, the researcher proposes the following:

1) Have a professional staff or administrator work in conjunction with campus units such as financial aid offices, scholarship offices, graduate schools, institutional development or advancement offices and local, state, and national off-campus organizations such as the state’s board of professional engineers, the National Society of Professional Engineers (NSPE), or the Society of Women Engineers (SWE) to identify opportunities of financial support for female graduate engineering students. Advertise these opportunities through the graduate program directors, electronic media, bulletin boards, student organizations, and other means.
2) Have a professional staff or administrator host at least two financial aid workshops during the semester to inform students about upcoming fellowship opportunities at the local, state, and national levels. For example, The National Science Foundation Research Fellowship Program (GRFP), The National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc. (GEM), and The Sandia National Laboratories, among others. Guide students through the application process. Bring experts or representatives of campus units and external organizations offering these fellowships to help students complete accurate, strong, and timely applications.

3) Encourage faculty who are writing new research grant proposals to request funds to support graduate engineering students through research assistantships.

4) Offer specific scholarships for female graduate engineering students.

To address the issue of students’ lack of time management skills because of their involvement in school, work, participation in extra-curricular activities, and personal life, the researcher proposes that engineering programs offer a series of time management skills workshops throughout the semester. These workshops could provide students with the skills they need to learn how to manage their time.

To address the lack of availability, communication and support provided to students by advisors, the researcher proposes that engineering programs do the following:

1) Lessen the load of current faculty by empowering them to take the initiative to propose the allocation of their time. Allow them to propose a percentage of the time they would like to dedicate to research, teaching, and service. Consider this a negotiation process in which faculty proposes, department chair negotiates with faculty, and the dean approves the negotiated allotment of time. By empowering and
allowing faculty to take this initiative they would feel that it is faculty driven, not top
down driven, and would be more receptive to it.

2) Develop a continuous improvement program by offering a series of workshops
throughout the semester aimed at faculty to help them improve their advising
practices and become better mentors for both master’s and doctoral students. Identify
senior faculty within your college or department who are willing to serve as
workshop leaders.

3) Develop a questionnaire for advisees to assess advisor’s effectiveness. Ask former
advisees to provide feedback regarding their advising experiences. Share the feedback
received through the questionnaire with advisors and encourage advisors to conduct a
self-evaluation in an effort to better their practice.

To address having female graduate engineering students feel like they have to prove
themselves to their male peers and issues of discrimination, the researcher proposes that
engineering programs do the following:

1) Develop an awareness campaign by defining and providing examples of
discrimination through the creation of posters, flyers, and announcements describing
inappropriate conduct or behavior. Once developed, utilize on-campus electronic
media and social media to broadcast these marketing materials to reach as many
students, faculty, and staff as possible.

2) Educate students through a series of workshops where they can learn to recognize
discrimination, establish boundaries in their classrooms and labs and in their
academic relationships with their peers, professors, and advisors, but mostly where
they can learn to speak for themselves.
3) Establish and educate students of protocols within the department or at the college level to report discrimination.

To address the underrepresentation of female graduate engineering students in engineering programs, begin cultivating students during their freshman year at the undergraduate level and create a steady and high caliber pipeline from one’s own undergraduate graduates. To accomplish the cultivation of students, the researcher proposes the following:

1) Encourage graduate program directors to give presentations to freshman undergraduate students to promote graduate engineering programs. Discuss the importance of maintaining a good grade point average at the undergraduate level as well as research and funding opportunities available at the graduate level.

2) Organize poster and research presentations where graduate students can showcase their research to undergraduate students.

3) In conjunction with graduate schools organize “Graduate Education Days” where undergraduate senior students can learn how to apply to graduate school and offer application fee waivers for those who apply on site. Invite graduate program directors to advise potential graduate engineering students as well as graduate engineering students to showcase their work on site, and advertise the event through undergraduate program directors, electronic media, and bulletin boards.

4) Provide funding opportunities to bridge undergraduate students straight to doctoral programs. Write grant proposals and request funding from one’s department, institution, or special entities such as the National Science Foundation (NSF) to develop programs to support talented undergraduate students in their senior year and bridge them to doctoral programs. Recruit students through department chairs and
undergraduate program directors and secure teaching or research assistantships related to their field of study for participating students. Monitor their academic progress on a semester by semester basis.

And finally, to address the issue of students being sole care givers, the researcher recommends that engineering programs do the following:

1) Contact on-campus student affairs offices and encourage them to develop on-campus child care development centers, if none exist. Having on campus child care facilities throughout the academic year and for extended hours is not only convenient for students, staff, and faculty but also eases the concerns of parents and fosters a sense of relief to know that one’s children are being cared for in a safe and positive environment within the university premises.

2) Encourage representatives of student affairs office and on campus child care development centers to work with local organizations that provide child care services such as the Young Women’s Christian Association (YWCA) and their Child Care Services program to assist parents in meeting their child care payments if these meet an eligibility criteria set by these entities.

The next section discusses recommendations for future research.

**Recommendations for Future Research**

1) Because only one female doctoral engineering student applied for the spring 2012 graduation, the current study was limited to describe the experiences of a single doctoral student. However, future research focused on female doctoral engineering students may allow researchers to compare experiences among these students and may determine the extent to which the experiences described by the doctoral
participant of the current study are representative of other domestic female doctoral engineering students.

2) Another line of future research may compare or further investigate the experiences of domestic female doctoral engineering students versus those of international female doctoral engineering students. Because of limited doctoral student participation, the current study briefly discussed this aspect that deserves further investigation.

3) Future research can also investigate to what extent the experiences of female master engineering students differ from those of doctoral engineering students. Because of limited doctoral participation the current study was unable to make such comparison.

4) To better understand why female graduate engineering students begin their academic programs with less confidence it is important to clearly understand why students still feel this way. Future research may investigate potential root causes of such behavior in an effort to address this issue.

5) Future research can assess the impact and success of current initiatives or strategies implemented on campus to recruit female graduate engineering students in an effort to evaluate their effectiveness.

6) Future research can unveil why there is such a difference in the way students described faculty from one institution to another. Such research can also clarify if such a difference is due to a difference in climate between undergraduate and graduate programs.

7) To better understand male engineering students’ perceptions and behaviors towards women at the master’s and doctoral level it is important to investigate male students perceptions of female engineering students at each level. Future research can provide
a better understanding of male students’ insights and help improve female and male peer academic relationships in engineering programs.

8) Future research can investigate to what extent race, culture, and ethnicity play a role in the participants’ experiences with their peers, self-confidence, and overall experiences in graduate engineering programs.

9) In conducting the literature review for the current study, it was surprising to learn that previous researchers acknowledged issues of sexual harassment and discrimination in their studies but failed to fully describe or address them. However, future research can fully describe issues of sexual harassment and discrimination experienced by female graduate engineering students in an effort to address them.

10) In conducting the literature review for the current study, the researcher found vast amounts of research addressing issues related to science, technology, engineering, and math (STEM) where engineering issues were to an extent embedded. Future research may concentrate in the experiences of female graduate students not only in engineering as a whole as the current study did but in each one of its fields or disciplines, i.e., biomedical engineering, civil engineering, industrial engineering, mechanical engineering, and metallurgical engineering, among others, because the experiences of these students could vary according to each field or discipline. The next section provides a summary of the chapter.

**Summary**

This chapter provided a summary of the current study by outlining its purpose which was to gain insight on how enrollment, persistence, and success factors are experienced by female graduate engineering students. The chapter pointed out that the research question that drove the
current study was: How have female graduate engineering students experienced a select number of enrollment, persistence, and success factors? The chapter presented evidence of the underrepresentation of women at the HSI’s college of engineering and nationally. The chapter also described the methodology utilized in the current study and outlined that male and female students were included only in the quantitative portion to compare male and female responses and assess what factors were greater for female students. Such factors were then considered for the qualitative portion of the current study in which only female students participated. The chapter also pointed out that the qualitative portion included one interview and three semi-structured focus groups.

In addition, the chapter described a wide range of reasons why participants decided to pursue graduate engineering studies. Such reasons included loving engineering, feeling that engineering is “the core” of many of the items we use in our daily lives, feeling that engineering would provide them with tangible tools “to solve problems” and “make a difference” in their communities, liking math and physics while in high school, having inspiring professors also while in high school, feeling that an undergraduate degree was not enough academic preparation to be truly successful in their own field, and the possibility of having a well-paid job upon graduation, among others. The chapter also pointed out that the participants of the current study experienced a wide array of challenges while at their academic programs. Some of these challenges included but are not limited to: feelings of insecurity, starting academic programs with less confidence, facing challenging classes, professors, and programs, having to prove themselves to their male peers and therefore feeling intimidated, programs that were not fully structured, feelings of isolation, having difficulty managing their time, having difficult academic relationships with their advisors, financial aid issues, and discrimination issues, among others.
However, they also experienced faculty who had open door policies, who provided academic and personal advice, who were encouraging and supportive, and who served as mentors and academic coaches. And most of them experienced the support and encouragement of their respective families to endure such challenges and be successful in their engineering programs.

Thus, the current study has contributed to better understanding the experiences of female graduate engineering students who are about to complete an engineering program which in turn may assist college administrators, faculty, and staff in providing additional support services for this particular student population. In addition, the current study provided programmatic recommendations to address its findings in an effort to provide the HSI being studied as well as other institutions of higher education across the nation with viable solutions that could address the issues faced by female graduate engineering students and make a positive difference in the way they experience their programs. Moreover, the current study provided future research recommendations that emerged through the course of the current study or that because of the design of the current study, funding and time constraints the researcher was unable to further develop. Lastly, the results of the current study have contributed to the body of knowledge in the area of enrollment, persistence, and success of female graduate engineering students.
References


Appendix A

Women Engineering Survey

Part One: Factors that assisted you in deciding to pursue a degree in engineering

(A) What factors in high school assisted you in deciding to pursue a degree in engineering? (check all that apply)
1. ______ Classes taken in high school (e.g., math, science, physics, technology)
2. ______ Did well in classes related to math/science/technology
3. ______ Excellent math/science/technology teachers
4. ______ Teachers who encourage me to pursue my interest in math/science/technology
5. ______ Participation in engineering/computer science related programs while in high school
6. ______ Participation in extracurricular activities in high school (e.g., math/science olympiad)
7. ______ Teachers provided advice and information about engineering
8. ______ Counselor provided advice and information about engineering
9. ______ Recruitment information about university engineering programs was provided
10. ______ Availability of scholarships/fellowships
11. ______ Others, Please specify:

(B) What factors with your family assisted you in deciding to pursue a degree in engineering? (check all that apply)
1. ______ Parents encouragement to pursue an engineering degree
2. ______ Parents support of my personal career choice
3. ______ Parents provided advice and information about careers in engineering
4. ______ Female engineer role-model in my family (e.g., mother, sister, aunt)
5. ______ Male engineer role-model in my family (e.g., father, brother, uncle)
6. ______ Pressured by parents to pursue a technical degree
7. ______ Others, Please specify:

(C) What factors in your personal life assisted you in deciding to pursue a degree in engineering? (check all that apply)
1. ______ High aptitude in engineering related fields
2. ______ I like problem-solving
3. ______ I like to design and build things
4. ______ Interested/fascinated by technical things
5. ______ Desire to gain respect in society
6. ______ I like to create and invent things
7. ______ Engineering will give me opportunities to make a difference
8. ______ Personal satisfaction.
9. ______ Others, Please specify:
Part Two: Obstacles that hindered you when you were deciding to pursue a degree in engineering

(A) What obstacles did you encounter in high school that hindered you when you were deciding to pursue a degree in engineering? (check all that apply)

1. _____ Discouraged by school counselor to pursue a technical degree
2. _____ Lack of advise from school counselor on engineering career options
3. _____ Lack of encouragement from teachers to pursue math/science/technical field
4. _____ Lack of university engineering programs information
5. _____ Limited career information/exposure
6. _____ Difficulty with courses that were related to math/science/technology
7. _____ Attended a high school with limited math/science/technology course opportunities
8. _____ Peer pressure
9. _____ Others, Please specify: ____________________________________________

(B) What obstacles did you encounter in your family life that hindered you when you were deciding to pursue a degree in engineering? (check all that apply)

1. _____ Lack of assistance in math/science/technology homework at home
2. _____ Lack of family role models and/or mentors
3. _____ Parents did not support my decision to major in engineering
4. _____ Parents wanted me to pursue a degree in a traditional female field like nursing/teaching
5. _____ Lack of financial support from parents for college tuition
6. _____ Others, Please specify: ____________________________________________
(C) What personal obstacles did you encounter that hindered you when you were deciding to pursue a degree in engineering? (check all that apply)

1. _____ Low self-esteem/confidence related to math/science/technology courses
2. _____ Feeling like an outsider in advanced math/science/technology classes
3. _____ Lack of knowledge related to engineering careers
4. _____ Lack of interest in engineering field
5. _____ Lack of understanding of courses needed for getting accepted into engineering program
6. _____ Lack of motivation to take courses needed for acceptance into an engineering program
7. _____ Low grades
8. _____ Others, Please specify: ______________________________________________________________

(D) What obstacles did you encounter in society that hindered you when you were deciding to pursue a degree in engineering? (check all that apply)

1. _____ Low expectation of females
2. _____ Lack of women engineer role models/mentors in my community
3. _____ Traditional views about education/careers for women
4. _____ Public image of engineering field is mostly male
5. _____ Advertisement of engineering field is mostly male
6. _____ Engineering is represented as a male dominated field
7. _____ Others, Please specify: ______________________________________________________________

**Part Three:** Factors that assisted you in completing your degree in engineering

(A) What factors at the university assisted you in completing your degree in engineering? (check all that apply)

1. _____ Good guidance by advisors/counselors
2. _____ Supportive/encouraging/motivational professors
3. _____ Teaching quality/excellent professors
4. _____ Being recognized by professors for my work
5. _____ Good relationships with professors
6. _____ Good performance in engineering classes
7. _____ Society of Women in Engineering
8. _____ Formal mentoring programs
9. _____ Involvement in campus student organizations
10. _____ Participation in work-study program
11. _____ Conferences
12. _____ Internships
13. _____ Research experiences
14. _____ Independent studies
15. _____ Not wanting to lose credit if switching majors
16. _____ Enjoyed engineering classes
17. _____ High GPA
18. _____ Received scholarship/fellowship
19. _____ Others, Please specify: ______________________________________________________________
(B) What factors in your family life assisted you in completing your degree in engineering? (check all that apply)

1. ______ Supportive and encouraging family
2. ______ Family members assisted in engineering homework
3. ______ Family helped me get an internship
4. ______ Family helped financially
5. ______ Others, Please specify: ________________________________

(C) What personal factors assisted you in completing your degree in engineering? (check all that apply)

1. ______ Very interested in engineering field
2. ______ I am highly disciplined
3. ______ I am rarely absent from classes
4. ______ I make sure my assignments are turned in on time
5. ______ I study enough to make sure I do well in my classes
6. ______ I study with my classmates/friends
7. ______ I study alone
8. ______ I am happy I chose to major in engineering
9. ______ I am self-motivated
10. ______ I am an optimistic person
11. ______ I am a hard worker
12. ______ High self-esteem/confidence
13. ______ Perseverance/determination
14. ______ Support from classmates/friends
15. ______ Good technical skills
16. ______ Others, Please specify: ________________________________
Part Four: Factors that hindered you while you were completing your degree in engineering

(A) What obstacles did you encounter at the university that hindered you while you were completing your degree in engineering? (check all that apply)

1. _____ Poor teaching quality
2. _____ Ineffective professors
3. _____ Professors who did not support or encourage me
4. _____ Professors who did not motivate me
5. _____ Lack of integrated/relevant curriculum
6. _____ Curriculum too demanding
7. _____ Excessively competitive environment
8. _____ Too much homework
9. _____ Too much lab work
10. _____ Class material too difficult
11. _____ Lack of female professors
12. _____ Lack of female role-models/mentors
13. _____ Lack of female classmates
14. _____ Treated differently and excluded/isolated in engineering classes/program
15. _____ Feeling like an outsider in the engineering classes/program
16. _____ Lack of opportunity to participate in internship program
17. _____ Having to work (e.g., part-time or full-time)
18. _____ Difficulty balancing school and work
19. _____ Exposed to racism
20. _____ Exposed to sexism
21. _____ Low grades in engineering classes
22. _____ Unsupportive classmates
23. _____ Others, Please specify: ____________________________________________

(B) What obstacles in your family life did you encounter that hindered you while you were completing your degree in engineering? (check all that apply)

1. _____ Lack of family involvement/support/encouragement
2. _____ Lack of financially support from family
3. _____ Others, Please specify: ____________________________________________

(C) What personal obstacles did you encounter that hindered you while you were completing your degree in engineering? (check all that apply)

1. _____ Lack of self-discipline
2. _____ Low self-esteem/confidence
3. _____ Lack of motivation
4. _____ Doubts about career goals
5. _____ Lack of finances
6. _____ Lack of free time
7. _____ Others, Please specify: ____________________________________________
1. What is your major? _______________________________________________________

2. What is your age? _______ Years

3. What is your race?
   _____ White/Caucasian
   _____ Black/African-American
   _____ Asian/ Asian American
   _____ Hispanic/ Latina
   _____ Native American
   _____ Other

4. Highest level of parents’ education?

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<th>Father</th>
<th>Mother</th>
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<td>Less than high school</td>
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<td>High school</td>
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<td>Bachelor</td>
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<td>Master</td>
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<td>Doctorate</td>
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</table>

5. What was your GPA in high school? _______

6. What is your current overall GPA? _______

7. If you could choose your major again, would you choose engineering?
   _____ Yes
   _____ No, Why not? _______________________________________________________

8. What are you planning to do after graduation?
   _____ I have accepted and will be working in a job related to engineering
   _____ I have accepted and will be working in a job not related to engineering
   _____ Search for a job related to engineering
   _____ Search for a job not related to engineering
   _____ Go to graduate school. Please specify major: _____________________________
   _____ Other. Please specify: ________________________________________________

9. How satisfied are you with your overall experience in your undergraduate engineering program?
   _____ Very satisfied
   _____ Satisfied
   _____ Neither satisfied nor dissatisfied
   _____ Dissatisfied
   _____ Very dissatisfied
10. What advice would you give a young female wanting to pursue a degree in engineering to be successful like you have been?

THANK YOU FOR TAKING TIME TO COMPLETE THIS SURVEY
Appendix B

THE UNIVERSITY OF TEXAS AT EL PASO
Office of the Vice President for Research and Sponsored Projects
Institutional Review Board
El Paso, Texas 79968-0587
phone: 915 747-8841    fax: 915 747-5931
FWA No: 00001224

DATE: March 30, 2012

TO: Sandra Aguirre-Covarrubias, M.A.
FROM: University of Texas at El Paso IRB

STUDY TITLE: [322208-1] An Analysis of Enrollment, Persistence, and Success Factors Experienced by Female Graduate Engineering Students at a Hispanic Serving Institution

IRB REFERENCE #: 322208-1
SUBMISSION TYPE: New Project

ACTION: APPROVED
APPROVAL DATE: March 30, 2012
EXPIRATION DATE: March 30, 2013
REVIEW TYPE: Expedited Review

Thank you for your submission of New Project materials for this research study. University of Texas at El Paso IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This study has received Expedited Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

Please report all NON-COMPLIANCE issues or COMPLAINTS regarding this study to this office.

Please note that all research records must be retained for a minimum of three years after termination of the project.

Based on the risks, this project requires Continuing Review by this office on an annual basis. Please use the appropriate renewal forms for this procedure.
Appendix C

March 7, 2012

Dr. Richard Schoephoerster  
Dean, College of Engineering  
The University of Texas at El Paso  
500 West University  
El Paso, Texas 79968

RE: Permission to Conduct Study

Dear Dr. Schoephoerster,

I am writing to request your written permission to conduct a study at The University of Texas at El Paso’s College of Engineering. I am a doctoral student in the Educational Leadership and Foundations Department at UTEP’s College of Education and Assistant Director for Graduate Studies and Research at UTEP’s College of Engineering. I am also in the process of writing my dissertation. The study is entitled “An Analysis of Enrollment, Persistence, and Success Factors Experienced by Female Graduate Engineering Students at a Hispanic Serving Institution”.

The research question that guides the study is: How have female graduate engineering students experienced a select number of enrollment, persistence, and success factors? Participants for the quantitative portion of the proposed study will include all graduate engineering students who have applied for graduation. A master list of this group of students will be obtained from UTEP’s Graduate School with written permission. This will allow me to compare responses between male and female students and clearly identify those factors that report the highest frequency among female students. Participants for the qualitative portion of the study will only include female graduate engineering students. The participants’ confidentiality will be protected by ensuring their anonymity by not identifying them individually. Furthermore, the results of the study will be reported in aggregate form only.

The quantitative portion of the study will include a questionnaire. The qualitative portion of the study will include semi-structured focus groups. The proposed protocol will be finalized after both quantitative portion and pilot’s results are reviewed. At least, two semi-structured focus groups: one at the master’s level and one at the doctoral level will be attempted for both the pilot and actual study.

As part of The University of Texas at El Paso Institutional Review Board (IRB) process, I must include written approval from you to conduct the study. Thus, I would like to receive your written approval by March 14, 2012 in order to meet my UTEP-IRB deadline. Thank you for your time and consideration to my request but most of all thank you for your support in my educational pursuit. Please do not hesitate to contact me via e-mail at sandraac@utep.edu or by phone at 915-373-3157 should you have any questions.

Respectfully,

Sandra Aguirre-Covarrubias
Appendix D

From: Schoephoerster, Richard  
Sent: Thursday, March 15, 2012 5:43 PM  
To: Aguirre-Covarrubias, Sandra  
Cc: Novick, David  
Subject: Re: Permission Request to Conduct Study

Sandra –

I am delighted to approve your study “An Analysis of Enrollment, Persistence, and Success Factors Experienced by Female Graduate Engineering Students at a Hispanic Serving Institution” described in the attached. As you know, we are working very hard to increase the number of female students in engineering at all levels. We look forward to using the results of your study to assist us in achieving our goal.

Richard T. Schoephoerster, PhD, PE  
Dean and Riter Professor  
College of Engineering  
The University of Texas at El Paso  
500 West University Avenue  
El Paso, Texas 79968-0517  
915-747-6917  
915-747-6444  
Schoephoerster@utep.edu  
www.engineering.utep.edu
I. To what extent did the following assist to your enrollment in your graduate engineering program? Please check the responses that best reflect your experience.

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<thead>
<tr>
<th></th>
<th>NOT AT ALL</th>
<th>A LITTLE</th>
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<tr>
<td>Your math skills</td>
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<td>Interest in research</td>
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<td>Having an undergraduate degree in engineering</td>
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<td>Having current limited job opportunities</td>
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<td>The notion that engineering is an interesting and challenging field</td>
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<td>The notion that engineering is a well-respected field</td>
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<td>The notion that engineering has a good job market</td>
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<td>The notion that engineering jobs are well paid</td>
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<td>Having a family member who is an engineer</td>
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<td>Encouragement from family</td>
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<td>Exposure to graduate programs information</td>
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<td>Exposure to research</td>
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<td>The location of the university</td>
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<td>The availability of a program in a specific field</td>
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II. To what extent did the following assist to your persistence in your graduate engineering program? Persistence means that you have completed at least one year of your graduate program. Please check the responses that best reflect your experience.

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<tr>
<th>Issue</th>
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<tr>
<td>Having a positive attitude</td>
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<td>Self-confidence</td>
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<td>The frequency with which I studied</td>
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<td>Time management skills</td>
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<td>Role models of my gender</td>
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<td>Participation in study groups</td>
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<td>Involvement in extracurricular activities</td>
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<td>Participation in internships</td>
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<td>Participation in research</td>
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<td>Participation in conferences</td>
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<td>A sense of belonging in the classroom</td>
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<td>A sense of belonging in the lab</td>
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<td>A classroom environment free of discrimination</td>
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<td>A lab environment free of sexual harassment</td>
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III. To what extent did the following assist your success in your graduate engineering program? Success means that you have applied for graduation. Please check the responses that best reflect your experience.

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<th>NOT AT ALL</th>
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<td>Having a positive attitude</td>
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<td>Having a positive academic performance</td>
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<td>Faculty availability</td>
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<td>Faculty acknowledgment when I participated in class</td>
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<td>Faculty feedback provided from informal meeting sessions</td>
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<td>Faculty encouragement to engage in research</td>
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<td>Faculty encouragement to participate in professional development activities (e.g. workshops, conferences, proposal development, publications, etc.)</td>
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<td>Faculty praise when I presented my ideas</td>
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<td>Faculty receptiveness to address my concerns</td>
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<td>The level of respect I received from faculty</td>
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<td>Availability of my thesis/dissertation advisor</td>
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<td>Regular constructive feedback provided by my thesis/dissertation advisor</td>
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<td>The level of respect I received from my thesis/dissertation advisor</td>
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<td>The level of confidence I received from my thesis/dissertation advisor</td>
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IV. Please answer the following questions:

1. Identify the degree you are pursuing.
   - Ph.D.
   - M.S.
   - Other. Please explain:
     ____________________________________________________________________

2. Select your Ph.D. program.
   - Civil Engineering
   - Computational Science (Multidisciplinary)
   - Computer Science
   - Electrical & Computer Engineering
   - Environmental Science and Engineering (Multidisciplinary)
   - Material Science & Engineering (Multidisciplinary)
   - Other. Please explain:
     ____________________________________________________________________

3. Select your M.S. program.
   - Civil Engineering
   - Computer Engineering
   - Computer Science
   - Construction Management
   - Electrical Engineering
   - Engineering Multidisciplinary (Biomedical Engineering; Software Engineering; and Engineering Education)
   - Environmental Engineering
   - Industrial Engineering
   - Information Technology
   - Manufacturing Engineering
   - Metallurgical & Materials Engineering
   - Mechanical Engineering
   - Systems Engineering
   - Other. Please explain:
     ____________________________________________________________________

4. Approximately, how many hours a week do you study?
   ______________________________________________________________________

5. Do you work?
   - Yes
   - No

6. Where do you work?
   - On campus
   - Off campus
7. Approximately, how many hours a week do you work?
________________________________________________________________________

8. Where do you live?
   o On Campus
   o Off Campus

9. What is your marital status?
   o Single
   o Married
   o Divorced
   o Widow/er

10. Who do you live with?
    o Alone
    o With parents and siblings
    o With spouse and/or children
    o With friends
    o Other. Please explain:
    ______________________________________________________________________

11. Identify your citizenship status.
    o U.S. Citizen
    o U.S. Permanent Resident
    o International student. Please specify nation or country:
    ______________________________________________________________________
    o Other. Please, explain:
    ______________________________________________________________________

12. Identify your race or ethnicity.
    o White/Caucasian
    o Black/ African American
    o Asian American/Pacific Islander
    o Hispanic/Latino(a)
    o Native American or American Indian
    o Other. Please, explain:
    ______________________________________________________________________

13. What is your personal annual income level?
    o 0 - $15,000
    o $15,001 - $30,000
    o $30,001 - $45,000
    o $45,001 - $60,000
    o $60,001 - $75,000
    o $75,001 – 100,000
    o Over $100,000
14. What is your family’s annual income level?
   - $0 - $15,000
   - $15,001 - $30,000
   - $30,001 - $45,000
   - $45,001 - $60,000
   - $60,001 - $75,000
   - $75,001 – 100,000
   - Over $100,000

15. Does your family assist you financially?
   - Yes
   - No

16. Has your father or mother graduated from a college or university?
   - Yes
   - No

17. How old are you? (In Years).

18. What is your gender?
   - Female
   - Male
   - Other. Please explain: __________________________

V. Would you be willing to participate in a focus group?
   - Yes. If yes, please provide the following:
     - UTEP E-mail address: __________________________
     - Other E-mail address: __________________________
     - Mailing address: ______________________________
     - Home telephone number: _______________________
     - Work telephone number: _______________________
     - Cell telephone number: _________________________
   - No, I do not wish to participate.

THANK YOU FOR TAKING TIME TO COMPLETE THIS SURVEY
Appendix F

SURVEY - COVER LETTER

Dear Graduate Student:

My name is Sandra Aguirre-Covarrubias and I am a doctoral student in the Educational Leadership and Foundations Department at the University of Texas at El Paso (UTEP)’s College of Education. I am also an Assistant Director for Graduate Studies and Research at UTEP’s College of Engineering. The purpose of my research is to gain insight on how enrollment, persistence, and success factors are experienced by graduate engineering students.

As part of my study, I would like to ask you to complete the enclosed survey. Your participation in this survey is completely voluntary and refusing to participate will not cause any penalties. You will not be compensated for taking part in this research study. The information gathered will be anonymous. No specific association will be made to individuals and findings will only be reported as an aggregate. Only I will receive the on-line data which is password protected and only I will have access to hard copies of the data which will be stored under lock and key in my office.

If you have any questions regarding the procedures of this study, you can contact me via telephone at (915) 747-6909 or via email at sandraac@utep.edu. In compliance with UTEP’s Institutional Review Board (IRB) protocol approved for this study, any information you provide will be kept confidential.

Any questions regarding the conduct of this research or your rights as a research participant may be directed to the IRB Administrator at (915) 747-7939.

By completing the survey, you are indicating that you understand the above and that you give consent to participate in the study. Please click on the link below to complete the survey.

Thank you for your time in completing this survey.

Sincerely,

Sandra Aguirre-Covarrubias
Doctoral Student
Educational Leadership and Foundations Department
The University of Texas at El Paso

(ADD LINK HERE)
Appendix G

FOCUS GROUPS – FINAL PROTOCOL

1. Tell me what about engineering encouraged you to pursue a graduate degree in this field.
2. Tell me how having a positive attitude helped you persist and succeed in your program.
3. Tell me how having self-confidence helped you persist and succeed in your program.
4. Tell me how your time management skills helped you persist and succeed in your program.
5. How would you describe your experiences in your engineering program?
6. If you believe you have experienced discrimination during your graduate studies, please tell me about at least one instance.
7. Tell me about the overall climate in your program.
8. What else would you like to say about your experience in the program?
Appendix H

FOCUS GROUPS - DEMOGRAPHIC SHEET

Please provide the following demographic information about yourself. This information will only be used to assist me in developing a participant’s profile.

1. Identify the degree you are pursuing
   - Ph.D.
   - M.S.
   - Other. Please explain:

2. If at the Ph.D. level please indicate your program of study. If at the M.S. level skip to Question 3.
   - Civil Engineering
   - Computational Science (Multidisciplinary)
   - Computer Science
   - Electrical & Computer Engineering
   - Environmental Science and Engineering (Multidisciplinary)
   - Material Science & Engineering (Multidisciplinary)
   - Other. Please explain:

3. If at the MS level please select your program of study.
   - Civil Engineering
   - Computer Engineering
   - Computer Science
   - Construction Management
   - Electrical Engineering
   - Engineering Multidisciplinary (Biomedical Engineering; Software Engineering; and Engineering Education)
   - Environmental Engineering
   - Industrial Engineering
   - Information Technology
   - Manufacturing Engineering
   - Metallurgical & Materials Engineering
   - Mechanical Engineering
   - Systems Engineering
   - Other. Please explain:

4. Approximately, how many hours a week do you study?
5. Do you work?
   _____ Yes
   _____ No. Skip to Question 8.

6. Do you work…
   _____ On campus
   _____ Off campus

7. Approximately, how many hours a week do you work?
   ____________________________________________

8. Do you live…
   _____ On Campus
   _____ Off Campus

9. Do you live …
   o Alone
   o With parents and siblings
   o With spouse and/or children
   o With friends
   o Other. Please explain:
     ____________________________________________

10. Identify your citizenship status.
    o U.S. Citizen
    o U.S. Permanent Resident
    o International student. Please specify nation or country: ________________________________
    o Other. Please, explain:
      ____________________________________________

11. Identify your race or ethnicity.
    o White/Caucasian
    o Black/ African American
    o Asian American/Pacific Islander
    o Hispanic/Latino(a)
    o Native American or American Indian
    o Other. Please, explain:
      ____________________________________________
12. What is your personal annual income level
   - 0 - $15,000
   - $15,001 - $30,000
   - $30,001 - $45,000
   - $45,001 - $60,000
   - $60,001 - $75,000
   - $75,001 - 100,000
   - Over $100,000

13. What is your family’s annual income level
   - 0 - $15,000
   - $15,001 - $30,000
   - $30,001 - $45,000
   - $45,001 - $60,000
   - $60,001 - $75,000
   - $75,001 - 100,000
   - Over $100,000

14. Does your family assist you financially?
   - Yes
   - No

15. Has your father or mother graduated from a college or university?
   - Yes
   - No

16. Have any of your siblings graduated from a college or university?
   - Yes
   - No

17. At the present time I am _____ years old.

18. Proposed Pseudonym____________________________________________________
Appendix I

FOCUS GROUPS - CONSENT FORM

INTERVIEWER:
Sandra Aguirre-Covarrubias, Doctoral Student, Department of Educational Leadership and Foundations
The University of Texas at El Paso, (915) 747-6909, sandraac@utep.edu

DESCRIPTION:
I am interested in exploring the enrollment, persistence, and success factors experienced by female graduate engineering students who are near graduation. This study involves you participating in an interview with me in which you answer questions and discuss issues related to my topic. The interview will be recorded and a summary will be made of the interview. You will be asked to sign a promise of confidentiality before the interview begins. If you agree, I can also meet with you after the summary has been written to confirm your comments and possibly ask follow-up questions. The length of your participation will be approximately three hours (one to two hours for the interview and an optional hour for a follow-up).

CONFIDENTIALITY:
I will keep any information that identifies you in a locked file cabinet. Any information that I will use for my study, will not identify you. I will use pseudonyms and personally identifying information will be removed.

BENEFITS:
There are no known benefits to you for participating in this project.

RISKS:
There are no known risks to you for participating in this project.

CONTACT PEOPLE:
If you have any questions about this project, please contact me at the number listed above.

VOLUNTARY NATURE OF PARTICIPATION:
Your participation in this project is voluntary. If you do not wish to participate, or would like to end your participation in this study, there will be no penalty or loss of benefits to you which you are otherwise entitled. In other words, you are free to make your own choice about being part of this study or not, and may quit at any time without penalty.

SIGNATURE:
Your signature on this consent form indicates that you fully understand the above study, what I am asking of you in this study, and that you are signing this voluntarily. If you have any questions about this project, please feel free to ask them now or at any time throughout the project.

Signature____________________________________________________
Date________________________________________________________

A copy of this consent form can be made available for you to keep upon request.
Appendix J

FOCUS GROUPS - PROMISE OF CONFIDENTIALITY FORM

This form is intended to protect the confidentiality of what you and I say during the course of this interview on your college experiences. Please read the following statement and sign your name indicating that you agree to comply.

I promise that I will not communicate or talk about the information discussed during the course of this interview with anyone.

Name: ____________________________________________________________

Signature: __________________________________________________________

Interview’s signature: ________________________________________________
## Appendix K

### COMPARISON BETWEEN MALE AND FEMALE RESPONSES

<table>
<thead>
<tr>
<th>To what extent did the following assist your enrollment in your graduate engineering program?</th>
<th>Male Responses</th>
<th>Female Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your math skills</td>
<td>3.41</td>
<td><strong>3.57</strong></td>
</tr>
<tr>
<td>Interest in research</td>
<td>3.18</td>
<td>3.43</td>
</tr>
<tr>
<td>Having an undergraduate degree in engineering</td>
<td>3.55</td>
<td><strong>3.85</strong></td>
</tr>
<tr>
<td>Having current limited job opportunities</td>
<td>3.00</td>
<td>2.43</td>
</tr>
<tr>
<td>The notion that engineering is an interesting and challenging field</td>
<td>3.52</td>
<td>3.43</td>
</tr>
<tr>
<td>The notion that engineering is a well-respected field</td>
<td>3.36</td>
<td><strong>3.50</strong></td>
</tr>
<tr>
<td>The notion that engineering has a good job market</td>
<td>3.27</td>
<td><strong>3.50</strong></td>
</tr>
<tr>
<td>The notion that engineering jobs are well paid</td>
<td>3.14</td>
<td><strong>3.71</strong></td>
</tr>
<tr>
<td>Having a family member who is an engineer</td>
<td>2.18</td>
<td>2.50</td>
</tr>
<tr>
<td>Encouragement from family</td>
<td>2.68</td>
<td>3.00</td>
</tr>
<tr>
<td>Encouragement from peers</td>
<td>2.32</td>
<td>2.50</td>
</tr>
<tr>
<td>Encouragement from faculty</td>
<td>2.64</td>
<td>3.14</td>
</tr>
<tr>
<td>Encouragement from an undergraduate advisor</td>
<td>2.14</td>
<td>2.86</td>
</tr>
<tr>
<td>Encouragement from a mentor</td>
<td>2.27</td>
<td>2.79</td>
</tr>
<tr>
<td>Encouragement from an employer</td>
<td>1.91</td>
<td>1.86</td>
</tr>
<tr>
<td>Financial support from family</td>
<td>2.19</td>
<td>2.93</td>
</tr>
<tr>
<td>Financial support from research assistantship or teaching assistantship</td>
<td>2.59</td>
<td>2.86</td>
</tr>
<tr>
<td>Financial support from scholarship or fellowship</td>
<td>2.23</td>
<td>3.07</td>
</tr>
<tr>
<td>Financial support from a paid internship</td>
<td>1.59</td>
<td>1.86</td>
</tr>
<tr>
<td>Financial support from an employer</td>
<td>1.86</td>
<td>1.64</td>
</tr>
<tr>
<td>Exposure to graduate programs information</td>
<td>2.05</td>
<td>2.69</td>
</tr>
<tr>
<td>Exposure to research</td>
<td>2.59</td>
<td>2.86</td>
</tr>
<tr>
<td>The location of the university</td>
<td>3.00</td>
<td>3.14</td>
</tr>
<tr>
<td>The availability of a program in a specific field</td>
<td>3.09</td>
<td>3.29</td>
</tr>
</tbody>
</table>
To What extent did the following assist your persistence in your graduate engineering program?

<table>
<thead>
<tr>
<th>Factor</th>
<th>Male Response</th>
<th>Female Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Having a positive attitude</td>
<td>3.64</td>
<td>3.85</td>
</tr>
<tr>
<td>Self-confidence</td>
<td>3.68</td>
<td>3.64</td>
</tr>
<tr>
<td>The frequency with which I studied</td>
<td>3.14</td>
<td>3.36</td>
</tr>
<tr>
<td>Time management skills</td>
<td>3.23</td>
<td>3.50</td>
</tr>
<tr>
<td>Role models of my gender</td>
<td>2.27</td>
<td>2.57</td>
</tr>
<tr>
<td>Participation in study groups</td>
<td>2.00</td>
<td>2.14</td>
</tr>
<tr>
<td>Involvement in extracurricular activities</td>
<td>1.77</td>
<td>2.21</td>
</tr>
<tr>
<td>Having a positive academic performance</td>
<td>3.23</td>
<td>3.38</td>
</tr>
<tr>
<td>Research progress</td>
<td>2.73</td>
<td>3.00</td>
</tr>
<tr>
<td>Encouragement from family</td>
<td>2.86</td>
<td>3.07</td>
</tr>
<tr>
<td>Encouragement from peers</td>
<td>2.36</td>
<td>2.50</td>
</tr>
<tr>
<td>Encouragement from faculty</td>
<td>2.55</td>
<td>2.57</td>
</tr>
<tr>
<td>Encouragement from a thesis/dissertation advisor</td>
<td>2.59</td>
<td>2.50</td>
</tr>
<tr>
<td>Encouragement from a mentor</td>
<td>2.32</td>
<td>2.79</td>
</tr>
<tr>
<td>Encouragement from an employer</td>
<td>1.91</td>
<td>1.64</td>
</tr>
<tr>
<td>Financial support from family</td>
<td>2.32</td>
<td>2.79</td>
</tr>
<tr>
<td>Financial support from research assistantship or teaching assistantship</td>
<td>2.86</td>
<td>2.71</td>
</tr>
<tr>
<td>Financial support from scholarship or fellowship</td>
<td>2.27</td>
<td>3.14</td>
</tr>
<tr>
<td>Financial support from a paid internship</td>
<td>1.68</td>
<td>1.86</td>
</tr>
<tr>
<td>Financial support from an employer</td>
<td>2.09</td>
<td>1.64</td>
</tr>
<tr>
<td>Participation in internships</td>
<td>1.82</td>
<td>1.62</td>
</tr>
<tr>
<td>Participation in research</td>
<td>2.73</td>
<td>2.64</td>
</tr>
<tr>
<td>Participation in conferences</td>
<td>2.14</td>
<td>2.29</td>
</tr>
<tr>
<td>A sense of belonging in the classroom</td>
<td>2.18</td>
<td>2.29</td>
</tr>
<tr>
<td>A sense of belonging in the lab</td>
<td>2.64</td>
<td>2.29</td>
</tr>
<tr>
<td>A classroom environment free of discrimination</td>
<td>2.36</td>
<td>2.36</td>
</tr>
<tr>
<td>A lab environment free of discrimination</td>
<td>2.18</td>
<td>2.36</td>
</tr>
<tr>
<td>A classroom environment free of sexual harassment</td>
<td>2.09</td>
<td>2.29</td>
</tr>
<tr>
<td>A lab environment free of sexual harassment</td>
<td>2.09</td>
<td>2.29</td>
</tr>
<tr>
<td>To What extent did the following assist your success in your graduate engineering program?</td>
<td>Male Response</td>
<td>Female Responses</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>---------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Having a positive attitude</td>
<td>3.68</td>
<td>3.71</td>
</tr>
<tr>
<td>Self-confidence</td>
<td>3.68</td>
<td>3.64</td>
</tr>
<tr>
<td>Having a positive academic performance</td>
<td>3.50</td>
<td>3.50</td>
</tr>
<tr>
<td>Research Progress</td>
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<td>3.21</td>
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<td>Encouragement from family</td>
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<td>3.07</td>
</tr>
<tr>
<td>Encouragement from peers</td>
<td>2.32</td>
<td>2.57</td>
</tr>
<tr>
<td>Encouragement from faculty</td>
<td>2.55</td>
<td>2.64</td>
</tr>
<tr>
<td>Encouragement from a thesis/dissertation advisor</td>
<td>2.76</td>
<td>2.79</td>
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<tr>
<td>Encouragement from a mentor</td>
<td>2.18</td>
<td>2.57</td>
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<td>Encouragement from an employer</td>
<td>1.86</td>
<td>2.07</td>
</tr>
<tr>
<td>Financial support from family</td>
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<td>2.79</td>
</tr>
<tr>
<td>Financial support from research assistantship or teaching assistantship</td>
<td>2.68</td>
<td>2.79</td>
</tr>
<tr>
<td>Financial support from scholarship or fellowship</td>
<td>2.32</td>
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</tr>
<tr>
<td>Financial support from a paid internship</td>
<td>1.55</td>
<td>1.71</td>
</tr>
<tr>
<td>Financial support from an employer</td>
<td>2.00</td>
<td>1.36</td>
</tr>
<tr>
<td>Faculty availability</td>
<td>2.77</td>
<td>2.85</td>
</tr>
<tr>
<td>Faculty acknowledgment when I participated in class</td>
<td>2.67</td>
<td>2.93</td>
</tr>
<tr>
<td>Faculty feedback provided from informal meeting sessions</td>
<td>2.91</td>
<td>2.29</td>
</tr>
<tr>
<td>Faculty encouragement to engage in research</td>
<td>2.73</td>
<td>2.43</td>
</tr>
<tr>
<td>Faculty encouragement to participate in professional development activities (e.g. workshops, conferences, proposal development, publications, etc.)</td>
<td>2.64</td>
<td>2.57</td>
</tr>
<tr>
<td>Faculty praise when I presented my ideas</td>
<td>2.77</td>
<td>2.50</td>
</tr>
<tr>
<td>Faculty receptiveness to address my concerns</td>
<td>3.09</td>
<td>2.29</td>
</tr>
<tr>
<td>The level of respect I received from faculty</td>
<td>2.95</td>
<td>2.93</td>
</tr>
<tr>
<td>Availability of my thesis/dissertation advisor</td>
<td>2.82</td>
<td>2.57</td>
</tr>
<tr>
<td>Regular constructive feedback provided by my thesis/dissertation advisor</td>
<td>2.82</td>
<td>2.50</td>
</tr>
<tr>
<td>The level of respect I received from my thesis/dissertation advisor</td>
<td>2.91</td>
<td>2.71</td>
</tr>
<tr>
<td>The level of confidence I received from my thesis/dissertation advisor</td>
<td>2.77</td>
<td>2.57</td>
</tr>
</tbody>
</table>
# Appendix L

## FOCUS GROUPS PARTICIPANTS AT A GLANCE

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Program</th>
<th>Level</th>
<th>Citizenship</th>
<th>Race or Ethnicity</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azucena</td>
<td>Environmental Science and Engineering</td>
<td>Ph.D.</td>
<td>Domestic</td>
<td>Hispanic</td>
<td>46</td>
</tr>
<tr>
<td>Margarita</td>
<td>Electrical Engineering</td>
<td>M.S.</td>
<td>International</td>
<td>Hispanic</td>
<td>26</td>
</tr>
<tr>
<td>Sofia</td>
<td>Civil Engineering</td>
<td>M.S.</td>
<td>International</td>
<td>White/Caucasian</td>
<td>24</td>
</tr>
<tr>
<td>Carolina</td>
<td>Civil Engineering</td>
<td>M.S.</td>
<td>International</td>
<td>White/Caucasian</td>
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<td>Mireya</td>
<td>Metallurgical and Materials Engineering</td>
<td>M.S.</td>
<td>Domestic</td>
<td>Hispanic</td>
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<tr>
<td>Deyanira</td>
<td>Electrical Engineering</td>
<td>M.S.</td>
<td>International</td>
<td>Hispanic</td>
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<td>Domestic</td>
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<tr>
<td>Yadira</td>
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<td>M.S.</td>
<td>International</td>
<td>Hispanic</td>
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</tr>
<tr>
<td>Genoveva</td>
<td>Electrical Engineering</td>
<td>M.S.</td>
<td>Domestic</td>
<td>Hispanic</td>
<td>26</td>
</tr>
</tbody>
</table>
Vita

Sandra Aguirre-Covarrubias was born in El Paso, Texas and raised in Cd. Juárez, Chihuahua, Mexico up until high school. The second daughter of Ramon Aguirre and Celia Bueno moved to El Paso, Texas right after graduating from high school and entered the El Paso Community College to learn English as a Second Language. In 1988, she graduated from EPCC with an Associate of Arts degree in Mass Communication and went on to pursue a bachelor’s of Arts in Journalism at the University of Texas at El Paso graduating in 1992. Sandra then went on to pursue a Master’s of Arts degree in Educational Administration with a Focus on Higher Education Administration at New Mexico State University graduating in 2004. In 2008, she enrolled in the Doctoral program in Educational Leadership and Administration with a Focus on Higher Education Leadership. Since 2008 to present, she has proudly served as an Assistant Director for Graduate Studies and Research at UTEP’s College of Engineering. In this capacity, she has monitored the application, admissions, enrollment, and progress of students towards timely degree completion. She has also assisted with the development of proposals for new master’s and Ph.D. programs in addition to proposals for study abroad programs or special projects. She has also coordinated logistics and implementation of approved/funded programs/projects and served as UTEP’s College of Engineering contact for the National Consortium for Graduate Degrees for Minorities in Engineering and Science. Her previous positions at UTEP have included a dual appointment as a Coordinator for the Center for Inter-American and Border Studies (2002-2008) and Mexico Liaison for the Graduate School (2002-2007). At El Paso Community College she also served as a District Wide Coordinator for the Distance Education Network (1996-2002).

Permanent address: 7357 Desierto Rico
El Paso, TX, 79912

This dissertation was typed by Sandra Aguirre-Covarrubias.